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RESEARCH ARTICLE

Structural Relationships Among Beliefs about Intelligence, Goal Orientation, and Cognitive Task Engagement

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ABSTRACT

This study examined the structural relationships among elementary students' beliefs about intelligence, achievement goal orientation, and engagement in cognitive tasks involving fluid and crystallized intelligence. Using data from 274 fifth- and sixth-grade students in South Korea, structural equation modeling (SEM) was conducted to investigate whether goal orientation mediates the relationship between intelligence beliefs and cognitive task engagement. The results showed that students with growth-oriented beliefs were more likely to adopt adaptive achievement goals, which in turn influenced their engagement in both fluid (analogical reasoning) and crystallized (curriculum-based academic performance) tasks. However, goal orientation partially mediated the relationship between intelligence beliefs and cognitive task engagement, exhibiting a suppressor effect that weakens the positive influence of intelligence beliefs. These findings underscore the complex interplay between self-beliefs and motivational constructs and suggest that promoting mastery goals alongside growth beliefs may enhance students' cognitive task engagement. This study underscores the value of fostering growth beliefs and adaptive goals to enhance cognitive engagement. Targeted interventions can support sustained and meaningful learning behaviors.

Keywords: Beliefs about intelligence, achievement goal orientation, cognitive task engagement

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Introduction

Beliefs about intelligence and goal orientation have both been studied as key motivational constructs that influence learning behaviors, including cognitive engagement (Dweck, 2000; Magno, 2012). Beliefs about intelligence are considered core self-theories—abstract and stable beliefs about one's ability-which are relatively resistant to change through short-term interventions. In contrast, goal orientation refers to the purposes students pursue in achievement contexts and is more context-sensitive, often shifting in response to instructional strategies and classroom environments. While these constructs are distinct, prior research has shown that beliefs about intelligence are closely related to goal orientation, often shaping students' motivational goals

(Haimovitz et al., 2011; Liu, 2021). Based on this relationship, the present study investigated the role of goal orientation as a mediator in the mechanism by which beliefs about intelligence influence cognitive engagement, focusing on two types of cognitive tasks: a fluid intelligence task and a crystallized intelligence task.

Background

Beliefs about Intelligence

Beliefs about intelligence are considered a central component of self-theories, which refer to individuals' implicit beliefs about the nature and malleability of personal attributes such as ability, personality, and competence (Dweck, 2013; Spinath et al., 2003). Dweck (1995; 2013) suggested that individuals' beliefs about intelligence play a key role in shaping academic motivation and achievement. Among these beliefs, students' views about the malleability of intelligence refer to the extent to which they believe intelligence can be developed through effort, learning, and experience, rather than being an entity and unchangeable trait. Fixed beliefs about intelligence view it as a fixed trait, leading individuals to be more concerned with demonstrating their ability and to sometimes avoid challenges or interpret effort as a sign of low ability. When students believe that intelligence is a fixed trait, they are more likely to avoid challenging tasks, interpret failure as a lack of ability, and disengage from effortful learning (Haimovitz et al., 2011; Liu, 2021). This fixed theory of intelligence views intelligence as an innate and unchangeable trait. In contrast, growth beliefs see intelligence as malleable and improvable through effort and learning (Macnamara & Rupani, 2017; Martin, 2015). Individuals with growth beliefs about intelligence sees it as something that can be developed through effort and learning. Dweck (2013) emphasized that while people may differ in their initial abilities, everyone has the potential to improve through learning and experience. Students who adopt a growth mindset tend to view academic challenges as opportunities to learn, rather than as threats to their self-worth. As a result, they are more likely to adopt mastery goals, persist in the face of setbacks, and engage more deeply with academic tasks.

Beliefs about intelligence is one of the core self-theories that influence other motivational factors, such as goal orientation, self-efficacy, and responses to failure (Kim & Karr, 2024). Individuals who believe in the malleability of intelligence are also more likely to exhibit self-regulated learning behaviors (Dweck, 2013; Marley & Wilcox, 2022), resilience in response to failure (Yeager & Dweck, 2012), and the use of effective learning strategies (Hertel et al., 2024). Research further shows a positive link between the growth mindset and students' emotional resilience and persistence in academic settings (Kim et al., 2022). These motivational factors, in turn, shape students' learning behaviors, such as persistence, strategy use, and help-seeking, and ultimately affect their learning outcomes (Magno, 2012). One of the motivational variables that is closely related is goal orientation. According to Dinger and Dickhäuser (2013), students with fixed intelligence beliefs are more inclined to adopt performance-avoidance goals, aiming to avoid looking incompetent, whereas those with growth beliefs pursue mastery goals focused on learning and self-improvement. Table 1 presents achievement goals and performance behaviors according to beliefs about intelligence (Dweck & Leggett, 1988), illustrating how individuals' views on the nature of intelligence shape their achievement goals, perceived abilities, and subsequent behavioral patterns.

Table1. Achievement Goals and Performance Behaviors based on Beliefs about Intelligence

Beliefs about Intelligence	Achievement Goals	Perceived Ability	Behavioral Pattern
Fixed	Performance goal	High	Mastery orientation
		Low	Helplessness
Growth	Mastery goal	High	Mastery orientation
		Low	

Cognitive Engagement and Beliefs about Intelligence

Cognitive engagement refers to the learner's deep, effortful investment in processing and making sense of information (Fredricks et al., 2004). Cognitive engagement is considered as a key driver of academic success, distinct from behavioral participation or emotional involvement (Appleton et al., 2006). It involves strategic, metacognitive behaviors such as elaboration, planning, self-monitoring, and applying complex thinking to new content. According to the ICAP framework (Chi & Wylie, 2014), higher levels of cognitive engagement are associated with deeper learning than passive or rote behaviors. Empirical studies consistently link cognitive engagement with positive educational outcomes: students exhibiting high sustained cognitive engagement demonstrate greater achievement, resilience, and meaningful learning gains in both in-person and online environments (Jang et al., 2023; Kuldas et al., 2015). Thus, cognitive engagement represents the deliberate, deep processing essential for effective learning and sustained achievement. For example, Dupeyrat and Mariné's (2005) study found that a specific cognitive processing system associated with fluid intelligence varied significantly across different types of achievement goal orientation. This suggests that students' beliefs and motivation may be linked to differences in their cognitive task engagement.

Students' beliefs about intelligence may shape their motivation and influence how they engage with different types of cognitive tasks. According to the Cattell-Horn framework of intelligence, cognitive tasks can vary in nature, such as those involving fluid versus crystallized intelligence. The Cattell-Horn framework offers a useful typology for categorizing cognitive tasks; those that tap into fluid intelligence and those that rely on crystallized intelligence (Horn & Cattell, 1966; Thorsen et al., 2014). Tasks that elicit fluid intelligence require individuals to solve novel problems or make decisions without relying on prior knowledge—such as pattern recognition, abstract reasoning, or logical puzzles. In contrast, tasks that engage crystallized intelligence draw on accumulated knowledge and experience, such as vocabulary tests, reading comprehension, or tasks that require applying learned facts or concepts. Those who view intelligence as malleable (growth beliefs) are more likely to persist in tasks involving fluid reasoning, where success depends on adaptive thinking and effort (Furnham, 2014). In contrast, individuals who hold a fixed beliefs may place greater emphasis on crystallized abilities, such as stored knowledge, and may avoid tasks that require novel problem-solving, perceiving them as tests of innate ability. These differing beliefs can shape how individuals allocate effort, interpret feedback, and regulate motivation, particularly when faced with unfamiliar or complex learning situations (Kraker-Pauw et al., 2022; Yeager & Dweck, 2012). Further, Pintrich and Garcia (1991) reported that students' beliefs about their abilities influenced not only performance but also their engagement in learning activities, including self-regulation and strategy use. Understanding the link between intelligence beliefs and cognitive engagement in these two task domains provides insight into how learners respond to academic demands and develop over time.

Achievement Goal Orientation

One key motivational mechanism assumed to explain the relationship between beliefs about intelligence and cognitive engagement is achievement goal orientation. Achievement goal orientation, grounded in achievement goal theory, is conceptualized as a framework that is activated in learning situations and reflects students' focus on either the task itself or on demonstrating competence relative to others (Kaplan & Flum, 2010). According to Dweck and colleagues (2004), students' direction of attention in achievement contexts depends on whether their primary aim is to master a task or to attain a different form of success, such as outperforming peers. The tripartite model, introduced by Elliot and Harackiewicz (1996), and further developed by Elliot and Church (1997), classifies these orientations into mastery goals, performance approach goals, and performance avoidance goals. According to the tripartite model of goal orientation, three types of goal orientation (mastery, performance-approach, and performance-avoidance) differ in their motivational focus and characteristic learning behaviors (Elliot and Harackiewicz, 1996). Students with a mastery goal are focused on learning and self-improvement, often engaging in deep learning strategies and persisting through challenges. Those with a performance-approach goal are motivated to demonstrate their competence and outperform others, which may lead to high achievement but often involves surface-level strategies. In contrast, students with a performance-avoidance goal aim to avoid appearing incompetent, often showing low self-efficacy, disengagement, and a tendency to avoid challenging tasks.

Mastery goal orientation, in particular, has been shown to significantly influence academic engagement, learning strategy use, and emotional development. For instance, mastery goals are positively associated with self-regulated learning (Pintrich et al., 2003), academic self-efficacy (D'Lima et al., 2014), and effective learning strategies (Alhadabi & Karpinski, 2020). Additionally, students with mastery orientation tend to participate more actively in class and adopt positive attitudes toward learning (Miller et al., 2021). In contrast, performance goal orientations have yielded more mixed results. Students with performance approach goals, who aim to demonstrate superiority over others, may achieve high academic outcomes under certain conditions (Senko & Harackiewicz, 2002). However, students with performance avoidance goals, who aim to avoid failure or the appearance of incompetence, are often less motivated and tend to perform poorly (Elliot & McGregor, 2001; Al-Emadi, 2001; Wirthwein et al., 2013). These distinctions are reflected in the 2×2 model of achievement goals (Elliot, 1999; Barron & Harackiewicz, 2001), which further refines the motivational framework by acknowledging that multiple goal types may co-occur in complex ways. These findings indicate that students' goal orientations influence other motivational factors, such as self-efficacy, as well as learning behaviors including self-regulated learning and help-seeking (Karabenick, 2004; Liu et al., 2023).

Though goal orientation affects other motivational factors and learning behaviors, it is also closely related to, and influenced by, more self-theories about the nature of intelligence (Dweck & Elliott, 1983; Marley & Wilcox, 2022). Specifically, students with fixed beliefs were more likely to choose performance goal-related tasks where they could receive favorable evaluations of their abilities, whereas students with incremental beliefs tended to select tasks that could help improve their abilities (Dweck & Elliott, 1983). Similarly, Leggett (1985) found that among science and mathematics students, those with performance goals were more likely to choose tasks that allowed them to demonstrate their competence, while those with mastery goals preferred tasks aimed at deepening their understanding. This distinction arises because fixed theorists tend to believe that their abilities are fixed and innate, which limits their motivation to improve; they therefore choose tasks where they can maximize positive evaluations and avoid negative judgments (Rhew et al., 2018). In contrast, students with growth beliefs believe that intelligence is changeable and can be improved, increasing their likelihood of selecting learning-oriented tasks that offer opportunities for growth and positive feedback. This suggests that the alignment between one's beliefs about intelligence and the goals one sets plays a central role in shaping learning behaviors.

Recent research has also examined intervention efforts to enhance achievement goal orientation, particularly by promoting mastery goals and reducing performance-avoidance tendencies. For example, peer-assessment interventions have been shown to enhance learning goal orientation, especially among students with high performance-approach or low performance-avoidance orientations (Yokoyama & Miwa, 2021). However, not all interventions have shown significant effects. For instance, Edwards et al. (2021) conducted a mastery goal intervention in an upper-division online educational psychology course, where students completed activities designed to promote mastery goals; however, the intervention did not yield significant positive effects on the targeted outcome variables including fear or failure and self-efficacy. Considering previous These studies collectively highlight the potential—and the challenges—of shaping students' goal orientations through targeted interventions.

Motivational constructs such as beliefs about intelligence, goal orientation, and cognitive engagement have received consistently high attention in educational research. Building on this foundation, the present study seeks to extend understanding by examining how these constructs interact within a unified framework. Specifically, it explores the role of goal orientation as a mediating mechanism through which beliefs about intelligence influence cognitive engagement. By focusing on cognitive engagement—a process-oriented indicator of how motivation translates into active learning—the study offers insight into the dynamic pathways from foundational beliefs to learning behaviors. Furthermore, by incorporating different types of cognitive tasks, including those involving fluid and crystallized intelligence, the study allows for an examination of how motivation may operate across varied cognitive demands. This approach contributes to a more detailed understanding of the processes linking beliefs, motivation, and engagement in diverse learning tasks. Given that beliefs about intelligence are foundational beliefs that influence motivational factors and learning behaviors, this study investigated their impact on engagement in cognitive tasks, as well as the potential mediating role of goal orientation in this relationship.

Research Questions

This study investigated the structural relationships among students' beliefs about intelligence, achievement goal orientations, and engagement in two types of cognitive tasks (fluid and crystallized in telligence tasks). Based on previous research, it is hypothesized that beliefs about intelligence affect cognitive task engagement both directly and indirectly, mediated by achievement goal orientation.

The specific research questions are as follows:

1. To what extent do beliefs about intelligence predict students' engagement in fluid and crystallized cognitive tasks?

2. Does goal orientation mediate the relationship between beliefs about intelligence and cognitive task engagement (fluid intelligence task and crystallized intelligence tasks)?

3. Does the mediating role of goal orientation differ in the relationship between beliefs about intelligence and engagement in fluid versus crystallized cognitive tasks?

Methods

Participants

The participants in this study were fifth- and sixth-grade students from three different elementary schools located in a metropolitan city in South Korea (Table 2). Upper-grade elementary school students were selected because they are at a developmental stage where beliefs about intelligence and achievement goals begin to stabilize and meaningfully influence learning behavior. At this age, students also face increased academic demands and become more sensitive to feedback and peer comparison, making the relationship between beliefs, motivation, and cognitive engagement especially salient. A total of 275 students participated in the study, and their data were included in the analysis. Of the participants, 153 were male (55.8%) and 122 were female (44.3%). The selection of participants was based on accessibility and consent, and all participants were informed that their responses would be used for research purposes only. Data from one participant were excluded because the student did not complete the cognitive tasks.

Table 2. Participant Demographics by Gender and Grade Level (N = 275)

	Male	Female	Total
5^{th} Grade	88	64	152
6^{th} Grade	65	58	123
Total	153	122	275

Measurement Instruments

Beliefs About Intelligence

To measure students' beliefs about intelligence, this study employed a scale originally developed by Abd-El-Fattah and Yates (2006), which was translated and adapted for use with elementary school students. The scale comprised 12 items in total—5 items assessed beliefs grounded in students' actual experiences, and 7 items focused on their beliefs regarding the potential for change and improvement in intelligence. Each item was rated on a 6-point Likert scale, ranging from strong disagreement to strong agreement. This scale included items such as "You are born with a fixed amount of intelligence" (fixed belief) and "Good preparation before performing a task is a way to develop your intelligence" (growth beliefs). In this framework, lower scores on entity beliefs and higher scores on incremental beliefs indicated a view of intelligence as malleable and capable of development. The internal consistency reliability (Cronbach's α) was .742 for the entity beliefs subscale and .722 for the incremental beliefs subscale. The overall reliability for the full scale was .822.

Achievement Goal Orientation

Achievement goal orientation was measured using an 18-item scale developed based on the framework proposed by Elliot and Church (1997). The scale assessed three distinct subtypes of goal orientation: mastery goal orientation, performance approach goal orientation, and performance avoidance goal orientation. Each subtype was represented by six items. Participants responded to each item using a 5-point Likert scale ranging from 1 (not at all true) to 5 (very true), with higher scores indicating stronger endorsement of the respective goal orientation. Example items are "It is important to me to do better than the other students" (performance approach), "I want to learn as much as possible from this class" (mastery), and "I worry about the possibility of getting a bad grade in this class" (performance avoidance). The internal consistency reliability (Cronbach's α) was .817 for the performance approach goal subscale, .725 for the mastery goal subscale, and .823 for the performance avoidance goal subscale. The overall reliability of the full scale was .881.

Engagement in Cognitive Tasks of Two Types: Fluid and Crystallized

In this study, cognitive task engagement was assessed using two types of tasks, fluid and crystallized. Fluid intelligence tasks involved analogical reasoning in verbal and geometric domains, while crystallized intelligence tasks required applying previously acquired knowledge. Verbal analogical reasoning was assessed with items adapted from previous studies by Sternberg and Nigro (1983) and Pellegrine (1982). These items were revised to match the cognitive level of elementary school students, resulting in 19 proportional analogy problems (e.g., A : B = C : ?), which required students to identify semantic relationships between word pairs. Geometric analogical reasoning was evaluated using visual analogy tasks based on the instrument developed by Park (1996). For the present study, 10 items were selected based on difficulty levels among the various types included in Park's instrument. Internal consistency reliability, calculated using Cronbach's α, was .85 for pictorial items and .89 for transformational items.

For crystallized intelligence tasks that require applying previously acquired knowledge, diagnostic academic assessment scores were collected. Crystallized intelligence refers to cognitive abilities that develop through accumulated knowledge and life experiences, and thus, its measurement should be sensitive to age and educational exposure (Cattell, 1963; Horn & Cattell, 1967). In this study, school diagnostic assessment results were used as indicators of engagement in crystallized intelligence tasks, as these assessments are designed to evaluate students' understanding of curriculum-based content. Such tasks require the retrieval, application, and integration of previously learned knowledge, which aligns with the core characteristics of crystallized intelligence. Therefore, the assessments were initially considered a valid proxy for students' accumulated academic knowledge and their engagement in tasks rooted in familiar learning contexts. Unlike rote recall, these assessments often involve interpreting familiar concepts, solving curriculum-based problems, and integrating learned information, all of which demand deliberate cognitive effort and engagement with content knowledge. For this study, assessment scores in Korean, mathematics, social studies, and science were collected to represent students' engagement in crystallized intelligence tasks.

Analysis

The data were analyzed using SPSS 21.0 and AMOS 26.0 software. Descriptive statistics, including means and standard deviations, were computed to summarize the overall distribution of each variable. Pearson's correlation analysis was conducted to examine the relationships among the major variables. To test the hypothesized structural relationships and investigate potential mediating effects, structural equation modeling (SEM) was employed using AMOS 26.0. Reliability tests were conducted for all scales, and the internal consistency (Cronbach's α) values indicated acceptable levels for research purposes. The hypothesized structural model is presented in Figure 1.

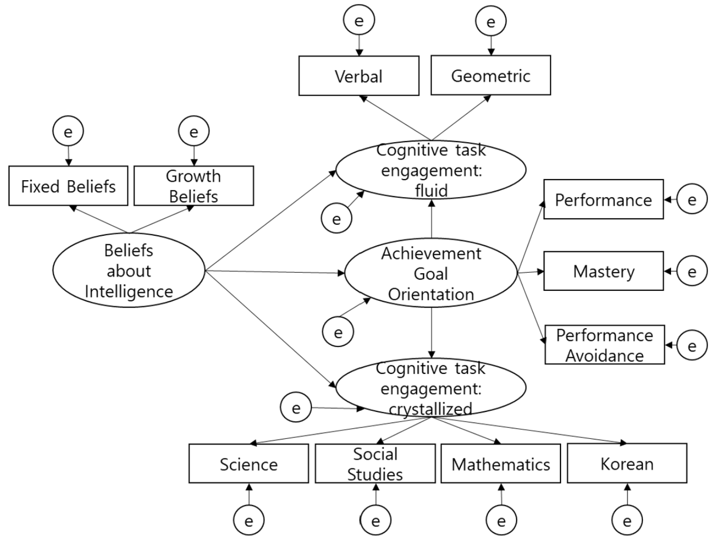

Fig. 1. Hypothesized structural equation model of the study

Results

Descriptive Statistics and Correlations

Descriptive statistics for all measured variables, including means and standard deviations, were calculated for the sample (Table 3). This descriptive statistics table summarizes data from 274 students across key variables. On average, students reported high growth beliefs about intelligence (M = 4.42) and low fixed beliefs (M = 2.38), indicating a general tendency toward growth beliefs. Among academic subjects, mathematics had the highest mean score (M = 3.32), while social studies had the lowest (M = 2.43).

Table 3. Descriptive Statistics of Measured Variables (N = 274)

Variables	Mean	SD
Fixed beliefs about intelligence	2.38	.79
Growth beliefs about intelligence	4.42	.91
Performance approach goal	3.25	.76
Mastery goal	3.35	.70
Performance avoidance goal	3.00	.80
Verbal analogical reasoning	11.94	4.82
Geometric analogical reasoning	3.76	1.86
Korean	2.91	1.05
Mathematics	3.32	1.27
Social studies	2.43	1.15
Science	2.65	1.06

Table 4 presents the results of a correlation analysis conducted to examine the relationships among intelligence beliefs, achievement goal orientation, and cognitive task engagement (fluid and crystallized). The correlation analysis revealed several notable relationships among the study variables. First, beliefs about intelligence were significantly correlated with achievement goal orientation, with correlation coefficients ranging from .174 to .302. Among the subtypes of goal orientation, growth beliefs about intelligence showed the strongest positive correlation with mastery goal orientation. Second, when examining the relationships between types of intelligence beliefs and cognitive task engagement, fixed beliefs about intelligence were negatively correlated with the assessment score of Korean ($r = –.155^{*}$), while growth beliefs showed a significant positive correlation in overall assessment scores across four subjects. Regarding fluid task engagement, growth beliefs showed a significant positive correlation with overall cognitive engagement in fluid tasks ($r = .142^{*}$ and $.135^{*}$). Lastly, with respect to the strength of correlation between goal orientations and cognitive engagement in crystallized tasks, assessment score of mathematics showed the highest correlation with mastery goals (.294**).

Table 4. Correlation coefficients among measured variables (N = 274)

	1	2	3	4	5	6	7	8	9	10
1.Fixed beliefs about intelligence	–									
2.Growth beliefs about intelligence	0.028	–								
3.Performance approach goal	.210**	.184**	–							
4.Mastery goal	.174*	.302**	.694**	–						
5.Performance avoidance goal	.263**	.212**	.680**	.729**	–					
6.Verbal analogical reasoning	–.110	.142*	.004	.036	-.074	–				
7.Geometric analogical reasoning	–.009	.135*	.049	.109	.038	.431**	–			
8.Korean	–.155*	.177**	.016	.056	-.031	.209**	.208**	–		
9.Mathematics	.006	.191**	.001	.119*	.058	.260**	.238**	.324**	–	
10.Social studies	.028	.158*	.022	.087	.067	.159**	.094	.543**	.223**	–
11.Science	–.035	.195**	-.048	.021	-.031	.294**	.269**	.455**	.398**	.476**

Model Fit

Structural equation modeling (SEM) was conducted to test the proposed model. The fit indices of the model were as in Table 4. The goodness-of-fit of the proposed model was evaluated using the indices χ^2, χ^2/df, TLI, CFI, and RMSEA. The model yielded a χ^2 value of 196.555 (df = 80), with a χ^2/df ratio of 2.457. According to Kim (2014), a χ^2/df value below 3 is generally considered indicative of a good model fit. Although the χ^2 value can be sensitive to sample size, it should be interpreted alongside other fit indices. The model's TLI and CFI values were .938 and .953, respectively, both exceeding the commonly accepted threshold of .90, indicating a good fit (Kim, 2010). In addition, the RMSEA value was .053 with a 90% confidence interval ranging from .06 to .08. This value meets the acceptable standard of below .08, as suggested by MacCallum et al. (2001). Taken together, these indices indicate that the proposed model demonstrates an acceptable level of fit to the data.

Table 5. Model fit analysis results (N = 274)

	χ^2 (df)	χ^2/df	TLI	CFI	RMSEA(CI□□)
Model	196.555^{**} (80)	2.457	0.938	0.953	.053 ([.060, .080])
Criteria	p > .05	< 3	> .90	> .90	< .08 (.06~.08)

** $p < .01$

The path coefficient analysis demonstrated that the proposed structural model was well supported by the data (Table 6), both in terms of statistical significance and effect size. According to Song (2009), a path coefficient (β) with an absolute value of .40 or higher indicates a meaningful contribution, and most paths in this model met or exceeded that threshold. Notably, beliefs about intelligence had a strong positive influence on goal orientation ($\beta = .776$, $p < .001$), and also positively affected fluid cognitive task engagement ($\beta = .735$, $p < .01$) and crystallized cognitive task engagement ($\beta = 1.362$, $p < .05$). Goal orientation significantly predicted subtypes of achievement goals, performance approach ($\beta = .808$), mastery ($\beta = .581$, $p < .001$), and performance avoidance ($\beta = .831$, $p < .001$), while showing negative associations with both analogical reasoning ($\beta = –.553$, $p < .05$) and academic achievement ($\beta = –1.041$). Fluid task engagement significantly predicted verbal analogy ($\beta = .529$) and geometric analogy ($\beta = .623$, $p < .001$), and crystallized task engagement significantly predicted performance in Korean, mathematics, social studies, and science, with all coefficients above .50. The overall pattern of findings confirms the theoretical assumptions of the model, with most predictors contributing meaningfully to their respective outcomes and supporting the hypothesized structural relationships.

Table 6. Path coefficients of measured variables

Path			Unstandardized Estimate	Standardized Estimate	Standard Error	C.R.	P
Beliefs about intelligence	→	Goal orientation	1.444	0.776	0.395	3.655	***
Goal Orientation	→	Fluid cognitive task engagement	–.815	–.553	0.335	–2.433	*
Goal Orientation	→	Crystallized cognitive task engagement	–.939	–1.041	0.557	–1.688	-
Beliefs about intelligence	→	Fluid cognitive task engagement	2.016	0.735	0.660	3.054	**
Beliefs about intelligence	→	Crystallized cognitive task engagement	2.285	1.362	1.254	1.821	*
Beliefs about intelligence	→	Fixed beliefs	0.245	0.098	0.175	1.395	**
Beliefs about intelligence	→	Growth Beliefs	1	0.408			-
Goal Orientation	→	Performance Approach Goals	1	0.808			-
Goal Orientation	→	Mastery Goals	0.746	0.581	0.085	8.817	***
Goal Orientation	→	Performance Avoidance Goals	1.077	0.831	0.104	10.385	***
Fluid cognitive task engagement	→	Verbal Analogy	1	0.692			
Fluid cognitive task engagement	→	Geometric Analogy	0.347	0.623	0.077	4.495	***
Crystallized cognitive task engagement	→	Korean Achievement	1	0.529	–	–	
Crystallized cognitive task engagement	→	Math Achievement	1.329	0.581	0.332	3.998	***
Crystallized cognitive task engagement	→	Social Studies Achievement	1.055	0.509	0.128	8.214	***
Crystallized cognitive task engagement	→	Science Achievement	1.680	0.878	0.369	4.554	***

*p<.05, **p<.01, ***p<.001

Direct, Indirect, and Total Effects of Latent Variables

The path analysis in this study examined how beliefs about intelligence influence student outcomes, specifically cognitive engagement in fluid and crystallized intelligence tasks, through the mediating role of achievement goal orientation (Table 7). The model included both direct and indirect effects based on unstandardized and standardized regression coefficients. Beliefs about intelligence had a significant direct effect on goal orientation ($\beta = .776$, $p < .01$), which in turn negatively predicted fluid cognitive task engagement ($\beta = -.553$, $p < .05$) and crystallized cognitive task engagement ($\beta = -1.041$). While beliefs about intelligence had strong direct effects on fluid cognitive task engagement ($\beta = .735$, $p < .01$) and crystallized cognitive task engagement ($\beta = 1.362$, $p < .05$), their indirect effects through goal orientation were negative ($\beta = -.429$, $p < .01$ and $-.808$, respectively).

Beliefs about intelligence had a positive direct effect on both fluid ($\beta = .735$, $p < .01$) and crystallized cognitive task engagement ($\beta = 1.362$, $p < .05$), but a significant negative indirect effect via achievement goal orientation ($\beta = -.429$, $p < .01$ for fluid; $\beta = -.808$, $p < .05$ for crystallized), yielding a smaller total effect of $\beta = .306$ for fluid and $\beta = .554$ for crystallized. This suggests an inconsistent mediation pattern, where achievement goal orientation partially suppresses the positive relationship between beliefs and achievement. These findings suggest that Beliefs about intelligence directly support crystallized cognitive task engagement, but when they lead to certain types of goal orientation (e.g., high performance avoidance), the effect on achievement becomes negative. In this case, goal orientation may partially suppress the positive influence of beliefs.

Table 7. Direct, indirect, and total effects of latent variables

Path			Ustd. Regression Coefficient (S.E.)			Std. Regression Coefficient (S.E.)		
			Direct Effect	Indirect Effect	Total Effect	Direct Effect	Indirect Effect	Total Effect
Beliefs about Intelligence	→	Goal Orientation	1.444^{**}	–	1.444	$.776^{**}$	–	0.776
Goal Orientation	→	Fluid cognitive task engagement	$-.815^{*}$	–	–.815	$-.553^{*}$	–	–.553
Goal Orientation	→	Crystallized cognitive task engagement	–.939	–	–.939	–1.041	–	–1.041
Beliefs about Intelligence	→	Fluid cognitive task engagement	2.016^{**}	-1.176^{**}	.840	$.735^{**}$	$-.429^{**}$	0.306
Beliefs about Intelligence	→	Crystallized cognitive task engagement	2.285^{*}	-1.356^{*}	0.929	1.362^{*}	$-.808^{*}$	0.554

$^{*}p<.05$, $^{**}p<.01$, $^{***}p<.001$

The structural equation modeling results revealed important relationships among beliefs about intelligence, goal orientation, and cognitive task engagement (fluid and crystallized). Beliefs about intelligence had a significant direct effect on goal orientation ($\beta = .776$, $p < .01$), indicating that students who held more adaptive growth beliefs were more likely to adopt positive achievement goals. These beliefs also had a significant direct effect on fluid cognitive task engagement ($\beta = .735$, $p < .01$), suggesting that students with growth beliefs about intelligence were more likely to perform better at fluid cognitive tasks. In addition, beliefs about intelligence had a significant negative indirect effect on fluid cognitive task engagement through goal orientation ($\beta = -.429$, $p < .01$), though the indirect effect was negative.

Similarly, beliefs about intelligence influenced cognitive engagement in crystallized cognitive tasks indirectly through goal orientation ($\beta = -.808$, $p < .05$), with a total effect of $\beta = 0.554$. However, the direct effect of goal orientation on engagement in crystallized cognitive tasks was negative and unexpectedly large ($\beta = -1.041$), and the effect of beliefs about intelligence on crystallized cognitive task engagement also appeared disproportionately high. These findings highlight the relationships between adaptive beliefs about intelligence, engaging in fluid cognitive tasks, and goal orientation, while also suggesting the need for further refinement of the model to resolve inconsistencies and better understand the complex dynamics among the variables. Figure 2 describes the final structural model of the study.

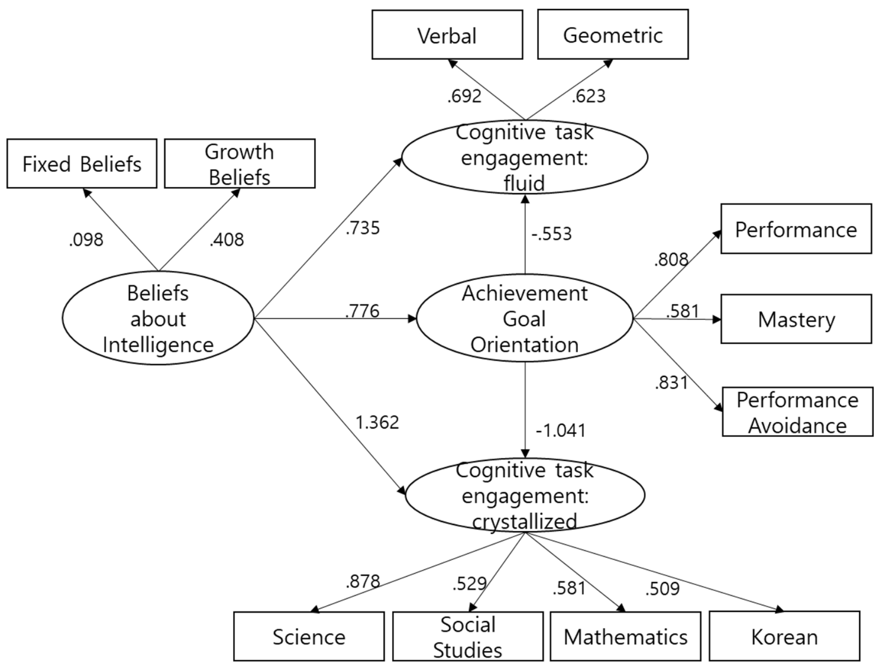

Fig. 2. Final structural equation model of the study

Discussion and Conclusion

The purpose of this study was to examine the structural relationships among beliefs about intelligence, achievement goal orientations, cognitive engagement (fluid and crystallized tasks) in upper elementary school students, and to verify whether achievement goal orientation mediates the effects of intelligence beliefs on cognitive task engagement. The proposed research model demonstrated a good model fit, satisfying the thresholds for TLI, CFI, RMSEA, and χ^2/df. The results showed that achievement goal orientation partially mediated the relationship between intelligence beliefs and cognitive task engagement. These findings suggest the complex role that goal orientation plays in linking students' foundational beliefs about intelligence to their actual engagement in cognitive tasks. Based on these findings, implications and directions for future research are discussed below.

Relationships Among Intelligence Beliefs, Achievement Goal Orientation, and Cognitive Task Engagement

The findings of this study revealed that students' intelligence beliefs significantly influence their achievement goal orientations, which in turn affect both types of cognitive task engagement. Specifically, students who held a growth view of intelligence were more likely to adopt positive goal orientations, which mediated their levels of cognitive task engagement. Growth beliefs about intelligence showed the highest correlation with mastery goal orientation and showed the weakest correlation with performance goal orientation among the three types of goal orientations. These findings indicate that when students believe their intelligence can be developed, they are more likely to adopt positive goal orientation that emphasize an interest in learning for its own sake. This supports prior findings (Dweck, 2004; Furnham, 2014) suggesting that students who believe intelligence is malleable are more likely to pursue learning goals and persist through academic challenges. In contrast, students who endorse a fixed theory of intelligence tend to adopt performance avoidance goals.

Second, in examining the relationships among latent variables, achievement goal orientation and cognitive task engagement was significantly negatively correlated. This finding is counterintuitive, as achievement goals—particularly mastery goals—are typically associated with higher levels of persistence and engagement. The negative correlation observed in this study suggests that certain aspects of students' goal orientations, such as performance avoidance tendencies, may have undermined their engagement in cognitively demanding tasks that require flexible thinking and prior knowledge. This pattern aligns with the suppressor effects identified in the path analysis, where goal orientation weakened the positive impact of adaptive intelligence beliefs on cognitive task engagement. The negative effects of less adaptive goal orientations, such as performance and performance-avoidance goals, may be more pronounced than the positive influence of mastery goals. As a result, combining all three goal types into a single composite variable may have led to an overall negative correlation with both forms of cognitive task engagement. These results highlight the importance of unpacking the multidimensional nature of goal orientation, as aggregated measures may mask divergent effects of different goal types.

Third, In the relationships among intelligence beliefs and cognitive task engagement, growth beliefs about intelligence generally showed a positive and statistically significant, albeit weak, association with both types of cognitive task engagement. In contrast, fixed beliefs demonstrated negative and very weak correlations with cognitive task engagement measures, though these were not statistically significant. At the individual level, this suggests that students' beliefs about the malleability of intelligence are meaningfully related to stronger cognitive engagement, though this relationship warrants further investigation. These findings are consistent with previous studies that found intelligence beliefs influence students' motivation and academic achievement through their impact on goal orientation and persistence (Chen et al., 2015; Dweck et al., 2004).

These results emphasize the importance of examining how beliefs about intelligence affect students' academic processes not only directly but also indirectly through goal orientation. Although this study did not include different types of goal orientation separately in the model, future research should investigate whether the direction and strength of effects differ depending on the goal orientation types and examine how various types of achievement goal orientations influence learning behaviors differently.

Direct and Indirect Effects of Intelligence Beliefs

First, this study confirmed that achievement goal orientation serves as a mediator in the relationships between intelligence beliefs and both types of cognitive engagement. Specifically, students with a growth belief about intelligence were more likely to adopt adaptive achievement goals, which in turn influenced their cognitive task engagement. This finding supports prior research indicating that achievement goal orientation channels the motivational impact of beliefs into concrete learning behaviors (Li & Shieh, 2016; Wolters, 2004). The mediating role of goal orientation suggests that intelligence beliefs may not directly enhance student performance in cognitive tasks unless translated into purposeful and adaptive goal-setting strategies, such as striving to master content or persist through challenges. These results highlight the importance of instructional strategies that help students internalize growth-oriented beliefs and translate them into meaningful academic goals.

Similarly, studies by Dweck (2000) and Wigfield and Cambria (2010) have shown that achievement goal orientation serves as a key variable in explaining academic outcomes. These studies argue that intelligence beliefs influence academic achievement not directly, but indirectly through the mediating role of goal orientation. These findings suggest that interventions aimed at shaping students' goal orientations may be particularly effective when paired with efforts to promote growth beliefs. This study also highlights the importance of examining not only whether intelligence beliefs directly affect learning behaviors and academic outcomes, but also whether motivational variables such as achievement goal orientation mediate the relationship. However, to confirm the mediating role of goal orientation, future research should further examine how specific subtypes (e.g., mastery, performance-approach, and performance-avoidance goals) differentially mediate this relationship across diverse age groups and academic domains. Rather than serving as a straightforward conduit, goal orientation may amplify or suppress the influence of these beliefs, depending on the specific motivational tendencies involved.

Academic achievement reflects the outcomes produced through learning and is influenced by a wide range of factors, including learners' abilities, beliefs, motivation, and environmental conditions. Among these, this study highlights the significant impact of intelligence beliefs and achievement goal orientation on students' engagement in cognitive tasks. When students believe that their intelligence can grow through effort and learning, they are more likely to adopt mastery-oriented goals and engage persistently with challenging tasks. This underscores the importance of fostering positive self-theories in learners and creating supportive classroom environments that encourage adaptive mindsets. Educators play a crucial role in this process by recognizing the role of implicit theories—students' underlying beliefs about intelligence—in shaping learning behavior and outcomes. To promote meaningful change, teachers should implement instructional strategies and educational programs that explicitly address and reshape these beliefs. For instance, incorporating principles related to incremental beliefs about intelligence into lessons or providing feedback that emphasizes effort and progress can help students maximize their potential. By doing so, schools can not only support individual academic success but also cultivate lifelong learning attitudes that extend beyond the classroom.

This study builds on previous research by reaffirming that students who hold growth-oriented beliefs about intelligence are more likely to adopt achievement goals, a finding consistent with earlier motivational theory and empirical evidence. However, a novel contribution lies in the simultaneous examination of both fluid and crystallized cognitive task engagement within a single structural model. The results reveal that beliefs about intelligence directly and positively influence both types of task engagement, demonstrating that such beliefs are broadly predictive of students' cognitive performance across distinct domains. Moreover, while the theoretical structure of the model aligns with existing frameworks, this study uniquely identifies complex indirect pathways—such as inconsistent mediation and suppressor effects—thereby highlighting the nuanced dynamics between motivational beliefs, goal orientations, and engagement in cognitive tasks. This complexity underscores the need to further refine motivational models to account for unintended effects of mediators like goal orientation.

Limitations and Future Research

The limitations of this study and suggestions for future research are as follows. First, this study examined the construct of intelligence beliefs as a single factor, and achievement goal orientation was also measured as a single variable without distinguishing between. This is because the current study conceived intelligence beliefs and goal orientation—including both their positive and negative aspects—as manifestations of a broader latent motivational disposition that can shape students' motivational tendencies. However, there are meaningful differences among subtypes of goal orientation in how they relate to intelligence beliefs, and therefore, treating them as a unified construct may obscure more nuanced patterns. Hence, future research should further examine the sub-dimensions of intelligence beliefs and achievement goal orientation, exploring how each subtype may play a distinct role in the relationships among motivational variables and learning outcomes.

Second, in this study, a diagnostic assessment conducted early in a school year was used as a measure of cognitive engagement in crystallized intelligence tasks. According to the concept of crystallized intelligence, measurement approaches should vary depending on students' age, as crystallized abilities are shaped by accumulated knowledge and experiences over time (Cattell, 1963; Horn & Cattell, 1967). Therefore, this study used school diagnostic assessment results, because the assessments evaluate students' learning based on the school curriculum, and were initially considered as a reflection of students' accumulated knowledge. However, school diagnostic assessments often focus on curriculum-specific skills and as a result, the measurement might not fully capture the broader performance of crystallized intelligence. Therefore, in future studies, using a validated crystallized intelligence instrument ensures that the construct is measured accurately and consistently across age groups, reflecting students' accumulated knowledge and experience.

Third, one limitation of this study is the absence of competing structural equation models. This decision was made because the primary goal was to test a theoretically grounded, parsimonious model based on prior research, and in such cases, including competing models is not always necessary—particularly when the hypothesized model has strong conceptual justification and prior empirical support. However, future studies could benefit from testing alternative models that treat subtypes of intelligence beliefs (i.e., fixed and growth) and goal orientations (e.g., mastery, performance-approach, performance-avoidance) as distinct constructs. Doing so may further elucidate the nuanced roles these variables play in shaping students' cognitive engagement and learning outcomes.

Conclusion

This study underscores the critical role of intelligence beliefs and achievement goal orientation in shaping students' cognitive engagement across both fluid and crystallized task domains. By demonstrating that goal orientation partially mediates the relationship between intelligence beliefs and cognitive task performance, the findings offer empirical support for motivational theories that posit beliefs as foundational drivers of academic motivation and learning behaviors. The study's integrated structural model, which includes both types of cognitive engagement (fluid and crystallized), highlights the complex and sometimes suppressive role of goal orientation. These insights suggest that fostering growth-oriented beliefs and supporting adaptive goal-setting strategies are essential for promoting deep cognitive engagement in elementary school students. This study highlights the significance of promoting growth-oriented beliefs and adaptive goal orientations to strengthen cognitive engagement. Interventions that target both belief systems and goal-setting may effectively enhance sustained learning behaviors.

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Conflicts of Interest

The author declared no conflicts of interest.

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