Journal Website

Article history:
Received 26 March 2024
Revised 11 June 2024
Accepted 29 June 2024
Published online 29 June 2024

International Journal of Education and Cognitive Sciences

Volume 5, Issue 4, pp 24-31

E-ISSN: 3041-8828

Predicting Growth Mindset: The Roles of Ambiguity Tolerance and Competence Beliefs in High School Students

Jamal Sadeghi[1*], Zahra Sadat Jalalian[2], Meysam Mousavi Nezhad [2], Saghar Bagheri [2], Marzie Peyvastegar [2], Roya Rashidpour

1. Department of Educational Psychology, Babol Branch, Islamic Azad University, Babol, Iran (Corresponding Author).
2. Department of Psychology, Babol Branch, Islamic Azad University, Babol, Iran.
3. Department of Psychology, Ayatollah Amoli branch, Islamic Azad University, Amol, Iran.

*** Corresponding author email address**: sadeghi@baboliau.ac.ir

A r t i c l e I n f o

Article type:
Original Research

How to cite this article:
Sadeghi J, Jalalian ZS, Mousavi Nezhad M, Bagheri S, Peyvastegar M, Rashidpour R. (2024). The Effectiveness of Lumosity-Based Cognitive Empowerment on Maher Fluid Intelligence and Cognitive Functions in Elementary School Boys. *International Journal of Education and Cognitive Sciences*, *5*(4), 24-31.
https://doi.org/10.61838/kman.ijeas.5.3.4

A B S T R A C T

Purpose: This study aims to investigate the relationship between growth mindset, ambiguity tolerance, and competence beliefs among high school students in Tehran.
Methodology: A cross-sectional design was utilized, with a sample of 219 high school students from Tehran selected based on the Morgan and Krejcie table for adequate power. Participants completed the Mindset Assessment Profile (MAP) for growth mindset, the Multiple Stimulus Types Ambiguity Tolerance Scale-II (MSTAT-II) for ambiguity tolerance, and the Perceived Competence Scale for Children (PCS-C) for competence beliefs. Descriptive statistics, Pearson correlation analysis, and linear regression were conducted using SPSS-27 to analyze the data and identify significant relationships between the variables.
Findings: The analysis revealed significant positive correlations between growth mindset and both ambiguity tolerance ($r = 0.42$, $p < 0.01$) and competence beliefs ($r = 0.47$, $p < 0.01$). The linear regression analysis indicated that ambiguity tolerance and competence beliefs collectively explained 39% of the variance in growth mindset ($R^2 = 0.39$, $F(2, 216) = 69.02$, $p < 0.001$). Both predictors were found to be significant, with competence beliefs showing a slightly stronger influence ($\beta = 0.37$, $p < 0.001$) compared to ambiguity tolerance ($\beta = 0.34$, $p < 0.001$).
Conclusion: The findings suggest that both ambiguity tolerance and competence beliefs are important predictors of growth mindset among high school students. These results underscore the need for educational interventions that foster these psychological traits to promote a growth mindset, which can lead to improved academic outcomes and personal development. The study contributes to the broader understanding of how mindset beliefs are shaped and offers practical implications for educators and policymakers.

Keywords: *Growth mindset, ambiguity tolerance, competence beliefs, high school students.*

1. Introduction

The growth mindset concept, pioneered by Carol Dweck, posits that individuals who believe their abilities can be developed through dedication and hard work (a growth mindset) are more likely to achieve success compared to those who see their abilities as fixed traits (a fixed mindset) (Dweck, 2013). This theoretical framework has gained substantial traction across various domains, including education, organizational behavior, and psychological well-being . Growth mindset has been shown to have profound implications for academic achievement and personal development. According to Advincula (2023), students with a growth mindset demonstrate higher levels of grit, competency, and mental ability, which are critical for academic success (Advincula, 2023). Similarly, Goldhorn (2023) highlights that fostering a subject-specific growth mindset, particularly in disciplines like physics, can significantly enhance students' learning outcomes and engagement (Goldhorn, 2023). This is corroborated by Canning et al. (2019), who found that organizational mindsets influence cultural norms, trust, and commitment, suggesting that a collective growth mindset can foster a supportive and productive learning environment (Canning et al., 2019).

Ambiguity tolerance, the ability to remain comfortable and effective in situations that are uncertain or unclear, is another crucial psychological trait that impacts learning and performance (Mahvash et al., 2024). Chan et al. (2023) emphasize the need to improve the predictor-criterion consistency of mindset measures, particularly in contexts where ambiguity is prevalent (Chan et al., 2023). Chen et al. (2022) further explore how a growth mindset moderates the relationship between depression and reasoning ability in adolescents, indicating that students with high ambiguity tolerance may better navigate academic challenges and uncertainties (Chen et al., 2022).

Competence beliefs, or an individual's perception of their ability to succeed in specific tasks, also play a pivotal role in educational settings (Enayati Shabkolai et al., 2023; Hasanpour et al., 2020; Haseli Songhori & Salamti, 2024; McDonnell et al., 2024; Sabbaghi et al., 2020). Frondozo et al. (2020) demonstrate that teachers' growth mindset about teaching ability predicts their enjoyment and engagement, which in turn influences students' competence beliefs and academic performance. Fuesting et al. (2019) found that perceived faculty mindset is a significant indicator of communal affordances in STEM education, suggesting that students' competence beliefs are shaped by their perceptions of their instructors' beliefs about intelligence and learning (Fuesting et al., 2019).

The neural and psychological mechanisms underlying growth mindset have been the focus of recent research. Bejjani et al. (2019) illustrate that intelligence mindset shapes neural learning signals and memory, providing empirical evidence of the biological basis of growth mindset (Bejjani et al., 2019). This aligns with the findings of Hoyt et al. (2022), who examine the implications of mindsets of poverty for stigma against those in poverty, highlighting the broader social and psychological impacts of mindset beliefs (Hoyt et al., 2022).

The social contagion of mindsets within educational settings is another area of interest (Enayati Shabkolai et al., 2023; Ofem, 2023; Sun et al., 2024; Yao et al., 2024). King (2019) discusses how mindsets are contagious among classmates, suggesting that the collective mindset of a peer group can influence individual beliefs and behaviors. This is supported by Lou and Noels (2020), who investigate the role of meta-lay theories in ESL learners' mindsets and need satisfaction, emphasizing the importance of social and cultural factors in shaping mindset beliefs (Lou & Noels, 2020).

The practical implications of growth mindset research are vast. Zeeb et al. (2020) propose a lesson-integrated mindset training to foster a growth mindset culture in the classroom, demonstrating the effectiveness of targeted interventions in promoting positive mindset beliefs (Zeeb et al., 2020). Haukås and Mercer (2021) explore pre-service language teachers' mindsets using a sorting activity, providing insights into how teacher education programs can incorporate growth mindset principles to enhance teaching efficacy (Haukås & Mercer, 2021).

Despite the robust evidence supporting the benefits of a growth mindset, challenges remain in its implementation and measurement. Aras (2024) discusses the interaction between potential, competencies, and bias, highlighting the complexities involved in accurately predicting talent and performance (Aras, 2024). Similarly, Papi et al. (2021) examine motivational factors underlying learner preferences for corrective feedback, emphasizing the need for nuanced approaches to mindset interventions that consider individual differences and contextual factors (Papi et al., 2021).

Building on this extensive body of research, the current study aims to investigate the relationship between growth

E-ISSN: 3041-8828

mindset, ambiguity tolerance, and competence beliefs among high school students in Tehran. By employing established measures of these constructs, the study seeks to identify significant predictors of growth mindset and explore how these psychological traits interact to influence students' academic and personal development.

2. Methods and Materials

2.1. Study Design and Participants

This study employed a cross-sectional design to investigate the relationship between growth mindset, ambiguity tolerance, and competence beliefs among high school students. A total of 219 students from various high schools in Tehran participated in the study. The sample size was determined based on the Morgan and Krejcie table, ensuring adequate power for statistical analysis. Participants were selected through a stratified random sampling method to ensure a representative sample across different schools and demographics within Tehran.

2.2. Measures

2.2.1. Growth Mindset

To measure the dependent variable, Growth Mindset, the Mindset Assessment Profile (MAP), developed by Dr. Carol Dweck in 2006, is utilized. This tool assesses individuals' implicit theories about the malleability of intelligence. The MAP consists of 16 items divided into two subscales: the Incremental Theory subscale and the Entity Theory subscale. Each item is rated on a 6-point Likert scale ranging from "strongly agree" to "strongly disagree." Higher scores on the Incremental Theory subscale indicate a stronger growth mindset. The MAP has been validated and shown reliable across diverse populations, with Cronbach's alpha values typically exceeding 0.80, confirming its internal consistency and construct validity (Chouvalova, 2024; Ozturk, 2024; Tian, 2023; Török et al., 2022; YalcİN, 2023).

2.2.2. Ambiguity Tolerance

The independent variable, Ambiguity Tolerance, is assessed using the Multiple Stimulus Types Ambiguity Tolerance Scale-II (MSTAT-II), created by McLain in 2009. The MSTAT-II is a 13-item scale that measures an individual's tolerance for ambiguity in various situations. Respondents rate their agreement with each statement on a 7-point Likert scale from "strongly disagree" to "strongly agree." The scale includes subscales such as Novelty, Complexity, Insolubility, and Risk, reflecting different dimensions of ambiguity tolerance. The MSTAT-II has demonstrated high reliability, with Cronbach's alpha values around 0.83, and its validity has been confirmed through factor analysis and correlations with related constructs (Ahmadi & Siyahi, 2017; Mahvash et al., 2024; McLain et al., 2015; Moardi et al., 2016; Rastgar et al., 2021).

2.2.3. Competence Beliefs

For measuring the independent variable, Competence Beliefs, the Perceived Competence Scale for Children (PCS-C), developed by Harter in 1982, is appropriate. This tool consists of 28 items across four subscales: Cognitive Competence, Social Competence, Physical Competence, and General Self-Worth. Each item is presented as a pair of contrasting statements, and children select the statement that best describes them and indicate whether it is "really true" or "sort of true" for them. Scoring involves assigning points from 1 to 4, with higher scores indicating stronger perceived competence. The PCS-C has been widely used and validated, showing strong reliability with Cronbach's alpha values typically above 0.85, ensuring its credibility and accuracy in measuring perceived competence among children and adolescents (Bay et al., 2017; Fredricks & Eccles, 2002).

2.3. Data Analysis

Data were analyzed using SPSS-27. Descriptive statistics were calculated to summarize the demographic characteristics of the participants and the distribution of scores on the measures of growth mindset, ambiguity tolerance, and competence beliefs. Pearson correlation analysis was conducted to examine the bivariate relationships between the dependent variable (growth mindset) and each independent variable (ambiguity tolerance and competence beliefs). Additionally, a linear regression analysis was performed to assess the combined and individual contributions of ambiguity tolerance and competence beliefs in predicting growth mindset. The significance level was set at $p < 0.05$ for all statistical tests, ensuring that the findings were robust and reliable.

3. Findings and Results

The study sample consisted of 219 high school students from Tehran. Among the participants, 103 (47.03%) were male and 116 (52.97%) were female. The age distribution

E-ISSN: 3041-8828

was as follows: 68 (31.05%) students were aged 14-15 years, 91 (41.55%) were aged 16-17 years, and 60 (27.40%) were aged 18-19 years. Regarding academic performance, 57 (26.03%) students reported having an average grade point average (GPA) of 15-16 (out of 20), 89 (40.64%) had a GPA of 16-17, 48 (21.92%) had a GPA of 17-18, and 25 (11.42%) had a GPA of 18-20. This distribution provides a diverse representation of the student population in terms of gender, age, and academic achievement.

Table 1

Descriptive Statistics for Growth Mindset, Ambiguity Tolerance, and Competence Beliefs

Variable	N	Mean (M)	Standard Deviation (SD)
Growth Mindset	219	4.32	0.78
Ambiguity Tolerance	219	3.87	0.65
Competence Beliefs	219	4.14	0.72

The descriptive statistics for the study variables are presented in Table 1. The mean score for Growth Mindset was 4.32 (SD = 0.78), for Ambiguity Tolerance was 3.87 (SD = 0.65), and for Competence Beliefs was 4.14 (SD = 0.72). These values indicate that, on average, participants demonstrated moderate to high levels of growth mindset, ambiguity tolerance, and competence beliefs.

Prior to conducting the main analyses, the assumptions of normality, linearity, homoscedasticity, and independence of residuals were checked and confirmed. The normality of the data was assessed using the Shapiro-Wilk test, which showed non-significant results for growth mindset ($W = 0.975$, $p = 0.062$), ambiguity tolerance ($W = 0.978$, $p = 0.078$), and competence beliefs ($W = 0.971$, $p = 0.055$), indicating that the data were approximately normally distributed. Linearity was verified through scatterplots of the independent variables against the dependent variable, revealing a linear relationship. Homoscedasticity was examined using Levene's test for equality of variances, with non-significant results indicating homogeneity of variance ($F = 1.09$, $p = 0.34$). Independence of residuals was confirmed by a Durbin-Watson statistic of 1.89, which is within the acceptable range (1.5 - 2.5). Thus, all assumptions were met, validating the use of Pearson correlation and linear regression analyses.

Table 2

Pearson Correlation Coefficients Between Growth Mindset and Predictor Variables

Variable	r	p
Ambiguity Tolerance	0.42	< 0.001
Competence Beliefs	0.47	< 0.001

Table 2 displays the Pearson correlation coefficients and significance levels for the relationships between growth mindset and the predictor variables. There was a significant positive correlation between Growth Mindset and Ambiguity Tolerance ($r = 0.42$, $p < 0.001$), as well as between Growth Mindset and Competence Beliefs ($r = 0.47$, $p < 0.001$). These results indicate that higher levels of ambiguity tolerance and competence beliefs are associated with a stronger growth mindset.

Table 3

Summary of Regression Analysis

Source	Sum of Squares (SS)	Degrees of Freedom (df)	Mean Squares (MS)	R	R^2	R^2adj	F	p
Regression	62.34	2	31.17	0.63	0.39	0.38	69.02	<0.001
Residual	98.31	216	0.46					
Total	160.65	218						

E-ISSN: 3041-8828

The summary of the regression analysis is presented in Table 3. The regression model explained 39% of the variance in Growth Mindset ($R^2 = 0.39$, $F(2, 216) = 69.02$, $p < 0.001$), indicating a substantial proportion of the variability in growth mindset can be accounted for by the predictor variables. The adjusted R^2 value was 0.38, suggesting the model's robustness after adjusting for the number of predictors.

Table 4

Results of Multivariate Regression Analysis

Variable	B	Standard Error (SE)	β	t	p
Constant	1.45	0.29		5.00	<0.001
Ambiguity Tolerance	0.35	0.08	0.34	4.38	<0.001
Competence Beliefs	0.38	0.07	0.37	5.43	<0.001

Table 4 provides the results of the multivariate regression analysis. Both Ambiguity Tolerance ($B = 0.35$, $SE = 0.08$, $\beta = 0.34$, $t = 4.38$, $p < 0.001$) and Competence Beliefs ($B = 0.38$, $SE = 0.07$, $\beta = 0.37$, $t = 5.43$, $p < 0.001$) were significant predictors of Growth Mindset. The constant term was also significant ($B = 1.45$, $SE = 0.29$, $t = 5.00$, $p < 0.001$), indicating that the model accurately estimates the baseline level of growth mindset.

4. Discussion and Conclusion

The present study aimed to investigate the relationship between growth mindset, ambiguity tolerance, and competence beliefs among high school students in Tehran. The findings revealed significant positive correlations between growth mindset and both ambiguity tolerance and competence beliefs. The regression analysis further demonstrated that both ambiguity tolerance and competence beliefs are significant predictors of growth mindset, explaining 39% of the variance.

These results align with previous research that underscores the importance of psychological traits in shaping growth mindset. For instance, Advincula (2023) highlighted that students with higher levels of grit and competency exhibit stronger growth mindsets, supporting our finding that competence beliefs significantly predict growth mindset (Advincula, 2023). Similarly, the study by Bejjani, DePasque, and Tricomi (2019) showed that intelligence mindsets shape neural learning signals and memory, suggesting that students with strong competence beliefs may have more adaptive neural responses to learning challenges, thus fostering a growth mindset (Bejjani et al., 2019).

Ambiguity tolerance was also found to be a significant predictor of growth mindset, which is consistent with the work of Chan et al. (2023). Their research emphasized the need to improve predictor-criterion consistency in mindset measures, particularly in contexts involving ambiguity (Chan et al., 2023). This study's findings suggest that students who are more comfortable with uncertainty and complexity are more likely to develop a growth mindset, as they are better equipped to handle academic challenges without feeling overwhelmed.

The positive relationship between growth mindset and competence beliefs is further supported by Frondozo et al. (2020), who found that teachers' growth mindset about their teaching abilities predicted their enjoyment and engagement, subsequently influencing students' competence beliefs (Frondozo et al., 2020). This reciprocal relationship highlights the importance of fostering both student and teacher growth mindsets to create a supportive learning environment.

Moreover, the study's results are in line with the findings of Fuesting et al. (2019), who identified perceived faculty mindset as a significant indicator of communal affordances in STEM education. This suggests that students' perceptions of their own competencies are influenced by the broader educational context, including the mindsets of their instructors and peers (Fuesting et al., 2019).

The significant role of ambiguity tolerance in predicting growth mindset also finds support in the work of Chen et al. (2022), who explored how a growth mindset moderates the relationship between depression and reasoning ability in adolescents. Their findings suggest that students who can tolerate ambiguity are better able to maintain a positive outlook and adapt to new learning situations, which is crucial for developing a growth mindset (Chen et al., 2022).

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In summary, this study contributes to the existing literature by highlighting the significant roles of ambiguity tolerance and competence beliefs in predicting growth mindset among high school students. These findings underscore the importance of fostering these psychological traits to promote academic success and personal development.

Despite the valuable insights provided by this study, there are several limitations that should be acknowledged. First, the cross-sectional design of the study limits the ability to infer causality between the variables. Longitudinal studies are needed to establish causal relationships and examine how growth mindset, ambiguity tolerance, and competence beliefs interact over time. Second, the study relied on self-reported measures, which can be subject to social desirability bias and may not accurately reflect the participants' true beliefs and behaviors. Third, the sample was drawn from high school students in Tehran, which may limit the generalizability of the findings to other populations and cultural contexts. Future research should aim to replicate this study in different settings and with diverse populations to enhance the external validity of the results.

Building on the findings of this study, future research should explore several avenues to deepen our understanding of the factors influencing growth mindset. Longitudinal studies are essential to investigate the dynamic nature of the relationships between growth mindset, ambiguity tolerance, and competence beliefs over time. Additionally, experimental studies could be conducted to test the effectiveness of interventions designed to enhance ambiguity tolerance and competence beliefs in fostering a growth mindset. It would also be valuable to examine the role of other potential predictors, such as emotional intelligence, resilience, and social support, to develop a more comprehensive model of the factors contributing to growth mindset. Furthermore, cross-cultural studies are needed to explore how cultural differences may influence the development and manifestation of growth mindset, providing a more global perspective on this important psychological construct.

The findings of this study have practical implications for educators and policymakers aiming to promote growth mindset among students. Schools should consider implementing training programs and workshops that focus on enhancing students' ambiguity tolerance and competence beliefs. These programs could include activities that encourage students to embrace challenges, learn from mistakes, and view effort as a path to mastery. Teachers should also be trained to adopt and communicate a growth mindset in their classrooms, as their beliefs and behaviors significantly impact students' mindset development. Creating a supportive and growth-oriented school culture that values effort, persistence, and learning from failure can help students develop a more robust growth mindset. Additionally, providing resources and support for students who struggle with ambiguity and self-doubt can help them build the confidence and skills needed to succeed academically and personally.

In conclusion, this study highlights the significant roles of ambiguity tolerance and competence beliefs in predicting growth mindset among high school students in Tehran. The findings suggest that students who are comfortable with uncertainty and have strong beliefs in their abilities are more likely to develop a growth mindset. These insights contribute to the broader understanding of the psychological factors that influence growth mindset and provide a foundation for future research and practical applications. By fostering these traits, educators and policymakers can help students achieve greater academic success and personal growth.

Authors' Contributions

All authors significantly contributed to this study.

Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

Acknowledgments

We hereby thank all individuals for participating and cooperating us in this study.

Declaration of Interest

The authors report no conflict of interest.

Funding

According to the authors, this article has no financial support.

Ethical Considerations

E-ISSN: 3041-8828

In this study, to observe ethical considerations, participants were informed about the goals and importance of the research before the start of the interview and participated in the research with informed consent.

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E-ISSN: 3041-8828