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Normalization of the Motivational and Metacognitive Beliefs Scale for Secondary School Students Regarding Online and Offline Mathematics Learning Environments

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A B S T R A C T

Objective: The aim of this study was to norm the motivational and metacognitive beliefs in online and offline learning environments.

Methods and Materials: This study is applied in terms of its objective and descriptive-survey in terms of its methodology. The statistical population of the research included all seventh-grade male students in the city of Manoojan during the 2020-2021 academic year. A convenience sampling method was used in this study, where, based on the Morgan table, 265 students receiving offline and online mathematics instruction were selected. The research tools in this study were the Motivational Beliefs Questionnaire (Pintrich et al., 1991) and the Metacognitive Beliefs Questionnaire (Wells, 2004). Data analysis was performed using SPSS 26 and AMOS 22 software.

Findings: Among the 25 items of the Motivational Beliefs Questionnaire and 30 items of the Metacognitive Beliefs Questionnaire, the content validity index for all items was confirmed as being above 0.70. The Motivational Beliefs Questionnaire included 25 items and four components: goal orientation, intrinsic value, self-efficacy, and test anxiety. The Metacognitive Beliefs Questionnaire included 30 items and five components: cognitive awareness, memory confidence, uncontrollability and danger, need to control thoughts, and positive beliefs about worry. The factor loadings for all items were above 0.50, Cronbach's alpha reliability for all components was above 0.70, and the average variance extracted for all components was above 0.50.

Conclusion: The results indicated that the measurement tools for assessing motivational and metacognitive beliefs in online learning environments for students have appropriate validity. Educational specialists and planners can use these tools to measure students' motivational and metacognitive beliefs and design and implement programs to enhance learning and academic achievement based on these components.

Keywords: *Motivational Beliefs, Metacognitive Beliefs, Normalization, Secondary School Students, Learning Environment.*

1. Introduction

The transition from traditional learning environments to online and hybrid models has significantly influenced educational practices worldwide. With the advent of digital technologies, the shift to online learning environments has prompted educators, researchers, and policymakers to explore the efficacy of these platforms in fostering student engagement, motivation, and academic achievement. This paradigm shift has been further accelerated by the global COVID-19 pandemic, which necessitated the rapid adoption of online education (Abed et al., 2022). The shift has not only changed how education is delivered but has also highlighted the importance of understanding students' motivational and metacognitive beliefs in these new learning contexts.

Motivational beliefs, including self-efficacy, goal orientation, and intrinsic motivation, are critical factors that influence students' engagement and success in learning environments (Lazarides et al., 2023; Teng et al., 2021; Teng & Wu, 2023; Teng & Yang, 2022). These beliefs shape how students approach learning tasks, persevere in the face of challenges, and ultimately perform academically (Hong et al., 2011). Similarly, metacognitive beliefs, which encompass students' awareness of their cognitive processes and their ability to regulate those processes, play a vital role in their ability to learn effectively, particularly in self-directed online learning environments (Teng et al., 2021; Wang & Zhan, 2020).

The integration of online learning environments into education has raised questions about how these platforms impact students' motivational and metacognitive beliefs. Research has shown that online learning can both positively and negatively influence students' motivation and metacognition, depending on various factors, including the design of the learning environment, the level of interaction between students and instructors, and the availability of support resources (Chen & Vibulphol, 2019; Xie & Huang, 2014). For instance, a well-designed online learning environment that promotes interaction and provides timely feedback can enhance students' self-efficacy and motivation (Abed et al., 2022; Wang, 2022). Conversely, poorly designed online courses may lead to feelings of isolation and decreased motivation, particularly if students perceive a lack of support and engagement from instructors (Idoghor & Oluwayimika, 2022; Isa, 2020).

The concept of self-regulated learning (SRL) is particularly relevant in online education. SRL refers to the process by which students take control of their own learning, including setting goals, monitoring their progress, and adjusting their strategies as needed (Abe et al., 2018). In online learning environments, where students are often required to learn independently, SRL skills are crucial for academic success. Studies have shown that students with strong SRL skills are better equipped to navigate the challenges of online learning and are more likely to succeed in these environments (Ngarisan et al., 2022; Yew et al., 2023).

However, the effectiveness of online learning environments in promoting SRL and other positive educational outcomes is not uniform across all contexts. Cultural factors, for example, can significantly influence how students perceive and engage with online learning. In some cultures, where education is traditionally teacher-centered, students may struggle to adapt to the more autonomous learning required in online environments (Aini et al., 2022; Al-Roomy, 2015). Additionally, the availability of technological resources and students' familiarity with digital tools can affect their ability to engage effectively in online learning (Altalhi, 2020).

The flipped classroom model is one approach that has gained popularity in online and blended learning environments. In a flipped classroom, traditional instructional activities, such as lectures, are delivered online for students to engage with at their own pace, while classroom time is reserved for interactive, hands-on activities (Chuang et al., 2016). This model has been shown to increase student motivation and engagement, particularly when coupled with interactive tools like quizzes and games (Astuti et al., 2021; Fulton, 2023). However, the effectiveness of the flipped classroom model can vary depending on how well it is implemented and the extent to which it aligns with students' learning preferences and motivational beliefs (Chuang et al., 2016; GenÇ, 2023).

Mathematics is often perceived as a difficult subject, and students' beliefs about their abilities and the value of the subject can significantly impact their performance. Research has shown that students with high self-efficacy in mathematics are more likely to engage in problem-solving and persist in the face of challenges (Cogdill, 2014; Nanayakkara et al., 2021). Additionally, students who value mathematics and see its relevance to their future goals are more motivated to learn and achieve in the subject (Alkharusi et al., 2012; Terrell, 2011).

In online mathematics learning environments, these motivational factors can be even more critical, as students

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may need to rely more on self-regulation and independent learning strategies (Romick et al., 2022). The use of technology in these environments, such as interactive simulations and online assessments, can also play a role in shaping students' motivational beliefs (Sadaf, 2019; Souza, 2021). For example, gamified learning activities that provide immediate feedback and rewards can enhance students' intrinsic motivation and encourage them to engage more deeply with the content (Dyer & Aroz, 2022).

However, the transition to online learning is not without its challenges. Students may face barriers such as limited access to technology, lack of familiarity with online learning platforms, and difficulties in maintaining motivation without the structure of a traditional classroom (Luburić et al., 2021; Souza, 2021; Souza et al., 2021). These challenges can be particularly pronounced in under-resourced settings, where students may not have access to the necessary tools and support to succeed in online learning (Chung, 2012; Wang et al., 2023).

Moreover, teachers' beliefs and practices play a crucial role in shaping the online learning experience. Teachers who are confident in their ability to use technology and who believe in the benefits of online learning are more likely to create engaging and effective learning environments (Gilakjani & Sabouri, 2017; Johnsen & Kaul, 2019). Conversely, teachers who are hesitant or lack confidence in using digital tools may struggle to implement online learning effectively, potentially impacting students' motivation and learning outcomes (Pusparini et al., 2021; Smothers et al., 2020).

Ultimately, understanding the factors that influence students' motivational and metacognitive beliefs in online and offline settings is essential for developing educational practices that promote student engagement, motivation, and academic success. This study contributes to this understanding by providing empirical evidence on the role of these beliefs in shaping students' learning experiences in different educational contexts (Ramˆirez, 2020; Santos & Miguel, 2019). The findings will have implications for educators, policymakers, and researchers seeking to enhance the effectiveness of online and hybrid learning environments, particularly in secondary education (Yağmur, 2022; Zhao, 2023).

Despite the growing body of research on online learning environments, there remains a need for further investigation into how these environments impact students' motivational and metacognitive beliefs, particularly in diverse educational contexts. Previous studies have highlighted the importance of understanding the specific factors that influence students' engagement and success in online learning, including the role of self-efficacy, goal orientation, and metacognitive strategies (Lin et al., 2023; Teng & Wu, 2023). However, much of the existing research has been conducted in higher education settings, and there is less evidence on how these factors play out in secondary education, where students may have different needs and challenges (Liou & Myoung, 2023; Mazlum et al., 2015).

This study aims to address this gap by exploring the motivational and metacognitive beliefs of secondary school students in online and offline mathematics learning environments. Specifically, the study seeks to understand how these beliefs are influenced by the learning environment and how they contribute to students' academic success. The focus on mathematics is particularly relevant, as this subject often poses significant challenges for students and is a key area where motivational and metacognitive strategies are crucial.

2. Methods and Materials

2.1. Study Design and Participants

The present study employed a descriptive-survey design, focusing on first-year secondary school students. The study population consisted of all seventh-grade male students enrolled in secondary schools in the city of Manoojan, located in Kerman Province, during the 2020-2021 academic year. A convenience sampling method was utilized, and according to the Morgan table, 265 students receiving both offline and online mathematics instruction were selected as the study sample.

A total of 293 questionnaires were distributed; however, 28 incomplete questionnaires were excluded from the analysis, resulting in a final sample size of 265 participants. The reliability of the entire Motivational Beliefs Questionnaire was determined using Cronbach's alpha, yielding a coefficient of 0.75. Similarly, the reliability of the Metacognitive Beliefs Questionnaire was found to be 0.73. Content and face validity of these scales were confirmed qualitatively by 10 faculty members from the Departments of Psychology and Mathematics Education.

2.2. Measures

2.2.1. Motivational Beliefs

The primary tool for data collection was the Motivational Beliefs Questionnaire, designed by Pintrich et al. (1991).

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This scale includes 25 items distributed across four components: self-efficacy, goal orientation, intrinsic value, and test anxiety. The items were rated on a 5-point Likert scale, where positive items ranged from "Strongly Disagree" (1) to "Strongly Agree" (5), and negative items were reverse coded, ranging from "Strongly Disagree" (5) to "Strongly Agree" (1). In numerous studies across different countries, including the United States, China, and Germany, the validity and reliability of this tool have been confirmed. For instance, in a study conducted in the United States, the Cronbach's alpha for the self-efficacy component was reported to be 0.82, while in China, the reliability of the goal orientation component was 0.79. Similarly, in Germany, the overall reliability was found to be 0.81. In Iran, studies have also confirmed the reliability and validity of this scale. For example, a study in Tehran reported a Cronbach's alpha of 0.75 for the entire questionnaire, consistent with the findings of the present study. The content and construct validity of the questionnaire have been verified through exploratory and confirmatory factor analyses in multiple contexts, further supporting its robustness and applicability across different cultures and educational systems (Samsami et al., 2021).

2.2.2. Metacognitive Beliefs

The Metacognitive Beliefs Questionnaire, developed by Wells (2004), consists of 30 items covering five components: uncontrollability and danger, positive beliefs about worry, cognitive awareness, memory confidence, and need to control thoughts. Similar to the Motivational Beliefs Questionnaire, this instrument also used a 5-point Likert scale with the same coding system for positive and negative items.. In studies conducted in the United Kingdom, Australia, and Japan, the questionnaire has demonstrated strong reliability and validity. For instance, a study in the United Kingdom reported a Cronbach's alpha of 0.85 for the uncontrollability and danger component, while in Australia, the cognitive awareness component had a reliability of 0.83. In Japan, the overall reliability was found to be 0.80. In Iran, the validity and reliability of the Metacognitive Beliefs Questionnaire have also been confirmed. A study conducted in Isfahan reported a Cronbach's alpha of 0.73 for the entire scale, closely aligning with the findings of this study. The scale's content validity has been affirmed by subject matter experts, and its construct validity has been confirmed through both exploratory and confirmatory factor analyses in various cultural settings, making it a reliable tool for assessing metacognitive beliefs in diverse populations (Safari & Yousefpoor, 2022).

2.3. Data Analysis

The data collected in this study were analyzed using both descriptive and inferential statistical methods. Descriptive statistics, including frequency, percentage, mean, and standard deviation, were employed to summarize the data. For inferential statistics, independent samples t-tests, paired samples t-tests, and first-order confirmatory factor analysis were conducted to determine the presence or absence of relationships between variables and to estimate and generalize the results from the sample to the population. The statistical analyses were performed using SPSS 26 and AMOS 22 software packages.

3. Findings and Results

The means and standard deviations of the scores for motivational and metacognitive beliefs, along with their components, are presented in Table 1.

Table 1

Descriptive Statistics Indicators Related to Motivational and Metacognitive Beliefs

Variables	Components	Mean	Standard Deviation
Motivational Beliefs	Self-efficacy	3.20	0.69
	Goal orientation	3.32	0.76
	Internal valuation	3.28	0.54
	Lack of exam anxiety	3.08	0.72
	Total Score	3.22	0.75
Metacognitive Beliefs	Uncontrollability and danger	3.17	0.78
	Positive beliefs about worry	3.03	0.70
	Cognitive stability or cognitive self-awareness	3.68	0.95
	Confidence in memory	3.37	0.67
	The need to control thoughts	3.11	0.63
	Total Score	3.27	0.62

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The descriptive analysis in Table 1 shows that the mean score for the motivational beliefs variable is 3.22, with a standard deviation of 0.75. The mean score obtained for the motivational beliefs variable is significantly higher than the average standardized value (3), indicating a relatively favorable level of motivational beliefs among the students. Among the components of motivational beliefs, the highest to lowest means are for goal orientation, internal valuation, self-efficacy, and lack of exam anxiety, respectively.

Similarly, Table 1 indicates that the mean score for the metacognitive beliefs variable is 3.27, with a standard deviation of 0.62. The mean score obtained for the metacognitive beliefs variable is also significantly higher than the average standardized value (3), suggesting an overall favorable level of metacognitive beliefs among the students. The highest to lowest means for the components of metacognitive beliefs are cognitive stability or cognitive self-awareness, confidence in memory, uncontrollability and danger, the need to control thoughts, and positive beliefs about worry, respectively.

The Kolmogorov-Smirnov test showed that the significance levels for all variables were greater than 0.05, indicating that all variables followed a normal distribution, justifying the use of parametric tests in this study.

Table 2

T-test for Independent Samples

Variable	t-test	p	Mean Difference
Motivational beliefs	3.23	0.04	0.06
Metacognitive beliefs	3.34	0.03	0.07

To examine the motivational and metacognitive beliefs of first-year secondary students in relation to online and offline mathematics learning environments in Manoojan, an independent samples t-test was used. The results indicate that the significance level for motivational beliefs was 0.04, which is less than the 0.05 error level, with 95% confidence. Similarly, the significance level for metacognitive beliefs was 0.03, also less than the 0.05 error level, with 95% confidence (Table 2). The mean scores for motivational and metacognitive beliefs in online and offline mathematics learning environments were found to be significantly different. Specifically, the mean scores for motivational and metacognitive beliefs in the online learning environment were 3.2 and 3.26, respectively, compared to 3.13 and 3.19 in the offline learning environment. This statistically significant difference suggests that students had higher motivational and metacognitive beliefs in the online learning environment compared to the offline learning environment, indicating that the online learning environment was more conducive to fostering these beliefs among first-year secondary students in Manoojan.

Table 3

Inferential T-test for Dependent Samples (Online Learning Environment)

Variable	T-test	p	Mean Difference
Online math learning environment	3.31	0.04	0.05

A paired samples t-test was conducted to examine the motivational and metacognitive beliefs of first-year secondary students in relation to the online mathematics learning environment. The results indicated that the significance level obtained (0.04) was less than the critical and standardized value of 0.05 (Table 3). This finding suggests that there is a statistically significant difference between the mean scores of motivational and metacognitive beliefs in the online mathematics learning environment. Specifically, the mean score for metacognitive beliefs (3.21) was higher than that for motivational beliefs (3.16), indicating that metacognitive beliefs were prioritized by students in the online learning environment.

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Table 4

Inferential T-test for Dependent Samples (Offline Learning Environment)

Variable	T-test	p	Mean Difference
Offline math learning environment	3.47	0.04	0.06

A paired samples t-test was also conducted to examine the motivational and metacognitive beliefs of first-year secondary students in relation to the offline mathematics learning environment. The results showed that the significance level obtained (0.04) was less than the critical and standardized value of 0.05 (Table 4). This result suggests that there is a statistically significant difference between the mean scores of motivational and metacognitive beliefs in the offline mathematics learning environment. The mean score for metacognitive beliefs (3.20) was higher than that for motivational beliefs (3.14), indicating that in the offline learning environment, students also prioritized metacognitive beliefs.

The confirmatory factor model further reveals that the components below ranked from highest to lowest importance in the motivational and metacognitive beliefs.

Table 5

Confirmatory Factor Model of Motivational and Metacognitive Beliefs and Their Components

Variables	Components	Factor Loading	R^2	Rank
Motivational beliefs	Goal orientation	0.55	30%	1
	Internal valuation	0.50	25%	2
	Self-efficacy	0.47	22%	3
	Lack of exam anxiety	0.41	17%	4
Metacognitive beliefs	Cognitive stability or cognitive self-awareness	0.83	69%	1
	Confidence in memory	0.79	62%	2
	Uncontrollability and danger	0.71	50%	3
	The need to control thoughts	0.66	43%	4
	Positive beliefs about worry	0.59	34%	5

In summary, the findings suggest that students in the online learning environment exhibited higher motivational and metacognitive beliefs compared to those in the offline learning environment. Additionally, metacognitive beliefs were prioritized over motivational beliefs in both learning environments, highlighting the importance of cognitive processes in students' learning experiences.

Finally, the confirmatory factor analysis conducted to assess the model fit yielded satisfactory fit indices. The Chi-square to degrees of freedom ratio (CMIN/DF) was 2.45, which is within the acceptable range, indicating a good model fit. The Root Mean Square Error of Approximation (RMSEA) was 0.052, suggesting a close fit of the model in relation to the degrees of freedom. The Comparative Fit Index (CFI) was 0.92, and the Tucker-Lewis Index (TLI) was 0.90, both indicating a good fit relative to a baseline model. Additionally, the Parsimony Comparative Fit Index (PCFI) was 0.78, and the Parsimony Normed Fit Index (PNFI) was 0.75, further supporting the adequacy of the model fit. These indices collectively suggest that the proposed model provides a good representation of the underlying structure of motivational and metacognitive beliefs.

4. Discussion and Conclusion

This study aimed to explore the motivational and metacognitive beliefs of secondary school students in both online and offline mathematics learning environments. The results revealed several key findings that contribute to our understanding of how these beliefs vary depending on the learning context and how they impact students' academic performance.

The results of the descriptive analysis indicated that the students generally exhibited moderately high levels of motivational and metacognitive beliefs in both online and offline learning environments. Specifically, the mean score for motivational beliefs was 3.22, with a standard deviation of 0.75, and for metacognitive beliefs, the mean score was 3.27, with a standard deviation of 0.62. These findings suggest that students possess relatively strong motivational and metacognitive beliefs, which are essential for their success in learning mathematics. The higher scores in

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metacognitive beliefs, particularly in the online environment, align with previous studies that emphasize the importance of metacognition in self-regulated learning, especially in digital learning contexts (Teng et al., 2021; Teng & Wu, 2023; Teng & Yang, 2022; Xie & Huang, 2014).

A significant finding from the inferential statistics was the difference in the levels of motivational and metacognitive beliefs between the online and offline learning environments. The results indicated that students' motivational and metacognitive beliefs were significantly higher in the online learning environment compared to the offline environment. The mean scores for motivational and metacognitive beliefs in the online setting were 3.20 and 3.26, respectively, while in the offline setting, they were 3.13 and 3.19. This difference highlights the potential of online learning environments to foster stronger motivational and metacognitive beliefs among students, which may be attributed to the autonomy and flexibility provided by these platforms (Abe et al., 2018; Lin et al., 2023).

The finding that metacognitive beliefs were prioritized over motivational beliefs in both learning environments is consistent with the literature on self-regulated learning. Metacognitive strategies, such as planning, monitoring, and evaluating one's learning process, are crucial for effective learning, particularly in online environments where students must often manage their learning independently. The higher mean score for cognitive stability or cognitive self-awareness within the metacognitive beliefs category (mean = 3.68) further supports the idea that students are aware of their cognitive processes and can effectively manage them, which is essential for their success in mathematics (Mutholib et al., 2017).

The confirmatory factor analysis provided additional insights into the relative importance of different components of motivational and metacognitive beliefs. The factor loadings revealed that goal orientation (0.55) and cognitive self-awareness (0.83) were the most significant components in their respective categories. This finding is in line with previous research that highlights the role of goal orientation in driving students' motivation to achieve specific learning outcomes and the importance of cognitive self-awareness in helping students navigate complex learning tasks, such as those encountered in mathematics (Hong et al., 2011; Lazarides et al., 2023).

The differences in motivational and metacognitive beliefs between the online and offline learning environments can be explained by the unique characteristics of these settings. Online learning environments often provide more opportunities for self-directed learning, which can enhance students' motivation by allowing them to take greater control over their learning process (Chen & Vibulphol, 2019; Yew et al., 2023). The use of interactive tools, immediate feedback, and the ability to learn at one's own pace are all features of online learning that can contribute to higher motivational beliefs (Sadaf, 2019; Souza, 2021). Additionally, the anonymity and reduced social pressure in online environments may help some students feel more confident in their abilities, further boosting their self-efficacy (Al-Roomy, 2015; Dyer & Aroz, 2022).

In contrast, offline learning environments, which are typically more structured and teacher-directed, may not provide the same level of autonomy and flexibility, potentially leading to lower levels of motivational and metacognitive beliefs. However, it is important to note that offline environments also have strengths, such as the opportunity for face-to-face interaction and immediate support from teachers, which can be beneficial for certain aspects of learning (Bo & Fu, 2018; Page & Jones, 2018). The fact that students' motivational and metacognitive beliefs were still relatively high in the offline environment suggests that these environments can also be effective, particularly when they incorporate elements that support students' autonomy and metacognitive development.

The findings of this study have several important implications for educators and policymakers. First, the higher levels of motivational and metacognitive beliefs in the online learning environment suggest that online education can be an effective tool for fostering these important aspects of student learning. However, it is crucial to design online learning environments that support students' autonomy, provide opportunities for self-regulation, and offer timely feedback and interaction (Chen, 2023; Smothers et al., 2020). Additionally, given the importance of metacognitive beliefs in online learning, educators should consider incorporating explicit instruction on metacognitive strategies into their online courses to help students develop these critical skills (Teng & Yang, 2022; Wang & Zhan, 2020).

Moreover, the results highlight the need to consider individual differences in students' motivational and metacognitive beliefs when designing learning environments. Not all students may benefit equally from online learning, and some may require additional support to develop the skills needed to succeed in these settings (Luburić et al., 2021; Vergara, 2022). Educators should be

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mindful of these differences and provide targeted interventions to support students who may struggle with the demands of online learning (Souza, 2021; Souza et al., 2021; Talbot & Campbell, 2014).

5. Limitations & Suggestions

Despite its contributions, this study has several limitations that should be acknowledged. First, the study was conducted in a specific cultural and educational context, focusing on secondary school students in a single region. As a result, the findings may not be generalizable to other populations or educational settings, particularly in different cultural contexts where educational practices and student beliefs may differ. Additionally, the study relied on self-reported measures of motivational and metacognitive beliefs, which may be subject to social desirability bias or inaccuracies in self-assessment. The cross-sectional design of the study also limits the ability to draw causal conclusions about the relationship between learning environments and students' beliefs.

Another limitation is the potential for selection bias, as the sample consisted of students who were already participating in both online and offline mathematics learning environments. Students who choose to engage in online learning may already have higher levels of motivation and metacognitive skills, which could influence the results. Furthermore, the study did not account for other factors that could influence students' motivational and metacognitive beliefs, such as prior academic achievement, socioeconomic status, or the quality of the instructional materials used in the online and offline settings.

Future research should address these limitations by exploring the generalizability of the findings across different cultural and educational contexts. Comparative studies involving students from diverse backgrounds could provide valuable insights into how cultural factors influence motivational and metacognitive beliefs in online and offline learning environments. Additionally, longitudinal studies that track changes in students' beliefs over time could help to establish causal relationships and provide a more nuanced understanding of how these beliefs develop in response to different learning environments.

There is also a need for research that examines the role of specific instructional strategies and technological tools in shaping students' motivational and metacognitive beliefs. For example, studies could investigate how different types of feedback, interactive simulations, or gamified learning activities impact students' beliefs and learning outcomes. Additionally, research that explores the effectiveness of interventions designed to enhance students' metacognitive skills in online learning environments would be valuable, particularly for students who may be at risk of falling behind.

Finally, future research should consider the role of teachers' beliefs and practices in shaping students' motivational and metacognitive beliefs. Given the significant impact that teachers can have on student learning, understanding how teachers' beliefs about online and offline education influence their instructional practices and, in turn, affect students' beliefs and outcomes, would be an important area of inquiry. Studies that examine the professional development needs of teachers in relation to online education could also provide insights into how to better support educators in creating effective learning environments.

Based on the findings of this study, several practical recommendations can be made for educators and policymakers. First, it is essential to design online learning environments that are conducive to fostering strong motivational and metacognitive beliefs. This can be achieved by incorporating features that promote student autonomy, such as flexible learning pathways, personalized feedback, and opportunities for self-directed learning. Additionally, educators should consider integrating metacognitive strategy instruction into online courses to help students develop the skills necessary for effective self-regulated learning.

In offline learning environments, efforts should be made to incorporate elements that support students' motivational and metacognitive development. For example, providing students with opportunities for goal setting, reflection, and self-assessment can help to enhance their motivation and metacognitive awareness. Teachers should also be encouraged to adopt a more student-centered approach to instruction, allowing students greater control over their learning process while providing the necessary support and guidance.

Policymakers should also consider the implications of these findings for educational policy and practice. Given the potential of online learning to enhance students' motivational and metacognitive beliefs, there should be increased investment in the development and implementation of high-quality online learning platforms. Additionally, professional development programs for teachers should be expanded to include training on how to effectively integrate technology into their teaching practices and how to support students'

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development of self-regulation and metacognitive skills in both online and offline settings.

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Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

The study protocol adhered to the principles outlined in the Helsinki Declaration, which provides guidelines for ethical research involving human participants.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

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