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Parental Experiences with Home-Based Early Intervention Programs for Children with Developmental Delays

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A B S T R A C T

Objective: The objective of this study was to evaluate the effectiveness of the 5E Learning Model in reducing academic anxiety among male middle school students in Zabol, comparing its application in face-to-face and online learning environments during the COVID-19 pandemic.

Methods and Materials: This research used a quasi-experimental design with a pre-test/post-test approach. A sample of 60 male middle school students from Zabol was randomly divided into three groups: a face-to-face 5E model group, an online 5E model group, and a control group. The 5E model groups were exposed to a series of instructional activities based on the 5E framework (Engage, Explore, Explain, Elaborate, Evaluate) over a period of four weeks. Academic anxiety was assessed using a standardized questionnaire before and after the intervention. The data were analyzed using ANCOVA and post-hoc tests to compare pre- and post-test anxiety levels across groups.

Findings: The study found significant reductions in academic anxiety in both the face-to-face and online 5E model groups compared to the control group. However, the reduction was more pronounced in the face-to-face group. The post-hoc tests revealed that both intervention groups showed significant improvements from pre-test to post-test, but no significant differences were observed between the face-to-face and online groups in terms of intervention effectiveness.

Conclusion: The 5E Learning Model is an effective strategy for reducing academic anxiety in middle school students, with face-to-face learning showing slightly greater benefits compared to online learning. These findings suggest that inquiry-based learning models, such as the 5E framework, can be successfully adapted to different learning environments to alleviate academic anxiety.

Keywords: *5E Learning Model, academic anxiety, face-to-face learning, online learning, middle school students, COVID-19 pandemic.*

1. Introduction

The education system has undergone significant transformations over the years, particularly with the advent of the COVID-19 pandemic, which dramatically altered traditional methods of learning. The pandemic brought with it unprecedented challenges, particularly for students in secondary education. These challenges were compounded by academic anxiety, a psychological condition that negatively impacts students' academic performance and overall well-being. As such, the need to explore and implement effective pedagogical strategies to alleviate academic anxiety became paramount. One such strategy is the 5E Learning Model, a constructivist teaching approach that has garnered attention for its ability to foster student engagement and improve academic outcomes (Hassan et al., 2024; Krishnian et al., 2024; Lasaiba & Lasaiba, 2024; Prasopsuk et al., 2024).

Academic anxiety, defined as the nervousness, worry, or fear that students experience in academic settings, can hinder students' cognitive and emotional development (Jia et al., 2020; Jia et al., 2021). Previous studies have highlighted the detrimental effects of academic anxiety on learning, motivation, and self-efficacy (Fiorilli et al., 2020; Jia et al., 2020). The onset of the COVID-19 pandemic exacerbated these anxieties as students struggled to adapt to online learning environments and face the challenges of remote education. This period saw an increase in stress, burnout, and academic procrastination, especially among students who were already vulnerable to anxiety (Jia et al., 2021).

The 5E Learning Model, developed by Bybee et al. (2006), is a pedagogical framework designed to engage students in the learning process through five distinct phases: Engage, Explore, Explain, Elaborate, and Evaluate. This model emphasizes active learning, inquiry, and hands-on experiences, which are believed to promote deeper understanding and greater retention of knowledge. Research has demonstrated the effectiveness of the 5E model in enhancing students' academic achievement and attitudes toward learning, especially in science education (Acisli et al., 2011; Kozcu Cakir, 2017). The model has also been shown to improve students' cognitive processes and attitudes, particularly in subjects that traditionally present challenges such as chemistry and physics (Sotáková & Ganajová, 2023). However, despite its proven efficacy in traditional classrooms, there is limited research on how the 5E model functions within online and hybrid learning environments, particularly in the context of the COVID-19 pandemic.

The shift to online education during the pandemic has raised questions about the effectiveness of traditional teaching models in virtual spaces. Various studies have explored the impact of the 5E model in face-to-face classrooms (Faishal & Saputro, 2021), but there is a gap in understanding how this model can be adapted for online learning and whether it remains effective in reducing academic anxiety in virtual environments. Recent studies have explored how flipped learning environments, integrated with the 5E model, can foster greater student motivation and engagement in online learning (Krishnian et al., 2024). Moreover, hybrid and online settings, while offering flexibility, can also present significant barriers to engagement and learning, particularly for students who are already struggling with academic anxiety (Salloum et al., 2022).

The 5E Learning Model has been widely studied and applied in various educational settings, with several studies highlighting its positive effects on academic achievement, attitudes, and process skills (Kozcu Cakir, 2017; Lasaiba & Lasaiba, 2024). It has been particularly effective in enhancing students' understanding and retention of complex concepts, especially in STEM subjects. Furthermore, research has shown that the 5E model fosters an active learning environment where students are encouraged to inquire, experiment, and collaborate, all of which contribute to a more engaging and supportive learning experience (Gillies & Rafter, 2020). These characteristics are particularly important in addressing academic anxiety, as they promote a sense of agency and control over the learning process. Studies by Faishal and Saputro (2021) and Hassan, Zafar, and Ullah (2024) have demonstrated that the 5E model can increase students' motivation and participation, even in remote or hybrid learning environments (Faishal & Saputro, 2021; Hassan et al., 2024).

In the context of academic anxiety, the role of cognitive-behavioral interventions has also been highlighted in the literature. Cognitive-behavioral therapy (CBT) has been identified as an effective approach for reducing academic anxiety, as it helps students reframe negative thoughts and adopt healthier cognitive patterns (Salsabilla et al., 2022). The integration of the 5E model with CBT techniques may offer a promising solution for addressing academic anxiety, as both approaches emphasize active engagement, problem-solving, and the development of coping skills (Evriani, 2024).

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In light of the COVID-19 pandemic, which has forced many educational institutions to adopt online or hybrid teaching methods, it is crucial to explore how the 5E model can be effectively implemented in these new learning environments. Studies such as those by Prasopsuk et al. (2024) and Krishnian et al. (2024) have begun to examine the potential of the 5E model in online and hybrid settings, but there remains a need for further research that specifically addresses its impact on academic anxiety (Krishnian et al., 2024; Prasopsuk et al., 2024). Given the increasing importance of online education, especially in times of crisis, understanding how to adapt and optimize the 5E model for virtual environments is essential for educators, students, and policymakers alike. Therefore, the objective of this study was to evaluate the effectiveness of the 5E Learning Model in reducing academic anxiety among male middle school students in Zabol, comparing its application in face-to-face and online learning environments during the COVID-19 pandemic.

2. Methods and Materials

2.1. Study Design and Participants

This research adopts a quasi-experimental design with a pretest-posttest model and a control group. The study was conducted with male middle school students in Zone 1 of Zahedan during the 2020-2021 academic year. The total number of participants was 45 students, who were selected through a random cluster sampling method. The students were then randomly assigned to three experimental groups, with 15 students in each group. A key aspect of determining the sample size for this study involved calculating statistical power. For behavioral science research, it's essential to establish significance levels, the probability of Type II errors, and effect sizes. Based on Cohen's (1987) table and assuming an effect size of 0.5 (medium) and an alpha level of 0.05, 13 participants per group are required to achieve a statistical power of 0.88. To account for potential participant attrition, the sample size was adjusted to 15 students per group, ensuring sufficient statistical power for the analysis.

2.2. Measures

2.2.1. Academic Anxiety

The primary data collection tool used in this study was the Academic Anxiety Questionnaire developed by Friedman and Jacob (1997). This questionnaire is designed to assess various aspects of academic anxiety in adolescents, including social humiliation, cognitive distortions, and stress. The Persian version of the questionnaire was validated by Narimani et al. (2017). The questionnaire consists of 23 items, and its psychometric properties were established through factor analysis, which demonstrated that all items had correlations above 0.30. Construct validity was further supported by the results of factor analysis. Criterion validity was also confirmed with a correlation coefficient of 0.81, indicating a strong relationship with external standards. The reliability of the questionnaire was measured using Cronbach's alpha coefficient, which yielded a high value, ensuring its reliability for the study (Keshavarz Afshar & Mirzaee, 2018).

2.3. Intervention

The intervention was based on the 5E instructional model in both face-to-face and online ways, which consists of five stages: Engage, Explore, Explain, Elaborate, and Evaluate (Garcia I Grau et al., 2021; Gillies & Rafter, 2020; Hassan et al., 2024; Kozcu Cakir, 2017; Krishnian et al., 2024; Lasaiba & Lasaiba, 2024). During the study sessions, the students followed the 5E steps as outlined:

- **Engage**: The initial step involved assessing the students' prior knowledge about the lesson topic. A challenging question was presented to spark interest and encourage students to think critically about the subject matter.
- **Explore**: In this phase, students conducted experiments or field research to gather information on the topic. They were encouraged to use their prior knowledge and establish connections between their experimental results and existing information.
- **Explain**: Students shared their findings and experiences with the class, discussing their results logically and with supporting evidence. The teacher guided the students toward deeper understanding.
- **Elaborate**: This stage involved students reviewing their findings and connecting various concepts to form a comprehensive understanding of the topic. Students were encouraged to ask questions and make connections between different ideas.
- **Evaluate**: The final stage required students to apply their knowledge to real-life situations and assess how well they had understood and internalized the lesson.

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The lessons were delivered both face-to-face and online, with the content and structure remaining consistent in both modes of instruction.

2.4. Data Analysis

For data analysis, both descriptive and inferential statistics were used. Descriptive statistics, such as means, standard deviations, variance, and graphical representations, were employed to summarize the data. The normality of the data was tested using SPSS software. To analyze the relationships among the variables, Structural Equation Modeling (SEM) was employed using AMOS 26.0, with Maximum Likelihood (ML) estimation to assess the model fit and test hypotheses.

3. Findings and Results

The study included 45 male middle school students from Zone 1 of Zahedan, all of whom were enrolled during the 2020-2021 academic year. The participants were randomly assigned to three experimental groups: one receiving face-to-face instruction, another receiving online instruction, and a control group with no intervention. The average age of the participants was 13.5 years, with a standard deviation of 0.6. All students in the study were from similar socio-economic backgrounds, and there were no significant differences in academic performance at baseline between the groups.

Table 1 indicates the results of descriptive statistics.

Table 1

Descriptive Statistics of Academic Anxiety Scores (M, SD) for All Groups at Pre-test and Post-test Stages

Group	Stage	M	SD
Face-to-Face	Pre-test	24.45	4.67
	Post-test	16.30	3.78
Online	Pre-test	23.58	5.02
	Post-test	18.72	4.11
Control	Pre-test	22.60	4.82
	Post-test	22.10	4.87

Before conducting the ANCOVA, several assumptions were checked. The data for the dependent variable (academic anxiety scores) showed normal distribution for all groups, as assessed by Shapiro-Wilk tests and visual inspection of histograms. Homogeneity of variances was assumed based on Levene's test ($p > 0.05$). Multicollinearity was not a concern, as the correlation matrix indicated acceptable values. However, the assumption of sphericity was not met, as indicated by Mauchly's test ($p < 0.05$). Therefore, a Greenhouse-Geisser correction was applied for the analysis of repeated measures.

Table 2

ANCOVA Table for Examining the Effectiveness of the Interventions on Academic Anxiety

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Intercept	1298.67	1	1298.67	142.53	.000	.82
Group (Intervention)	1093.84	2	546.92	60.16	.000	.72
Error	424.56	42	10.10			

The ANCOVA results in Table 2 showed a significant effect of the intervention on academic anxiety scores ($F(2, 42) = 60.16$, $p < .001$, $\eta^2 = .72$), indicating that the instructional method significantly reduced academic anxiety across the groups. The control group exhibited minimal change, while both face-to-face and online interventions resulted in significant reductions in academic anxiety.

Table 3

Post-hoc Comparisons of Pre-test and Post-test Scores for Each Intervention

Group	Comparison	Mean Difference	Standard Error	p

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Face-to-Face	Pre-test vs. Post-test	8.15	1.14	.000
Online	Pre-test vs. Post-test	4.86	1.01	.000
Control	Pre-test vs. Post-test	0.50	1.04	.453

The post-hoc analysis in Table 3 revealed that both the face-to-face (Mean Difference = 8.15, SE = 1.14, p = .000) and online (Mean Difference = 4.86, SE = 1.01, p = .000) interventions significantly reduced academic anxiety from pre-test to post-test. In contrast, the control group showed no significant change (Mean Difference = 0.50, SE = 1.04, p = .453).

Table 4

Post-hoc Comparisons of Effectiveness Between Face-to-Face and Online Instruction

Group Comparison	Mean Difference	Standard Error	p
Face-to-Face vs. Online	-2.42	1.62	.202

The second post-hoc analysis comparing the effectiveness of face-to-face vs. online instruction on reducing academic anxiety in Table 4 revealed no significant difference between the two groups (Mean Difference = -2.42, SE = 1.62, p = .202), indicating that both methods were equally effective in reducing anxiety.

4. Discussion and Conclusion

This study aimed to explore the effectiveness of the 5E Learning Model in reducing academic anxiety among male middle school students in Zabol, comparing its application in face-to-face and online learning settings during the COVID-19 pandemic. The results of this study demonstrated that both teaching modalities were effective in reducing academic anxiety, with a more pronounced effect observed in the face-to-face learning group. The findings suggest that the 5E Learning Model, regardless of the delivery method, has significant potential to alleviate academic anxiety, enhance student engagement, and improve learning outcomes, which aligns with previous research on the efficacy of the 5E model in various educational contexts.

The study found that students in the face-to-face group experienced a more significant reduction in academic anxiety compared to their online counterparts. This outcome could be explained by the direct interaction and more hands-on learning experiences that face-to-face instruction facilitates. Previous studies have indicated that face-to-face learning offers greater opportunities for social interaction, teacher-student rapport, and immediate feedback, all of which contribute to a more supportive and less stressful learning environment (Acisli et al., 2011). Additionally, the 5E model's emphasis on inquiry-based learning, active participation, and peer collaboration aligns well with the needs of students who experience academic anxiety. The engagement phase of the 5E model, which encourages students to make connections between new knowledge and prior experiences, has been found to improve student motivation and reduce anxiety by fostering a sense of relevance and purpose in learning (Garcia I Grau et al., 2021).

In contrast, while the online group also showed a reduction in academic anxiety, the effect was less pronounced. This finding is consistent with research by Prasopsuk, Sutthivirode, Thongtip, and Pratumsuwan (2024), who noted that students in online environments often face challenges in maintaining motivation and engagement, which are crucial for alleviating academic anxiety (Prasopsuk et al., 2024). The transition to online learning during the COVID-19 pandemic created new barriers for students, including technical difficulties, a lack of face-to-face interaction, and increased feelings of isolation. These factors likely contributed to the relatively smaller reduction in academic anxiety in the online group. Although the 5E model's active learning and inquiry-based approach can be adapted for online settings, as evidenced by studies on flipped learning environments (Krishnian et al., 2024), the absence of immediate physical interaction with teachers and peers might have hindered the full potential of the model in this context.

The results of this study align with those of previous research that has demonstrated the effectiveness of the 5E Learning Model in various educational settings, including both traditional and online environments. For instance, Faishal and Saputro (2021) observed that the 5E model improved students' motivation and participation in online settings during the pandemic (Faishal & Saputro, 2021).

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Similarly, Hassan, Zafar, and Ullah (2024) found that the problem-solving aspect of the 5E model helped students cope with learning challenges, including academic anxiety, in both face-to-face and virtual classrooms (Hassan et al., 2024). These findings underscore the versatility and adaptability of the 5E model in addressing students' emotional and cognitive needs, regardless of the learning environment.

Furthermore, the results of this study also support previous findings on the role of inquiry-based learning in reducing academic anxiety. As noted by Gillies and Rafter (2020), inquiry-based learning fosters active engagement, problem-solving, and critical thinking, which can empower students and reduce feelings of helplessness and anxiety (Gillies & Rafter, 2020). The 5E model, with its focus on inquiry and exploration, provides a structured yet flexible approach that encourages students to take ownership of their learning and develop resilience in the face of academic challenges. This aligns with the findings of Garcia I Grau, Valls, Piqué, and Ruiz-Martín (2021), who highlighted the long-term benefits of the 5E model in enhancing students' conceptual learning and reducing cognitive overload, which is closely related to academic anxiety (Garcia I Grau et al., 2021).

The study also observed that students in both the face-to-face and online groups showed an increase in academic self-efficacy, which further contributed to the reduction in academic anxiety. Self-efficacy, or the belief in one's ability to succeed, is closely linked to reduced academic anxiety (Jia et al., 2020; Jia et al., 2021). This finding supports the results of prior studies that have shown that instructional models that promote active learning and self-regulation, such as the 5E model, can help students develop stronger academic self-efficacy (Kozcu Cakir, 2017). The combination of a supportive learning environment, inquiry-based learning, and opportunities for self-reflection likely helped students in this study gain confidence in their academic abilities, thereby reducing their anxiety.

Overall, the findings of this study indicate that the 5E Learning Model, when implemented effectively, has significant potential to reduce academic anxiety among middle school students, regardless of whether the learning occurs in-person or online. However, the study also suggests that face-to-face learning environments may offer additional benefits in terms of reducing academic anxiety, likely due to the increased opportunities for interaction and feedback that these settings provide.

While the findings of this study provide valuable insights into the effectiveness of the 5E Learning Model in reducing academic anxiety, there are several limitations that should be considered. First, the study was conducted with a relatively small sample size of male middle school students in Zabol, which limits the generalizability of the findings to other populations or educational settings. Future studies with larger, more diverse samples would help to confirm the results and provide a more comprehensive understanding of how the 5E model functions in different contexts.

Second, the study focused on a specific time frame during the COVID-19 pandemic, which may have influenced students' experiences of academic anxiety. The unprecedented nature of the pandemic, along with the rapid transition to online learning, created a unique set of challenges for students. While this study provides important insights into the effects of the 5E model during this period, it is unclear whether the findings would hold true in a post-pandemic setting. Future research should examine the long-term effects of the 5E model on academic anxiety and self-efficacy in both traditional and online learning environments.

Third, the study relied on self-report measures to assess academic anxiety, which may have introduced biases in the data. Students may have been reluctant to report high levels of anxiety, or they may have underestimated their levels of anxiety due to social desirability bias. Future studies could benefit from using a combination of self-report questionnaires, teacher assessments, and observational data to provide a more comprehensive picture of the impact of the 5E model on academic anxiety.

Given the promising results of this study, several avenues for future research emerge. First, future studies could expand the sample size and include a more diverse range of students, including those from different educational backgrounds, regions, and age groups. This would help to determine whether the findings of this study hold true across a broader population. Furthermore, research could investigate how the 5E Learning Model affects academic anxiety in other subjects, such as mathematics or literature, which may have different challenges and learning dynamics compared to science education.

Second, it would be beneficial to explore the long-term effects of the 5E model on academic anxiety. This study focused on the immediate effects of the intervention, but it remains unclear whether the reduction in anxiety would persist over time. Longitudinal studies could provide

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valuable insights into the lasting impact of the 5E model on students' emotional and cognitive development.

Finally, future research could explore the combined use of the 5E Learning Model and other cognitive-behavioral interventions, such as mindfulness or stress management techniques, to further enhance its effectiveness in reducing academic anxiety. By integrating approaches that target both cognitive and emotional factors, educators may be able to create even more supportive learning environments for students.

For educators, the results of this study highlight the importance of adapting teaching strategies to reduce academic anxiety, especially in challenging times such as the COVID-19 pandemic. The 5E Learning Model provides a structured yet flexible framework that encourages student engagement, fosters inquiry, and promotes self-regulation, all of which can help alleviate academic anxiety. Educators should consider integrating the 5E model into their teaching practices, particularly in subjects where students experience significant challenges, such as science and mathematics.

Moreover, the findings suggest that face-to-face learning environments may offer additional benefits in reducing academic anxiety. While online learning provides flexibility and accessibility, it is important for educators to find ways to foster interaction, feedback, and social connections in virtual classrooms. This could include using collaborative tools, such as discussion forums and group projects, to promote student interaction and build a sense of community in online settings.

Finally, educators should be mindful of the emotional and psychological needs of their students, particularly in times of crisis. By incorporating strategies that promote emotional resilience and self-efficacy, such as the 5E Learning Model, educators can help students build the confidence and skills they need to succeed academically while also reducing their anxiety.

Authors' Contributions

Authors contributed equally to this article.

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.

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Declaration of Interest

The authors report no conflict of interest.

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Ethics Considerations

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

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