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Predicting the Effect of Design Thinking based Story-telling on Health and Resilience in Middle School Students: Moderating Role of Feedback

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ABSTRACT

Objective: This study aimed to investigate the impact of an educational intervention based on design thinking combined with storytelling on students' resilience, with a focus on the moderating role of feedback.

Methods: A total of 120 students from a public school in Tehran completed the Resilience Scale. Based on the initial assessment, 78 students were randomly assigned to four groups. Group 1 received design thinking instruction with both teacher-written feedback and student self-assessment. Group 2 received design thinking instruction with teacher-written feedback only. Group 3 received design thinking instruction without feedback. Group 4 served as the control group and received no intervention. The intervention lasted one semester.

Results: The findings indicated a significant improvement in resilience among students who participated in the intervention compared to the control group. The greatest gains were observed in Group 1, where students received both teacher feedback and engaged in self-assessment.

Conclusions: Incorporating design thinking and storytelling, supported by diverse feedback mechanisms, can effectively enhance student resilience. The combination of teacher-written feedback and student self-assessment appears to yield the most substantial improvements, highlighting the importance of integrating multiple feedback strategies in educational practice.

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Introduction

Young people are an essential part of the population of any nation because they bring new ideas and energies. Young people contribute to the overall development of the nation and the world. In this context, in a country like Iran, 50 percent of its population is young and under 30 years old (Census, 2016). On the other hand, over the past twenty years, mental health issues among children and adolescents worldwide have been increasing and have become one of the leading causes of disability (WHO,2003). Given the mental health issues among young people, the need to ensure the health and proper development of this age group increases severalfold.

Especially when students start their higher education, they face several new tasks that they must cope with, such as the need for greater autonomy and solving problems they are not yet accustomed to. Students should also adhere to schedules, attend classes, organize different subjects with various teachers, and participate in exams. In addition, they may face other demands that can be challenging, as they need to maintain appropriate relationships and act responsibly to resolve their problems/conflicts. On the other hand, the school environment during middle school provides a suitable context for developing educational independence to address new cognitive and academic needs (Wang y et al., 2021; Abu Mady, 2019). Therefore, schools and the educational system must be prepared to help students navigate this situation.

In the meantime, *resilience* can be defined as the latent positive emotions that help in the education of public domains (Wang & et al., 2021). *Resilience* is an individual's ability to adapt to challenges, stress, distress, or trauma healthily (Park et al., 2019). Resilience enhances individuals' capacity to face challenging environments (Yoleri, 2020). Students should consider resilience an essential feeling to enhance their effective performance, as the learning and education processes can be accompanied by stress (Shafiee et al., 2023). In the educational context, resilience means utilizing all available resources to encourage productivity and well-being in the face of difficulties and challenges (Gu & Day, 2011).

Students can harness resilience to navigate the stress and challenges of the educational environment, enabling them to thrive in schools, universities, and institutions. The literature suggests that resilience is not an innate trait, but a skill that can be cultivated through education and practice (Grabbe et al., 2012; Joyce et al., 2018). Therefore, it is crucial to explore modern

methods for developing resilience skills, such as the innovative cognitive approach of design thinking.

Design thinking is a non-linear protocol for observing, shaping, and gaining insights into problem-solving processes (Eklund et al., 2022). Design thinking is a learning strategy for solving a specific and practical problem that aligns with the characteristics of constructivist learning (Pande & Bharathi, 2020), and Shively et al. (2018) have introduced design thinking as a learning strategy across education. As a result, considering that design thinking is referred to as a learning approach. The literature also shows that design thinking can be applied in all disciplines and schools (Krieger, 2010). Therefore, there is the possibility of using design thinking in education and enhancing resilience.

Research findings, particularly those of Tsai (2023), highlight the positive relationship between design thinking and problem-solving. This approach allows students to confront ambiguous and unsuccessful situations by gradually implementing five stages to test solutions or prototypes. The results indicate that design thinking indeed enhances problem-solving skills in learners, further reinforcing its potential in education and resilience enhancement.

Additionally, Avci et al. (2023) showed that solution-oriented thinking is essential to resilience. In continuation, Liu(2024) introduced five personal characteristics for thinkers in his research: empathy, integrative thinking, optimism, experientialism, and collaboration. In this context, Xu et al. (2022) state that the characteristics of young people who show resilience include "self-soothing," optimism, personal determination, perseverance, and family cohesion. Moreover, research findings indicated that design thinking allowed learners to enhance emotional awareness, empathy, complex reasoning, creative problem-solving, and dynamic social intelligence (Hews et al., 2022). Additionally, Sang et al. (2022) confirmed the positive relationship between empathy and resilience. The review of the above research shows that the characteristics of design thinkers have a lot in common with resilient individuals.

In design thinking, various implementation tools include stakeholder maps, empathy maps, the five whys, journey maps, interviews, etc. It exists. In this context, one of the design thinking tools is narrative writing and storytelling, which has also been highlighted in various studies as a tool of design thinking (Grimaldi et al., 2013; Gülmez et al., 2020).

Storytelling is an essential educational technique that may play a significant role in the development process of individuals. Storytelling connects past experiences to the present and

provides a rich source for emotional coping and psychological resilience to face life's events. (Nguyen & et al,2015). Research results have shown that storytelling, which promotes thinking, creativity, and socialization, may provide practical tools for enhancing resilience (Nguyen et al., 2015; Mager,2019; Jess-Cooke,2015). Storytelling provides a way to convey life experiences, offer enjoyable opportunities, and support social connections in communities (East et al., 2010). Storytelling can be a therapeutic dialogue that allows the storyteller to rewrite and reimagine the past flexibly, leading to reconciliation and healing (Hernandez Muztafa,2021).). The research results also showed that teaching narrative writing creatively has recently emerged as a promising tool for enhancing self-efficacy and resilience in adult learners (Fletcher et al., 2023).

They are considering the characteristics of design thinking with storytelling tools that may align with fostering resilience development. Therefore, the main objective of this research was to understand the impacts of design thinking-based storytelling on students' resilience. Now, after selecting the approach and educational tools in the present study, since educational situations require evaluating the quality of teaching and learning, feedback can be employed to assess the quality of teaching and learning.

Multiple studies have highlighted feedback's important role in the learning process (Mendoza & Yan, 2023; Griffiths et al., 2023). Feedback guides learners toward the appropriate type of study or practice and helps individuals identify areas of deficiency, which can be used to strengthen learning tactics and strategies (Bürgermeister et al., 2021). Feedback comes in various forms. One type of feedback is self-assessment. In this context, research identifies the impact of self-assessment on learning (Yang et al., 2022). Liu (2022) also believed that self-assessment facilitates learning and sets the stage for accuracy.

Another type of feedback is written feedback from the teacher. In the existing literature, researchers have paid considerable attention to the effects of teacher-written corrective feedback (WCF) on accuracy and learning enhancement (Karim & Nassaji, 2020). While academic researchers acknowledge the value of feedback in facilitating learning, examining the impact of different types of feedback in non-academic areas, such as resilience skills, could provide a new perspective on teaching these skills. Therefore, in this research, two types of feedback (written self-assessment and written teacher assessment) were specifically and separately considered in addition to daily oral feedback.

Recent decades have seen an increase in mental health issues among children and adolescents. Despite the multitude of studies describing effective school-based mental health programs, current research reviews in this field indicate a lack of solid consensus on the use of appropriate techniques to promote resilience, which is one of the key contributors to adolescent mental health. On the other hand, some researchers have shown that resilience can be measured, reinforced, and taught through various strategies (Chow et al., 2020). In this context, research findings indicate that design thinking can be used as a discipline in an educational program (Henriksen et al., 2018). Additionally, research findings have shown that storytelling improves emotional and physical health in many populations. At the same time, the feasibility and potential effectiveness of a new writing program introduced in a clinical setting to enhance resilience remain unknown (Glass et al., 2019).

Despite previous efforts, there still needs to be more information on integrating design thinking into diverse curricula, considering the positive outcomes of implementing design thinking and the need to enhance resilience in individuals. However, the present article attempted to fill this gap through a design thinking process based on narrative writing. Therefore, the main objective of this study is to incorporate narrative-based design thinking as an educational approach in middle school to enhance students' learning toward improving resilience while simultaneously examining and analyzing the moderating effects of different types of feedback. Ultimately, the present research seeks to answer the following questions:

q1: How effective is design thinking education based on storytelling in enhancing resilience?

q2: Do resilience levels differ among the experimental groups regarding receiving feedback?

Material and Methods

This research employed a robust quasi-experimental pre-test and post-test design with three experimental and one control group. The independent variable was carefully applied to the experimental groups, and the results were meticulously compared between the experimental and control groups, underscoring the significance of the research design in this study on resilience in students.

School and participants

The environment of the public girls' school was culturally diverse and located in the southwestern part of Tehran Province, in Baharestan County. Most of the students in this area are economically

disadvantaged, and this region is ethnically and racially diverse because Iran has 31 provinces. Baharestan is close to the capital, so people can migrate to this country more efficiently and be near the capital in terms of cost. Therefore, different ethnicities live in Baharestan County. This study examined a girls' middle school consisting of 19 classes from the seventh, eighth, and ninth grades. As an example, it was used in the available context. The researcher considered the classroom culture and the student's willingness to cooperate with the teacher, who was one of the researchers when selecting the classes. Finally, 4 seventh-grade classes were selected as a sample, with 80 female students (aged 13 to 15, M = 14.50) participating in these classes. It is worth mentioning that allocating students to different classes was entirely random and beyond the researcher's control.

Measure

The Resilience Questionnaire was developed by Connor and Davidson in 2003. It consists of 25 questions and measures four factors: "competence/personal strength" (8 questions), "trust in personal instincts/tolerance of negative emotions" (7 questions), "acceptance of positive emotions/secure relationships" (5 questions), and "self-control" (3 questions) and "spirituality" (2 questions). Participants rate their responses on a 5-point scale, ranging from 1 (does not describe me at all) to 5 (describes me completely). In a study conducted by Badzaban et al. (2019) in Iran, the reliability of the questionnaire was found to be 0.88. In the current study, the reliability coefficient was calculated to be 0.85.

Procedure

Initially, by ethical standards, the mentioned items were presented to the guardians in a meeting for informed consent. It was also announced that participants can withdraw from the research if needed, and in case of publication, individuals' names will not be mentioned at all. The necessary approval was also obtained from the school principal. This study was conducted immediately after the first semester exams and approximately in late January 2023. Data from 80 female students in a high school were collected by the author over approximately three months, with one 90-minute session each week—the author, who was also a teacher to the students. The students were instructed to complete the five-point Likert scale resilience items. The teacher assured the students that their participation was entirely voluntary and that their responses would be confidential. After

implementing design thinking-based training, data related to resilience were collected and analyzed to identify the level of students' resilience.

These students were randomly assigned to 3 experimental groups and one control group. The control group received no treatment and attended regular classes according to the school schedule. However, the experimental group was trained based on the intervention program for the rest of the second semester by the author, who was well-versed in the program's content, to ensure the proper application of techniques in the class. In other words, the students in the experimental group participated in a support program based on design thinking to enhance resilience. The experimental group was also exempted from attending their regular work and technology classes, held once a week for 90 minutes. The time and class for the experimental group (only in the subject of work and technology) were scheduled according to the school calendar and the principal's instructions. In total, 12 sessions of 90 minutes each were conducted for the experimental group over 12 weeks in the second semester, which lasted for three months. Finally, before the end of the semester, around May 2023, students were asked to complete the resilience questionnaire again to understand the resilience status after the intervention program.

The intervention conditions were as follows:

- Group 1 class received design thinking-based education, written feedback from the teacher, and student self-assessment.
- Group 2 class received design thinking-based education and the teacher's written feedback.
- Group 3 class only received the education.

Class Group 4 has yet to receive any education. The written self-assessment strategy was implemented in the class so that a draft of the expected criteria for the class, based on the literature of design thinking, was extracted and provided to the students. Self-assessments were conducted individually and once every two sessions. In this way, after completing the process of each story, the teacher explained the points to the students one by one, and after the end of the second session of each story, the students began to grade and write their experiences of the learning process. The teacher's written feedback was also given in a group setting at the end of each session. This way, a draft form was prepared based on the design thinking training method and provided to the groups. In this type of feedback, the teacher considers the students' work process in each session and informs the group members of the strengths and weaknesses of each group's activities in the form

of sentences and writing to show what points the students should consider to improve their own and the group's work.

This study utilized design thinking activities proposed by Stanford University (2015) and storytelling and scenario writing techniques successfully implemented in various studies for operationalizing design thinking. Based on this, the five stages of the Stanford School design thinking model—empathy, definition, brainstorming, prototyping, and evaluation—were implemented so that the teacher initially wrote the first two lines of the story on the board in one session. Then, the students continued writing the story with empathy and discussion within their groups. In story writing, the design thinking model was used. First, the students empathized with the characters in the story, then the problem was identified. Through brainstorming, each group member narrated the continuation of the story from their perspective, creating a wall of ideas for the story's continuation. Finally, a final story was selected and written by consolidating the opinions. In the session, after the students' storytelling, each group reads their story aloud, and after reading the story, the teacher asks relevant questions and engages in discussion with the students. Based on the discussion and the students' stories, an assignment is also given to the students. This stage was evaluation and rewriting.

It is worth mentioning that to make the intervention program more practical, the appropriateness and relevance of the story for high school students were considered, taking into account the Iranian context. Therefore, after extensive review and consideration, it was decided to seek the students' help writing the story. Therefore, the author divided 120 eighth-grade students into groups of four in four classes and asked them to write stories focused on problems in school and society and related factors such as empathy, tolerance, self-awareness, and premature judgment in four 90-minute sessions. After collecting the students' manuscripts, the author, in consultation with two educational specialists and school counselors, selected and approved the final story to ensure the best possible choice.

Analysis method

Descriptive statistical methods such as frequency, mean, standard deviation, and inferential statistical methods, including the one-way ANOVA test for comparing experimental groups before and after the training, were used to analyze the data obtained in the research section. Additionally, before using the analysis of the covariance test, the assumptions of this method, such as the

normality of the dependent variable distribution (using the Kolmogorov-Smirnov test), the equality of regression line slopes (using the interaction between the pre-test score group effect), and the homogeneity of variances (using the Levene's test), were examined using SPSS version 20 software.

Results

Based on the results obtained from the examination of descriptive indices of resilience components, differentiated by the studied groups in the pre-test and post-test, table 1 shows that the average resilience in different groups intuitively differs.

Table 1. descriptive statistic

Groups		Pre test	Post test
Group1	N	19	19
	Mean	41.4737	58.1579
	Std. Deviation	10.50592	17.50639
Group2	N	21	21
	Mean	45.6190	53.3333
	Std. Deviation	15.74635	16.34115
Group3	N	17	17
	Mean	37.6471	51.5294
	Std. Deviation	18.14504	19.17393
Group4 (control)	N	21	21
	Mean	41.5714	54.5714
	Std. Deviation	18.40807	15.19727
total	N	78	78
	Mean	41.7821	54.4487
	Std. Deviation	15.95175	16.82272

For the analysis of covariance, the homogeneity of variances was first examined using Levene's test. The results can be seen in Table 2.

Table2. Levene-Test

	F	Df1	Df2	P
Resilience	0.431	3	74	0.731

Considering the values in Table 2 and the significance level obtained in Levene's test is more significant than 0.05, we can confidently confirm the hypothesis of homogeneity of variances.

In the second stage, the hypothesis of normality of the resilience variable was meticulously examined using the Kolmogorov-Smirnov test. The results, which provide a comprehensive understanding, are as follows (Table 3):

Table3. Kolmogorov-Smirnov test

	Test statistic	P
Resilience	0.069	0.2

The significance level obtained for the test is more significant than 0.05. Therefore, the hypothesis of normality is confirmed.

The results showed that the examined variables have a normal and natural distribution ($p > 0.05$). The results of Levene's test also showed that the resilience variance between the groups is homogeneous ($F=0.431$, $df1=3$, $df2=74$, $p=0.73$). ANCOVA analysis was used to examine the intervention effect of design thinking education based on unfinished stories for first-year middle school girls in Baharestan County. Based on the results, the two groups showed a significant difference in resilience. The obtained Eta-squared value for resilience (Eta=0.38) indicates that 38 percent of the changes in the participants in the design thinking group can be attributed to an educational intervention emphasizing a design thinking approach based on unfinished stories for female middle school students in Baharestan County (Table 4).

Table4. Test of Between-subjects Effect Test

Source	SS	DF	MS	F	P	η2
Corrected Model	5634.864[a]	4	1408.716	6.365	.000	
Intercept	55799.375	1	55799.375	252.120	.000	
Pretest	5202.141	1	5202.141	23.505	.000	
group	686.690	3	228.897	1.034	0.021	0.382
Error	16156.430	73	221.321			
Total	253035.000	78	1408.716			
Corrected Total	21791.295	77	55799.375			

Discussion

The present research was an intervention-based educational program on design thinking through storytelling, which was used in a collective case study aimed at developing, enhancing, and maintaining personal resilience among middle school students. Participants attended twelve sessions over three months. Participants were removed from their usual school learning environment and gathered to participate in this intervention while learning about the key features and strategies of personal resilience. The new contribution of this intervention for student

education was to support the learning experience with design thinking, which used storytelling to improve well-being and increase participants' resilience. The role of the educator in this process is crucial, as they guide the students through the design thinking process, encouraging them to think creatively and critically. Considering the characteristics of design thinking after the intervention, participants reported positive personal and professional outcomes, including increased self-confidence, self-awareness, communication skills, and conflict resolution. They strengthened their relationships with their friends. Their educational intervention enabled them to make decisions and solve problems without conflict in the face of difficulties and psychological pressures arising in school.

From the perspective of design thinking specialists, the transformative power of design thinking education is evident. It equips individuals to approach life's challenges not with impulsive, quick, and underutilized recognition of their abilities, but with a positive and accurate evaluation of the existing conditions, leading to logical solutions and decisions. The data collected in this study, along with the findings of Carroll et al. (2010), confirm that design thinking focuses on developing empathy, promoting hands-on activities, encouraging ideation, enhancing metacognitive awareness, and strengthening creativity for problem-solving. Design thinking is a formal method for practically and creatively solving problems or issues to improve future outcomes, inspiring hope and optimism for its potential impact on students.

Problem-solving skills can help students cope with conflicts, assist them in decision-making, and aid them in relationship issues. The ability to resolve conflicts along with coping strategies are cognitive processes that deal with the needs of daily academic life, as they involve effort, planning, and alternative actions aimed at resolving any situation (Hirsch, 2015; Oliveira et al., 2014). One of the key processes in the design thinking intervention was 'rewriting the continuation of the story. This involved student revisiting and reimagining past experiences, and then creating alternative, more positive outcomes. This process not only led to the recovery of critical situations but also addressed problematic situations during the training. Simultaneously, the self-assessment conducted by the students led them to evaluate and improve their characteristics in dealing with various issues. In this regard, research results also indicate that design thinking enhances problem-solving skills (Noel y Liub, 2017; Carlgren y et al, 2014; Jobst y et al, 2012). Additionally, students provide personal resources for coping with adversities by conducting self-assessments (Oliveira & et al, 2013; Juliano & Yunes, 2014), which in turn enhances problem-solving skills.

Design thinking and problem-solving skills, as powerful tools, can help students tackle various academic and social challenges. The key processes of revising stories and self-assessment enable students to review their experiences, identify their strengths and weaknesses, and continuously improve. These processes not only strengthen problem-solving skills but also empower students to become more resilient in the face of their daily challenges and find more effective ways to cope with them. The importance of self-assessment in the problem-solving process cannot be overstated. Students who regularly self-assess can better identify their needs and resources and respond more effectively to various issues. This process also helps students gain more confidence and resilience in new challenges. As a result, educational programs that incorporate design thinking help students improve their resilience and acquire the necessary tools to tackle their daily educational and social challenges, providing a sense of empowerment to the audience.

As this article argues, teaching design thinking by activating empathy in students as the first stage of design thinking can facilitate students' access to individual, relational, and contextual resources that are related to overall mental and physical performance and well-being. Empathy, the ability to feel the emotions of others and understand them from their perspective, is not just a personal trait in the context of design thinking. It is a tool that can be used to understand the needs and experiences of others, which is crucial in the design process. Empathy is a key component of resilience. Because when a person tries to understand others' perspectives, they prepare themselves to deal with any situation that may arise. By putting ourselves in others' shoes, we can learn resilience. Various researchers over the years have found a positive relationship between empathy and resilience. These results indicate that empathy, as a key element in the design thinking process, can help improve students' social relationships, which can lead to reduced tensions and increased satisfaction in educational environments. The emphasis on empathy in design thinking underscores its importance in the educational process, making the audience feel its significance.

As this article argues, design thinking education, by activating empathy in students as the first stage of design thinking, can facilitate students' access to individual, relational, and contextual resources related to overall mental and physical performance and well-being. Empathy, the ability to feel the emotions of others and understand them from their perspective (Vinayak & Judge, 2018), is a crucial component of resilience (Brooks & Goldstein, 2003). Resilience, the ability to bounce back from adversity, is developed through understanding and sharing the experiences of

others. By putting ourselves in the shoes of others, we can learn resilience. Over the years, various researchers have found a positive relationship between empathy and resilience (Haramati & Weissinger, 2015; Grant & Kinman, 2014). These results show that empathy, as a critical element in the design thinking process, can help improve students' social relationships, and this can lead to reducing tensions and increasing satisfaction in educational environments. This is because empathy can be used to improve students' resilience and psychotherapy.

Also, in this study, the level of resilience was related to the type of feedback. This may be because of the teacher's written feedback and the emphasis that the teacher has on writing for the student; the participants become sensitive to the teaching steps and the teaching style and pay attention to what step they did not do correctly and complete it in the next step. (Liu, 2022; Mendoza & Yan, 2023). When students are careful in doing the steps and doing them correctly, the conclusion will also be favorable. In addition, when the teacher's written feedback was combined with the student's self-evaluation, it was observed that the level of resilience also increased. This may be because the subjects' ability to recognize individual deficiencies is more acute in the continuous training of self-assessment (Osakwe et al., 2022; Yan et al., 2022).

Resilience is a vital skill for modern students, and the results of this study demonstrate the positive impact of design thinking on its development. Teaching design thinking by activating empathy in students and strengthening their problem-solving and decision-making capabilities can significantly improve their resilience and psychotherapy. For instance, in a science class, students can use design thinking to empathize with the challenges faced by a species in a particular ecosystem, and then design solutions to improve the species' resilience. The role of the teacher's written feedback and students' self-evaluation as important factors in the educational process cannot be overstated, as they can significantly affect the student's learning level, which was considered resilience in the present study. In line with this research and considering the positive results of the implementation of the design thinking approach, it is suggested to the curriculum planners to provide planning and design conditions for the implementation of the design thinking approach. It seems necessary to train and empower teachers on how to use design thinking, as well as the use of different types of feedback to improve learning. In addition, the potential of storytelling was also determined in changing students' behavior. Therefore, design thinking based on story writing can also be used for other cases. But in this regard, teachers should be well trained.

The most important limitations are using a non-random sampling method in the first sampling stage and the population's limitation to female students. In addition, the limitations of this research may include the relatively small sample size, time limitations for further follow-ups, and the inability to control all variables in the natural environment because no research is comprehensive. Therefore, some directions are also suggested for future studies:

1. The study was conducted only in one city in Iran. Therefore, future researchers may repeat a similar study in other cities of Iran to confirm the findings for generalization.
2. This study was conducted exclusively for twelve weeks. Therefore, future studies may replicate a similar study for a year or more to gain in-depth knowledge related to the nature of resilience and its correlation with storytelling-based design thinking.
3. The current study limited its focus to half-finished stories about increasing resilience. At the same time, design thinking has countless methods, so it is also valuable for future research to examine other methods.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Ethics statement

The studies involving human participants were reviewed and approved by the ethics committee of Farhangian University. The patients/participants provided their written informed consent to participate in this study.

Author contributions

All author(s) contributed to the study conception and design, material preparation, data collection, and analysis. All author(s) contributed to the article and approved the submitted version.

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Conflict of interest

The author(s) declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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