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HYBRID DESIGN THINKING MODEL FOR CREATIVITY ENHANCEMENT: AN EMPIRICAL STUDY USING MIRO BOARD

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Abstract
The present study investigated the effectiveness of a Hybrid Design Thinking Model in enhancing creativity among 8th grade students in science, with specific emphasis on the integration of digital collaborative tools such as Miro Boards. Employing an experimental research design, a total sample of 100 students was divided equally into experimental and control groups. The experimental group was taught science concepts using a hybrid design thinking approach that combined face-to-face classroom activities with online collaborative design tasks, while the control group received instruction through conventional teaching methods. Creativity was assessed using a researcher-developed creativity test based on Guilford's divergent thinking model, focusing on the dimensions of Fluency, Flexibility, and Originality. Statistical analysis revealed significant differences in the mean gain scores of overall creativity between the experimental and control groups, favouring the experimental group. Further analysis indicated that students exposed to the hybrid design thinking model demonstrated significantly higher gains across all three creativity dimensions. Gender-wise analysis also showed significant differences, with girls outperforming boys, and a significant interaction effect between treatment and gender on creativity scores. The findings provide strong empirical evidence that design thinking, when implemented through a hybrid learning framework supported by digital tools like Miro Boards, serves as an effective pedagogical strategy for fostering creativity in school science education. The study highlights the potential of integrating design thinking and technology-enabled collaborative learning to promote creative problem-solving, innovation, and 21st-century skills among secondary school students.
Keywords: Hybrid Design thinking Model, Creativity, Digital Miro Board & Science Subject.

INTRODUCTION

The Indian education system has undergone significant modifications over the years. Innovation was a key component of the most recent education strategy, despite the fact that previous ones placed more emphasis on it because the epidemic gave the educational system a much-needed shake. The COVID-19 epidemic has hastened the integration of technology. The National Education Policy (NEP) 2020 emphasizes problem-solving skills and creative solutions while promoting overall growth. It highlights the importance of experience learning and critical thinking. In 2020, NEP intends to implement Design Thinking as a talent at the educational level. Design thinking promotes innovation and creativity, which align with NEP 2020's objectives. Additionally, it encourages students to strive for experiential learning in order to prepare them for the real world (Choudhury & Sharma, 2024).
To address the growing issues of today's digital world, students must acquire the critical talent of design thinking. According to Simon (1969), the main goal of education is to encourage pupils to consider how to construct things that are applicable to what they observe in the real world. Over the past few decades, the idea of design thinking has become quite popular in K–12 education (Dunne & Martin, 2006; Scheer, Noweski & Meinel, 2012). A collaborative, analytical, creative, iterative process, design thinking involves people experimenting, creating, prototyping models, gathering input, and rethinking (Razzouk & Shute, 2012; Wrigley & Straker, 2015). In other words, one such scientific method that aids in the creation of prototypes while taking into account creativity, visualisation, design and redesign in response to feedback is Design Thinking (DT), which provides workable answers to any socio-economic or educational issues. The design thinking approach emphasizes the double helix relationship between design and thinking, which is both generative and creative. "Design Thinking" refers to the cognitive process of design work, as well as the tools and approaches designers use to produce new ideas or things or to address practical difficulties (Cross, 2011; Simon, 1969; Kaur & Rai, 2024). Creativity is one of the most vital life talents in the current situation. Creativity entails developing fresh and inventive ideas, thinking beyond the box, and approaching issues in novel ways. It often involves imagination, originality, and the ability to see

things from different perspectives (CBSE, 2020) In other terms, creativity is the ability to develop or invent new objects, concepts, ideas, and solutions. It is a 21st-century ability that can transfer an imaginary environment into the real world. Creativity is the act of making new and inventive ideas a reality. Thinking and producing are the two phases of creativity. Innovation is the development or implementation of a concept. You are imaginative but not creative if you have ideas but don't implement them (Linda, 2011). Design thinking places more emphasis on collaboration, open-mindedness, and—above all—creativity than traditional thinking paradigms in many businesses. These are all critical 21st-century skills. To negotiate workable solutions to global educational and political conflicts, as well as environmental challenges that will undoubtedly persist into the next century, educators must create collaborative and authentic learning activities that help students develop their knowledge, skills, and values (UNESCO, 2015). To address these problems, design thinking is a very inventive strategy that teachers commonly utilize in the classroom to improve students' learning by coming up with unique solutions and effectively solving the problem. However, the design thinking process is rapidly expanding in the educational setting, as stated below;

TABLE: 1 FRAMEWORK OF DESIGN THINKING: TRADITIONAL → EXPANDED IN EDUCATION

Dimension	Traditional Thinking (Original Design Practice)	Expanded Educational Application	Sources
Purpose	Solve industrial design problems	Develop student creativity, collaboration, real-world problem solving	Anu, K., N. (2024)
Process Focus	Structured stages for product design	Iterative learner engagement across curriculum contexts	Li, T. & Zhan, Z. (2022)
Learner Role	Design expert role	Active co-creator of solutions and knowledge	Anu, K., N. (2024)
Teacher Role	Instructor of content	Facilitator of student inquiry and reflection	Quintanilla, G. S., Everaert, P., Chiluiza, K. & Valcke, M. (2022)
Assessment	Product success	Process, reflection, collaboration, creativity outcomes	Li, T. & Zhan, Z. (2022)
Scope	Design disciplines	Across STEM, Arts, Humanities, Social Sciences	Li, T. & Zhan, Z. (2022)
Learning Mode	Face-to-face	Hybrid/blended and digital learning environments	Anu, K., N. (2024)

Evolution of Design thinking in Education

The origins of design thinking in education may be found in Herbert A. Simon's seminal work from 1959, which described design as a methodical, logical approach to problem solving in a variety of fields, including engineering, arithmetic, and physics. This viewpoint established the theoretical foundation for implementing design principles in educational settings. Peter G. Rowe (1987) developed design thinking as a systematic paradigm for architecture and urban planning, stressing introspective and iterative thinking. David Kelley (2005) popularized the educational application of design thinking by founding Stanford University's D. School, which developed a learner-centred five-stage model: Empathy, Define, Ideate, Prototype, and Test. In India, design thinking made its way into Higher Education about 2010 at IIT Bombay, mainly in architecture and engineering. More recently, the National instruction Policy (NEP 2020) included design thinking into school instruction, supporting project-based learning and encouraging students to create innovative, sustainable solutions that are connected with the Sustainable Development Goals. Timeline of evolution of Design thinking in Education as given below:

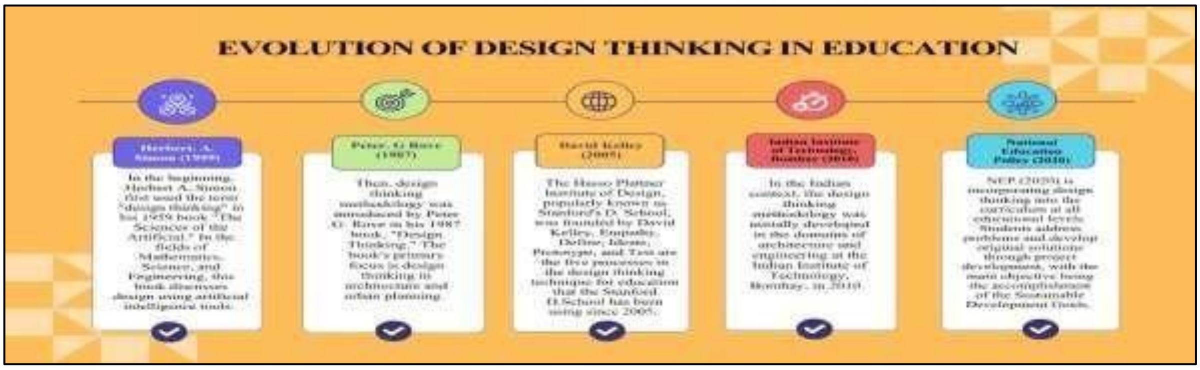

Figure 1: (Simon, 1959; Rove 1987; Kelley, 2005; IIT's, 2010 & National Education Policy, 2020)

The evolution of design thinking in education represents a gradual shift away from discipline-specific problem solutions and toward a learner-centred, innovation-driven educational approach (Cross, 2006; Rowe, 1987). From Simon's early conception of design as a logical cognitive process (Simon, 1969) to Kelley's human-centred educational approach (Kelley & Kelley, 2013) design thinking has evolved into a potent framework for developing creativity, critical thinking, and real-world problem-solving abilities (Brown, 2008). Its implementation in the Indian educational setting, particularly through institutions such as IIT Bombay, and official incorporation under NEP 2020 demonstrate its growing importance in tackling contemporary educational and societal concerns. By incorporating design thinking into curricula, education institutions may promote experiential learning and provide students with the skills they need to achieve sustainable development (Brown & Wyatt, 2010).

Supportive theories of Design Thinking

The integrated application of constructivist, social constructivist, and experiential learning theories forms the basis of design thinking in education. These theories collectively offer a solid theoretical framework for learner-centred and innovation-driven pedagogy. Constructivist theory describes how students actively create knowledge by working on real-world, unstructured situations. This approach is essential to design thinking exercises like problem framing, brainstorming, and prototyping (Piaget, 1973).

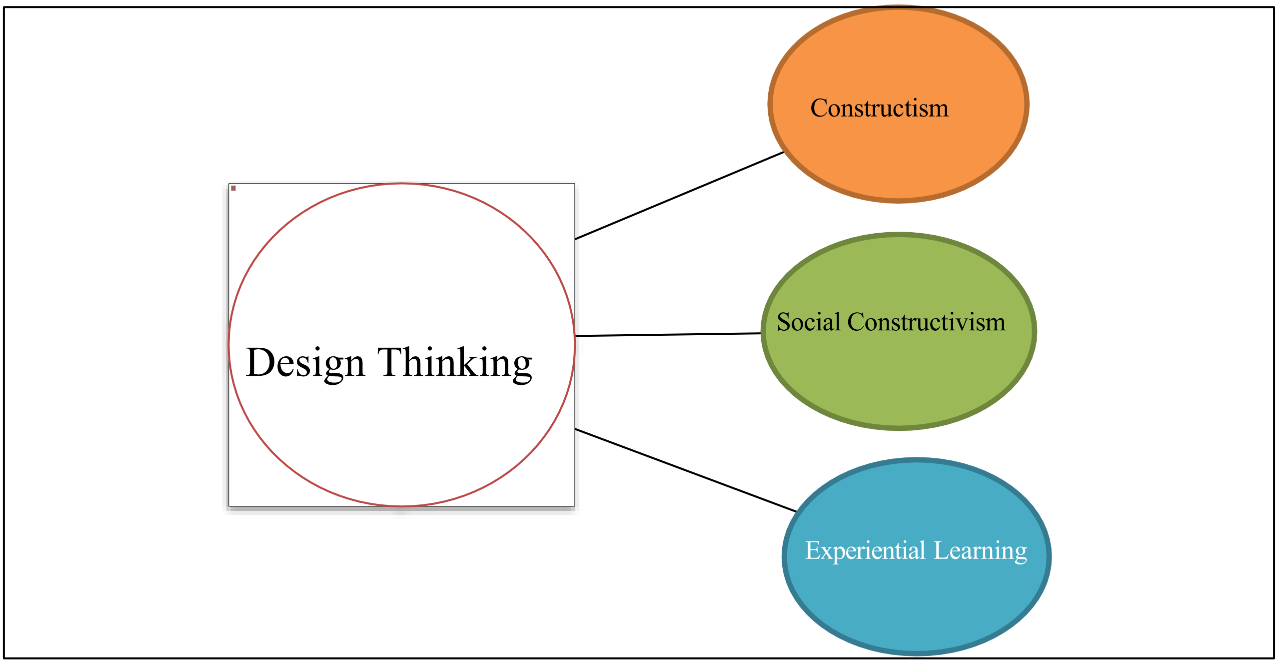

Figure 2: Supportive theories of Design Thinking

By highlighting cooperative learning, communication, and scaffolding within the Zone of Proximal Development all of which are mirrored in the cooperation, co-creation, and iterative feedback practices inherent in design thinking social constructivism further reinforces this paradigm (Vygotsky, 1978). Kolb's experiential learning cycle of concrete experience, reflective observation, abstract conceptualization, and active experimentation is closely paralleled by the cyclical stages of Design thinking: Empathizing, Defining, Ideating, Prototyping, and Testing (Kolb, 1984; Brown, 2008). Design thinking is a theoretically grounded instructional method that fosters creativity, critical thinking, and real-world problem-solving in educational settings because of the confluence of these theories.

Model of Design Thinking

The Hasso Plattner Model of Design Thinking is a structured, human-centred innovation framework developed and established by the Hasso Plattner Institute of Design at Stanford University (D. School) and the Hasso Plattner Institute (HPI) in Germany. This methodology, which has its roots in interdisciplinary cooperation, empathy, and experimentation, sees design thinking as a methodical yet adaptable way to resolving complicated, ill-defined issues by thoroughly comprehending human needs and iteratively creating solutions. Throughout the design process, the approach encourages learners to participate cognitively, emotionally, and socially by emphasizing a balance between analytical thinking and creative inquiry. Stages like empathize, define, ideate, prototype, and test are essential to the Hasso Plattner model because they are iterative rather than linear, enabling ongoing improvement based on feedback and introspection (Plattner, Meinel, & Leifer, 2011; Stanford D. School, 2018). This approach promotes learner-centred, immersive, and collaborative learning in educational settings, which makes it especially useful for developing critical thinking, creativity, and practical problem-solving abilities in line with current educational reforms. The stages of design thinking model are as following:

(1) Empathize: At this point, the instructor introduces the subject and stimulates students' feelings, curiosity, and empathy by using the narrative technique. By fostering an emotional connection between students and real-world situations and issues, storytelling increases motivation and engagement. This phase aligns with the Empathize phase of design thinking, which prioritizes comprehending users' viewpoints and feelings as a basis for significant learning (Brown, 2008; Kelley & Kelley, 2013).

(2) Define: With the teacher's help and direction, students use activity-based learning to acquire conceptual understanding in the second stage. In order to build knowledge, learners actively engage in discussions, guided exploration, and practical activities. By offering scaffolding and clarification as needed, the instructor serves as a facilitator. This stage represents social constructivism, which holds that understanding is formed by contact and guidance, and constructivist learning theory, which sees learning as an active process of knowledge production (Piaget, 1973; Vygotsky, 1978).

(3) Ideate: It entails ideation and brainstorming, where the instructor plans a range of individual and group brainstorming exercises to increase students' comprehension. Based on what they have already learned, students comprehension. Based on what they have already learned, students come up with a variety of concepts and viewpoints, which promotes flexibility, creativity, and divergent thinking. This stage fosters the growth of higher-order thinking abilities and creative cognition and corresponds with the ideate phase of design thinking (Guilford, 1967; Brown, 2008).

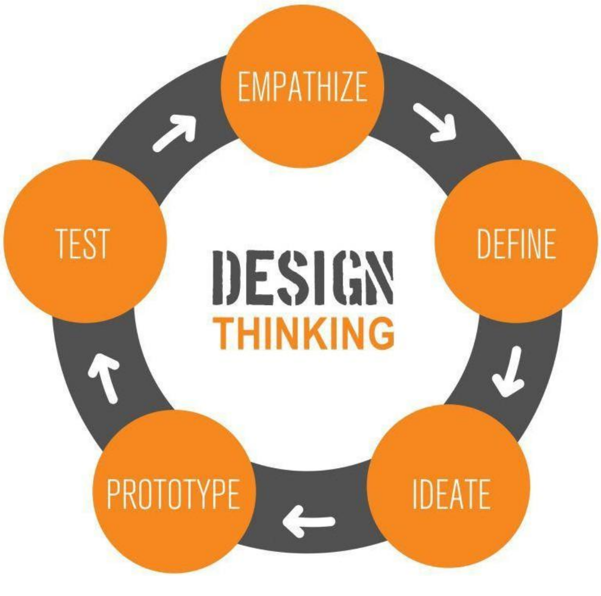

Figure: 3 Hasso Plattner Model of Design Thinking (https://i.pinimg.com/originals/23/38/86)

(4) Prototype: Students put what they've learned into practice by using digital tools and platforms to create projects online in groups. With the help of this project-based exercise, students can combine the knowledge they have learned in previous phases to create useful digital artifacts. As students actively investigate and apply concepts in the real world, the stage embodies the philosophy of experiential learning (Kolb, 1984). In this phase, students design their own projects, which help to develop the creativity which is the foremost demand of 21st century skills.

(5) Test & Feedback: Redesign, reflection, and feedback are the main topics of this phase. The instructor offers helpful criticism based on creativity, conceptual clarity, and design quality. In order to reinforce learning through iteration and improvement, students consider the input and make necessary revisions to their projects. This phase emphasizes reflection-on-action and on-going learning and is consistent with testing in design thinking and reflective practice. (Schon, 1983; Stanford D. School, 2018).

Creativity

Creativity is a fundamental human skill that allows people to develop ideas, interpretations, or solutions that are both original and meaningful within a certain environment. In educational psychology, creativity is typically defined as a cognitive and affective process that includes imagination, originality, thought flexibility, and issue sensitivity. Guilford's (1967) fundamental work integrated creativity into the structure of intellect paradigm, emphasizing divergent thinking as the foundation of creative activity. According to Guilford, creativity reveals itself through skills such as fluency, adaptability, and originality, which enable people to consider numerous viewpoints and options when faced with a problem. This viewpoint defined creativity as a measurable and developable construct, rather than an intrinsic skill limited to a few people. Subsequent study extended our understanding of creativity beyond divergent thinking. Torrance (1974) defined creativity as a dynamic process that begins with identifying gaps or issues, then proceeds to hypothesis generation, testing, and sharing of findings. This process-oriented viewpoint connects creativity to real-world problem-solving and learning opportunities. In educational settings, creativity is increasingly recognized as a skill that can be developed through effective pedagogical tactics, learning environments, and instructional designs that promote exploration, risk-taking, and reflection. Design thinking emerges as a systematic yet adaptable approach to operationalizing creativity in a deliberate way. It is a human-centred methodology that focuses on understanding users' needs, reframing challenges, developing novel ideas, and iteratively evaluating solutions (Brown, 2008; Lubart, 2001; Runco, 2007). Rather than viewing creativity as a spontaneous or solitary act, design thinking offers a systematic framework for guiding, refining, and transforming creative thinking into actionable results. The stages of design thinking; empathizing, defining, ideating, prototyping, and testing, create purposeful places for creative involvement while remaining focused on practical application.

The relationship between creativity and design thinking is highly interconnected. Creativity serves as the cognitive engine of design thinking, allowing students to envisage alternative solutions, challenge assumptions, and develop original ideas during the ideation phase. Simultaneously, design thinking fosters creativity by providing a supporting framework that eliminates fear of failure and encourages experimentation. Razzouk and Shute (2012) underline that design thinking combines divergent and convergent thinking processes: divergent thinking promotes idea development, whereas convergent thinking facilitates evaluation, refinement, and decision-making. This balance guarantees that creativity is both expressive and productive. In educational settings, design thinking is an effective pedagogical strategy for fostering creativity. Design thinking increases intrinsic motivation, teamwork, and reflective thinking by involving students in actual, real-world challenges, all of which are crucial components of creative development highlighted by Amabile's (1996) componential theory. Students are encouraged to empathize with others, collaborate, and iteratively develop their ideas based on feedback, which boosts their creative confidence and problem-solving skills. Carroll et al. (2010) contend that design thinking classes foster an environment in which creativity becomes a collaborative and ongoing practice rather than a solitary or episodic activity. Thus, creativity and design thinking are not distinct or conflicting notions, but rather complimentary aspects of inventive learning. Creativity gives the imaginative and cognitive power to produce new possibilities, whereas design thinking provides the methodical framework for organizing, applying, and validating those possibilities. When combined, they allow students to move from abstract imagining to real solutions, promoting ingenuity, adaptability, and higher-order thinking skills. This integrated approach is especially useful in today's education for training students to deal with complicated, ill-structured challenges and thrive in fast changing social and professional environments.

Review Of Related Literature

Several empirical and review research provide clear explanations for the relationship between design thinking and creativity in educational, professional, and innovative contexts. According to research, design thinking serves as a structured yet flexible framework that fosters creativity by incorporating divergent and convergent thinking, teamwork, and iterative problem solving (Brown, 2008; Cross, 2011). Razzouk and Shute (2012) argued that design thinking improves creative problem-solving by allowing students to reframe challenges through empathy, experimentation, and reflection, which directly fosters creativity and adaptability. Henriksen, Richardson, and Mehta (2017) stressed that design thinking fosters creative mind-sets by fostering risk-taking, brainstorming, and learning from failure, making it especially useful in educational settings. Empirical studies in higher education and STEM classrooms have shown that students exposed to design thinking-based instruction have significantly higher creativity scores, creative self-efficacy, and innovation skills than those taught traditional methods (Luka, 2019; Retna, 2020). Another significant study conducted by Cosculluela et al. (2020) found that many ideas and solutions assist students develop introspective and creative analysis skills, which are essential in today's diverse and dynamic environment. A protocol and case-based analysis of interdisciplinary and hybrid design thinking contexts reveals that organized online platforms paired with face-to-face involvement promote collaborative creativity, emotional interaction, and problem reframing throughout ideation and prototype stages (Han & Ellis, 2021). Furthermore, research in online and mixed instructional design reveals that well-designed digital learning environments promote higher-order thinking, creative self-efficacy, and reflective practice—key outcomes linked with design thinking pedagogy (Lu et al., 2021). Similarly, industry-focused experimental studies that integrated AI-assisted visual tools into Miro reported reduced cognitive workload and increased creativity during brainstorming activities, demonstrating how digital affordances interact with human-computer collaboration in design thinking processes (Zhong et al., 2024). Another study in the craft and cultural domain compared design thinking processes to traditional Rajasthani craft practices, revealing that empathy, iteration, and creative problem solving are shared by indigenous creative practices and formal design thinking approaches (Walia et al., 2024). Furthermore, a systematic literature review of Indian management training contexts identifies design thinking as a valuable methodological approach in virtual and hybrid management education settings, demonstrating that creative engagement through design thinking extends beyond design disciplines to business and organizational learning (Bathla et al., 2024). Meta-analytical research reveals that design thinking treatments have a strong beneficial influence on creative outcomes, with gains in fluency, originality, and problem-solving ability observed across a variety of learning environments (Suprapto, 2024). Empirical research in instructional design and higher education has shown that using Miro boards for co-creation, brainstorming, and concept mapping helps learners articulate, connect, and refine ideas collaboratively, scaffolding both divergent and convergent thinking, which is required for creative outcomes (Cuesta, 2024). Overall, these studies demonstrate that design thinking functions as a systematic accelerator for creativity, converting it from an unstructured skill to a teachable, measurable, and scalable process.

Although the existing literature firmly supports the function of design thinking in increasing creativity, there are numerous obvious **Research gaps**. First, there are few empirical studies conducted in the Indian context, particularly those that systematically assess creativity development through design thinking in a variety of educational settings, highlighting a need for context-specific data. Second, despite growing interest in design thinking, there is a scarcity of standardized and well-validated tools for assessing creativity from a design thinking perspective, with many studies relying on broad creativity measures rather than instruments aligned with design thinking stages and dimensions. Third, the majority of existing research focuses on higher education and professional training, while school education, particularly at the secondary level, is underrepresented, leaving a gap in our understanding of how design thinking might stimulate creativity among students. Finally, most research has been conducted in sectors such as management, engineering, design, and entrepreneurship, with little studies in science education, despite design thinking's significant potential to enhance inquiry, problem solving, and creativity in science classrooms. These gaps indicate the need for further targeted research on design thinking-based creativity treatments in Indian school science instruction, as well as assessment systems that are appropriate and culturally relevant. The investigator has chosen the title "Hybrid Design Thinking Model for Creativity Enhancement: An Empirical Study Using Miro Board" to clearly reflect the purpose, approach, and scope of the study, as it emphasizes the integration of hybrid learning environments, the application of a structured design thinking model to enhance creativity, the use of empirical evidence to validate outcomes, and the purposeful adoption of Miro Board as a digital collaborative tool to support creative ideation, visualization, and iterative learning.

Use of Digital Miro Board for Project Creation in Design Thinking

There are numerous Design Thinking tools that may be used to effectively generate digital prototypes/models. After extensive conversations with the supervisor and experts (Teacher Educators and Subject teachers), assessment of the numerous researches, the Miro Board for Design Thinking was chosen. There are several

reasons to use this tool by the investigator: (1) It is primarily intended for students at the school level. (2) Open access to sign in. To begin, the investigator provided the students with only one day of orientation before designing a Prototype/Model/Project on Miro board, during which time the students got expertise designing any project. The process to work on the Miro Board app is as following in a systematic way:

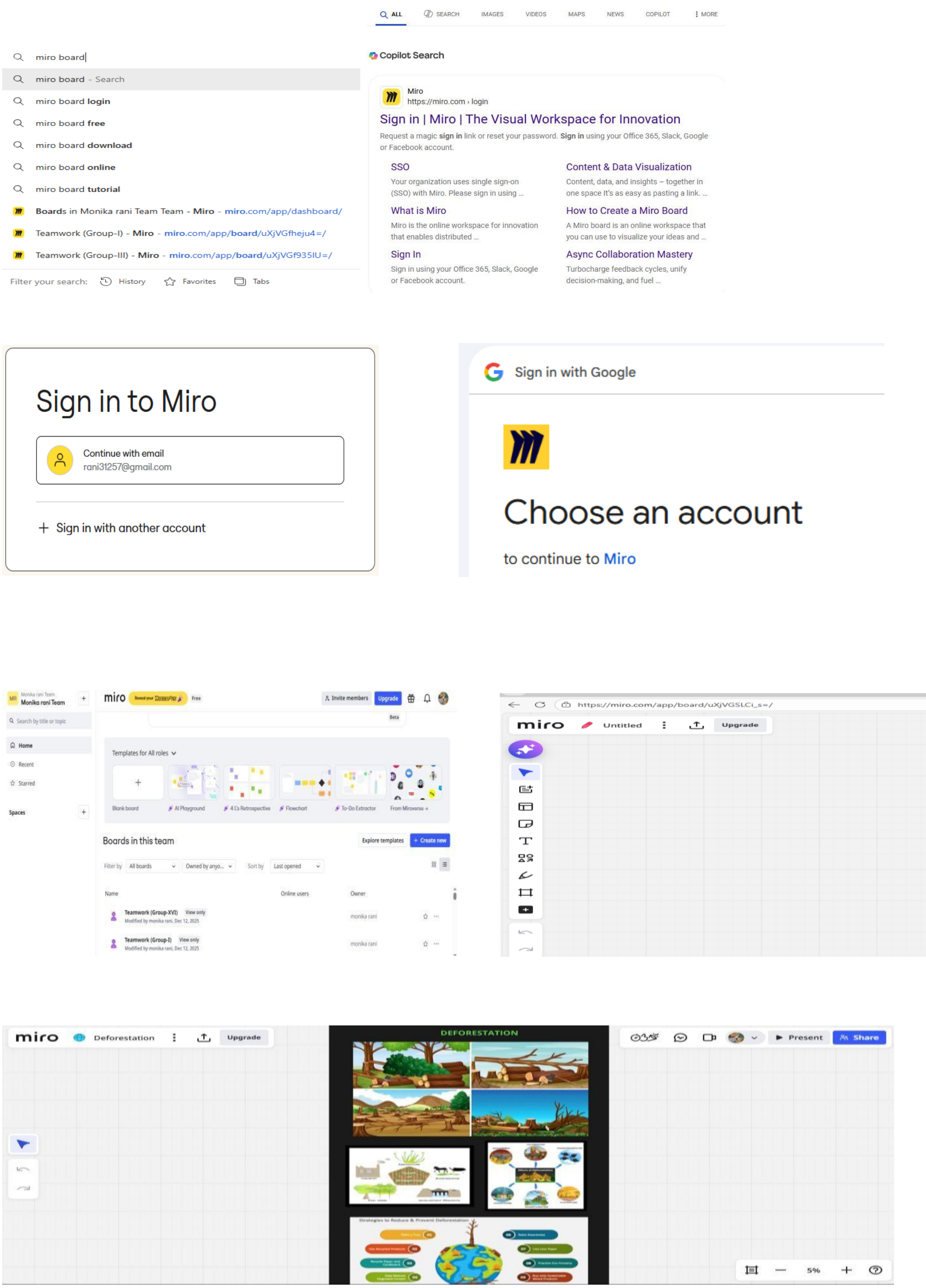

Figure: 4 Steps to Sign in on Miro Board and Designing the Project

By following this procedure, students can create an effective Project on Miro Board. So, Miro Board is a design tool that allows students to obtain more experience designing projects in digital environments, which improves knowledge, creativity, problem-solving ability, and digital abilities significantly.

Design Thinking through Hybrid Mode of Learning

The National Curriculum Framework for School Education (NCFSE, 2023) and India's National Education Policy (2020) both support the inclusion of design thinking in schools through a hybrid method of learning from a research and policy perspective. The NEP 2020 encourages learner-centered, immersive, competency-based pedagogies that develop students' critical thinking, creativity, problem-solving skills, and digital literacy (Ministry of Education, 2020). Design thinking, an instructional approach based on empathy, ideation, experimentation, and reflection, promotes these skills by immersing students in authentic, real-world problem scenarios. The policy also supports blended and technology-enabled learning to improve flexibility, access, and continuity, which can be achieved efficiently via a hybrid learning paradigm. NCFSE 2023 supports this orientation by promoting inquiry-based, transdisciplinary learning and the use of digital resources to encourage collaboration, reflective practices, and learner agency (NCERT, 2023). According to research, design thinking promotes learner-centred education, boosts creative confidence, and improves collaborative problem-solving skills in schools (Razzouk & Shute, 2012; Henriksen et al., 2017; Carroll et al., 2010; Retna, 2016). Face-to-face classroom interactions allow for empathy building, hands-on activities, and peer discussions in hybrid learning environments, whereas online platforms support ideation, prototyping, documentation, and continuous feedback, enriching the iterative nature of design thinking (Graham, 2013; Hrastinski, 2019; Means et al., 2013; Picciano, 2017). According to research on hybrid and blended learning, such settings improve student engagement, autonomy, and deeper knowledge by offering flexible learning routes and access to a wide range of digital materials. Thus, combining design thinking with a hybrid mode of learning puts national policy goals into action while also providing school pupils with critical 21st-century skills within an inclusive, flexible, and future-ready education ecosystem.
Following an exhaustive evaluation of relevant literature and ongoing conversations with teacher educators and the research supervisor, the investigator chose a hybrid method of learning at the school level for the current study. This decision was influenced by both theoretical insights and practical considerations, as previous research demonstrated the efficacy of mixing face-to-face training with technology-supported learning environments. Furthermore, talks with teacher educators and the supervisor gave context-specific guidance on classroom practicality, learner engagement, and pedagogical fit. As a result, the hybrid mode of learning was chosen as an ideal instructional technique to promote effective implementation and meaningful learning experiences at the school level. The Design Thinking model was implemented using a blended mode of learning in the following manner:

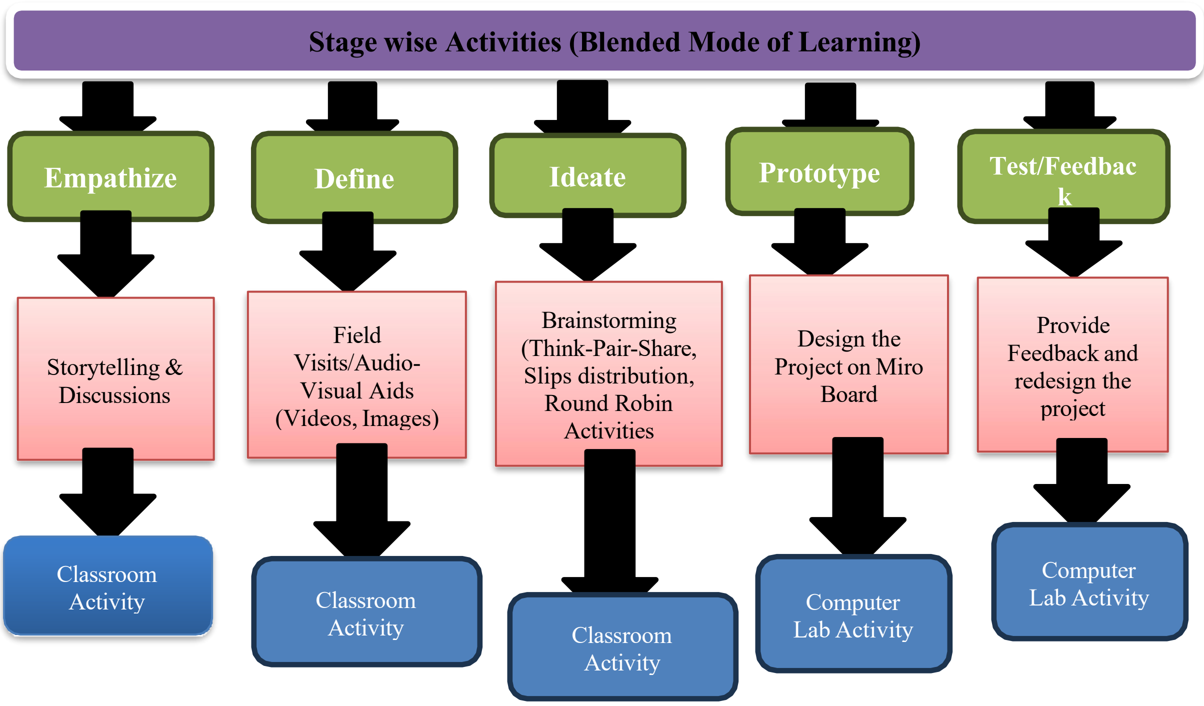

Figure: 5 Stage wise Activities in Classroom and Computer Lab

Statement of the Problem

In context with the above justification, the problem in hand can be stated as **Hybrid Design Thinking Model for Creativity Enhancement: An Empirical Study Using Miro Board.**

Delimitations of the Study

1. Only the city of Amritsar was included in the current study.
2. Only eighth-grade Middle Stage students were included in the current study.
3. Only eighth-grade boys and girls were included in this study.
4. This study was restricted to topics related to science.

Objectives of the Study

1. To study the effect of Design thinking method on Creativity of 8th grade students.
2. To study the creativity of 8th grade students with respect to gender.
3. To study the interaction between treatment and gender on the gain scores of creativity.

Hypotheses of the Study

1. There was no significant difference in the mean gain scores of Creativity among 8th grade students taught through Design thinking and Conventional teaching method in Science.
2. There was no significant difference in mean gain scores of Experimental and Control groups with respect to Flexibility, Fluency and Originality dimensions of Creativity among 8th grade students.
3. There was no significant difference in the mean gain scores of Creativity among 8th grade students with respect to gender.
4. There was no interaction between treatment and gender on the mean gain scores of creativity among 8th grade students.

Sample

100 (One hundred) eighth-grade students from Amritsar represented the study's sample size. For this objective, the investigator employed the random Sampling technique.

Study Design

There were two groups: Experimental and Control. Fifty students were assigned to the experimental group, and the remaining fifty to the control group. The investigator administered the Creativity Pre-test to Grade 8 students (both experimental and control groups). The experimental group was taught the steps of Hasso Plattner's Design Thinking paradigm, whereas the control group was taught conventionally. Students were taught using hybrid modes of learning, which included empathy, define, ideate, prototype, and test. In the first three steps (Empathy, Define, Ideate), students worked with community members (environmental activities) with the assistance of a teacher to solve the problem through brainstorming sessions, and in the final two steps (Prototype and Test), students created a prototype or model in digital form by providing a solution, and then the teacher provided feedback. Students used Miro boards to create a product in the prototype stage, and the teacher provided comments to them. The investigator then conducted a post-test to assess the students' scientific originality in both groups.

Tools to be used in the Study

1. Modules based on Design thinking in science developed by the investigator.
2. Creativity test constructed by the investigator.

Statistical Techniques

Statistical techniques like mean, standard deviation, t-test, and ANOVA (Analysis of Variance) were used to analyse the data.

Results And Findings

HYPOTHESIS-1

"There was no significant difference in the mean gain scores of Creativity among 8th grade students taught through Design thinking and Conventional teaching method in Science"

TABLE1.1 PRESENTING THE EXPERIMENTAL AND CONTROL GROUPS' MEAN GAIN SCORE,

STANDARD DEVIATION, AND T-VALUE IN TERMS OF CREATIVITY

Group/Method	N	Mean Gain Score	S. D	df	t- Value	Remarks
Experimental Group	50	8.70	7.20	98	13.75	Significant at 0.05 level
Control Group	50	3.44	2.21			

Table 1.1 demonstrates that the mean gain scores for creativity in the Experimental and Control groups were 8.70 and 3.44, respectively, with standard deviations of 7.20 and 2.21. It is also stated that the t-value for the two groups was 13.75, which was higher than the table value (1.97) at the 0.05 confidence level. As a result, there was a substantial difference in the creativity of science projects between the Experimental group (taught using the Design Thinking Method) and the Control group (taught using the traditional teaching method). Therefore, our Null Hypothesis **"**There was no significant difference in the mean gain scores of Creativity among 8th grade students taught through Design thinking and Conventional teaching method in Science" was rejected. It can conclude that Design thinking method also help to increase the creativity of students in an effective way.
These findings are strongly supported by previous research. **Razzouk and Shute (2012)** reported that Design Thinking enhances learners' creative problem-solving abilities by engaging them in iterative processes such as ideation, prototyping, and reflection, which directly contribute to creativity development. Similarly, **Henriksen, Richardson, and Mehta (2017)** found that integrating Design Thinking into school classrooms significantly improves students' creative thinking and innovation by encouraging exploration, collaboration, and learner autonomy. The present study corroborates these findings by demonstrating that Design Thinking not only supports conceptual learning but also significantly enhances creativity among 8th-grade students, particularly in science project work.

HYPOTHESIS-2

"There was no significant difference in mean gain scores of Experimental and Control groups with respect to Flexibility, Fluency, and Originality dimensions of Creativity among 8th grade students"

TABLE 1.2 PRESENTING THE EXPERIMENTAL AND CONTROL GROUPS' MEAN GAIN SCORE, STANDARD DEVIATION, AND T-VALUE IN TERMS OF CREATIVE DIMENSIONS

Dimensions of Creativity	Groups	N	Mean Gain Score	SD	df	t-value	Remarks
Flexibility	Experimental	50	6.78	1.56	98	2.70	Significant
	Control	50	2.60	1.70	98		
Fluency	Experimental	50	5.90	2.09	98	3.90	Significant
	Control	50	2.00	1.99	98		
Originality	Experimental	50	4.26	2.99	98	1.99	Significant
	Control	50	1.98	2.10	98		

From table 1.2, which indicated that the hybrid design thinking intervention significantly enhanced students' creativity across all three measured dimensions—flexibility, fluency, and originality. Specifically, the experimental group demonstrated higher gain scores compared to the control group, with flexibility showing a mean gain of 6.78 versus 2.60 ($t = 2.70$, $p < 0.05$), fluency a mean gain of 5.90 versus 2.00 ($t = 3.90$, $p < 0.05$), and originality a mean gain of 4.26 versus 1.98 ($t = 1.99$, $p < 0.05$). These statistically significant differences suggest that students exposed to the hybrid design thinking model were able to generate more ideas (fluency), apply ideas in varied contexts (flexibility), and produce novel and unique solutions (originality) compared to peers who received traditional instruction. So our Null Hypothesis "There was no significant difference in mean gain scores of Experimental and Control groups with respect to Flexibility, Fluency, and Originality dimensions of Creativity among 8th grade students". Overall, the findings provide empirical support that the design thinking, particularly when integrated with collaborative tools like Miro Boards, effectively fosters multiple dimensions of creativity in students.
The findings of the present study are supported by earlier research highlighting the effectiveness of Design Thinking in enhancing multiple dimensions of creativity. **Dym et al. (2005)** demonstrated that design-based learning environments promote divergent thinking by encouraging students to explore multiple solution pathways through iterative ideation and prototyping, thereby strengthening fluency and flexibility. Similarly, **Scheer, Noweski, and Meinel (2012)** reported that Design Thinking–oriented instructional practices significantly enhance learners' creative confidence and originality by fostering collaborative problem-solving and reflective learning. These studies corroborate the present findings by confirming that Design Thinking, particularly when implemented through structured and collaborative learning experiences, effectively nurtures flexibility, fluency, and originality among

students.

HYPOTHESIS – 3

"There was no significant difference in the mean gain scores of Creativity among 8th grade students with respect to gender."

TABLE1.3 PRESENTING THE EXPERIMENTAL AND CONTROL GROUPS' MEAN GAIN SCORE, STANDARD DEVIATION, AND T-VALUE IN RELATION TO GENDER

Variable	Gender	N	Mean Gain Score	SD	t-value	Remarks
Creativity	Boys	50	14.23	21.10	24.11	Significant at 0.05 level
	Girls	50	19.20	25.30		

Table 1.3 shows that the mean gain score for boys was 14.23, while for girls it was 19.20. The researcher utilized the "Independent Sample test" to see if there was a significant difference in originality across genders. The t-value was found to be 24.11, which was more than the table value (1.97) at the 0.05 level of confidence. So, our Null Hypothesis **"**There was no significant difference in the mean gain scores of creativity among 8th grade students with respect to gender." was rejected." As a result, there was a significant difference in inventiveness between boys and girls. Because girls had greater mean gain scores than boys, this was taught using the design thinking method. Girls did better use the Design Thinking method because they have the imagination to design objects and tasks effectively.

The present finding of a statistically significant difference in creativity gain scores with girls outperforming boys after the Design Thinking intervention is supported by recent educational research emphasizing gender-related patterns in creativity and design learning. A gender-focused study in creative design education reported that female students scored higher than male counterparts on metrics related to novelty and elaboration, indicating that girls often exhibit strengths in originality and expressive aspects of creative tasks (e.g., novelty and affective characteristics), although differences may vary by specific creativity component and context **(Dong & Zhu, 2023).** Additionally, research examining the impact of Design Thinking and Maker Education integrated into project-based learning found that such innovative, hands-on pedagogies can significantly improve students' confidence and engagement particularly among female learners, suggesting that inclusive and collaborative Design Thinking experiences may help reduce early gender disparities in STEM confidence and creative self-efficacy **(Patricia, Khadija, Miriam & Amaia, 2024).**

HYPOTHESIS – 4

"There was no interaction between treatment and gender on the mean gain scores of creativity among 8th grade students."

TABLE 1.4 SUMMARY TABLE OF TWO-WAY ANOVA OF GENDER AND TREATMENT ON STUDENTS' CREATIVITY

Sources of Variance	**Sum of Squares**	**df**	**Mean Sun of Squares**	**F**	**Significance**
Gender (A)	604.28	1	604.50	5.611	.000
Treatment (B)	120.206	1	120.206	591.670	.005
Gender * Treatment (AxB)	30.150	1	30.230	2.180	.001
Error	2244.844	97	22.244		
Total	3789.000	100			

Table 1.4 also shows that the f-value for the interaction impact of gender and treatment on student creativity was.001, which was statistically significant at 0.05 level. The high interaction effect shows that gender and treatment (as taught via the design thinking) have a significant impact on students' creativity. Thus, our Null Hypothesis, "There was no interaction between treatment and gender on the mean gain scores of creativity among 8th grade students" was rejected. It may be concluded that the design thinking method enhances the creativity of students (boys and girls) through indoor and outdoor environmental activities.

The significant interaction effect of gender and treatment on creativity found in Table 1.4 aligns with emerging Indian educational research demonstrating that Design Thinking interventions both enhance creativity and interacts with learner characteristics such as gender. For instance, a recent Indian study on the integration of Design Thinking into school education highlights how human-centred, iterative pedagogies not only promote creativity and problem-solving in students but also encourage differentiated engagement, suggesting that contextual, student-focused instructional strategies can interact with individual learner variables to influence outcomes like creativity **(Prakash, 2024).** Additionally, investigations into Design Thinking implementation in Indian classrooms have underscored its potential to foster innovation and creative expression by reorienting curriculum and teacher practice toward student agency and exploratory learning, particularly when supported by structured activities that leverage both indoor and outdoor environments; such integrative pedagogy can interact with students' backgrounds and dispositions, thereby amplifying effects on creativity across groups **(Nirupama, 2024).** Together, these studies support your finding that Design Thinking not only enhances creativity overall but also interacts with gender to influence creative outcomes among students.

Discussion Of Findings

The study's findings clearly indicate the effectiveness of the hybrid design thinking approach in increasing creativity among eighth-grade students, particularly in science instruction. The significant difference in overall creativity gain scores between the Experimental and Control groups suggests that students taught using the design thinking method outperformed those taught using traditional methods, resulting in the rejection of the first null hypothesis. Further examination of the dimensions of creativity (Flexibility, Fluency, and Originality) revealed that the experimental group consistently outperformed the control group across all dimensions, confirming that the hybrid design thinking intervention effectively promotes idea generation, adaptability, and originality. These findings imply that structured design thinking activities, when accompanied by collaborative tools like Miro Boards, allow students to explore multiple solutions, think differently, and produce unique ideas more successfully than traditional training. Furthermore, the significant gender gap in creativity gain scores suggests that girls benefited more from the design thinking intervention than boys, possibly due to greater imaginative engagement and sensitivity to creative tasks in collaborative and exploratory learning environments. The strong interaction effect between gender and treatment supports the hypothesis that both instructional methods and learner characteristics influence creativity development. Overall, the findings provide strong empirical evidence that hybrid design thinking pedagogy, which includes digital collaboration and experiential learning activities, significantly improves students' creativity across gender, validating design thinking's instructional value in school-level science education.

Educational Implications of the Study

The Education Implications of the study are as following:

(1) Incorporating design thinking into school curricula, particularly in scientific education, can significantly boost students' creativity. Design thinking encourages empathy, ideation, experimentation, and reflection, all of which boost higher-order thinking and creativity beyond typical rote-learning methods (Brown, 2008; Razzouk & Shute, 2012).

(2) The effectiveness of the hybrid design thinking methodology emphasizes the value of combining in-person classroom encounters with online collaborative platforms. Such hybrid environments allow for hands-on activities, peer conversations, and emotional engagement in classrooms, while digital spaces promote ideation, prototyping, documentation, and constant feedback (Graham, 2013; Hrastinski, 2019).

(3) Miro Boards' favourable impact on flexibility, fluency, and creativity implies that digital whiteboards and collaborative technologies should be integrated into instructional techniques. These tools encourage visual thinking, brainstorming, and co-creation, supporting both divergent and convergent thinking, which is necessary for creativity (Henriksen et al., 2017; Lu et al., 2021).

(4) Teachers require structured training to successfully implement design thinking pedagogy and digital tools in the classroom. Professional development programs should emphasize enabling creative problem-solving, collaborative learning, and the utilization of technology-enabled design processes (Retna, 2020).

(5) Gender disparities and interaction effects indicate that design thinking promotes inclusive learning for diverse learners. Educators should use design thinking tools to promote equal involvement, creative expression, and confidence in both boys and girls (OECD, 2018).

(6) Since creativity has evolved as a measurable and improvable outcome, assessment methods should expand beyond material recall to incorporate evaluations of creative qualities such as fluency, adaptability, and originality. Design thinking-based projects and digital artefacts can be used as authentic evaluation tools (Razzouk & Shute, 2012).

(7) The findings support educational practices that emphasize creativity, innovation, and problem-solving as fundamental competencies for 21st-century learners. Embedding design thinking and technology-supported creativity is consistent with worldwide educational reforms and future-ready education aims (OECD, 2018).

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