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The Impact of Project-Based Learning within Blended Learning on Creative Thinking for Tenth-Grade Students

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Absract

Objectives: This study investigated the impact of project-based learning (PjBL) within a blended learning (PjBL-BL) approach on developing creative thinking skills among tenth-grade students studying Physics. **Methodology:** The study used a quasi-experimental design involving two classes, one using PjBL-BL and the other following traditional teaching methods as a control group. The Torrance Test of Creative Thinking (Form B) was used to measure the two groups' creative thinking differences. **Results:** The study's key findings revealed that the PjBL-BL group exhibited statistically significant differences in creative thinking compared to the traditional teaching group, with PjBL-BL positively impacting creative thinking skills. This suggests that integrating blended learning within project-based learning can enhance the teaching of Physics concepts by providing opportunities for practical implementation. **Conclusion:** The study advocates revising Physics curricula for diverse scientific skills, urging further research on how blended learning in projects enhances students' grasp of Physics concepts and practical application of theoretical knowledge.

Keywords: Project-based learning, Blended learning, Creative thinking, Tenth-grade student.

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Introduction

The rapid development of the internet has significantly impacted the educational landscape, leading to a new approach to e-learning. This flexible and dynamic interface allows learners to engage in traditional learning without constraints, promoting knowledge acquisition, self-renewal, and innovation. E-learning offers access to content anytime, anywhere, and facilitates numerous exchanges. However, e-learning does not replace the conventional methods of learning and teaching. Therefore, blended learning emerged as a natural evolution of e-learning. This approach does not supplant e-learning or traditional learning but instead combines both. According to Abueita (2013), blended learning integrates e-learning and face-to-face learning using various pedagogical techniques and theories appropriate for their respective educational settings to maximize the effectiveness of the learning and teaching process. Several research studies have highlighted the benefits of blended learning (Bahtiar & Ibrahim, 2022; Wahyudi et al., 2020; Abueita, 2013). A cross-sectional study conducted by Bahtiyar and Ibrahim (2022) on 70 students of Government Senior Secondary School (Government Islamic Secondary School) in Mataram using blended learning methods indicated that pupils in the 'high creativity' group were able to meet all indicators for creative thinking, including understanding context and solving problems correctly.

Blended learning alone is not enough to improve students' self-organizing, inquiry skills, problem-solving skills, critical thinking, logical thinking, and creative thinking. According to Abueita (2013), integrating teaching strategies such as project-based learning helps students develop the necessary skills to thrive in a technological society. A technological society relies on cognitive knowledge, complex problem-solving, creative thinking, personal responsibility, critical thinking, communication, and decision-making skills (Edutopia, 2007). Blended project-based learning is implemented in a web-based learning environment with interactive tools that enable students to participate and interact through the web. Participation, interaction, and adaptability principles have multiple applications in web-based education. Integrating technology with project-based learning encourages student engagement, such as discussing ideas and exchanging information, and performance through task authenticity by connecting new knowledge with real-world situations (Abueita, 2013). These technologies include Podcasting, Blogs, Forums, Wikis, Ajax, RSS, and others.

Research have shown that internet-based learning technologies can be pivotal in structuring and facilitating BL delivery (Yustina et al., 2020; Al-Mozan, 2018; Almualid, 2019). Online information research and collaborative projects prove to be a practical alternative for teachers to enrich the execution of PjBL. Project-based learning within blended learning can potentially improve thinking skills, especially creative thinking. Due to this, education institutes are keen on encouraging innovators to develop educational strategies that support creative learning and supply all the technological means and conditions that will contribute to creative development. The implementation of complex educational curricula will facilitate innovative development. The application of modern strategies, such as technological approaches to education, uses modern scientific methods and applications in the fields of teaching and learning using computer skills as part of these applications. Therefore, this study examined the effect of project-based learning within blended learning (PjBL-BL) on creative thinking.

Developing the learners' ability to think creatively is necessary at all levels of education and requires a proper educational strategy such as blended learning and project-based teaching strategies. These strategies depend on the student's activity, environment, and background knowledge. The most suitable method for teaching Physics (force and motion) and designing creative projects is aligned with these strategies following the constructivist theory proposed by Biggs (1996). Experiential learning promotes interaction with the outside world as the primary means of learning (Auger & Rich, 2007). Relevant literature also points out the importance of an individual's background knowledge and assumes that learners construct knowledge internally while being influenced by their environment (Tynjälä, 1990; Zeitoun, 2013). The approach involves a collaborative learning environment that supports cognition within the context of project-based activities, providing integrated instruction and intellectual scaffolding. According to Kilpatrick (1951), who invented this strategy, the role of the teacher is to guide, direct, and define the project-based activity.

Learners then engage in this activity naturally, within a social atmosphere closely resembling the learning environment. Consequently, project-based learning enhances learners' attention to the problems they encounter while interacting with the project's steps, leading to the development of higher-order thinking skills, such as creative thinking (Almualid, 2019). Creativity improves students' learning by stimulating higher-order thinking as they acquire and share knowledge (Arantes & Lino, 2018). Learners can transfer their school-based activities to real-world environments, preparing them for 21st-century skills (Borich, 2016). Taylor and Getzels (1975) identified three types of creativity: technical creativity, which reflects an individual's internal needs, perceptions, and motivations; scientific and technological creativity; and hybrid creativity, seen in architecture, which solves problems in novel ways and reflects the creator's personality.

The importance of teaching thinking skills has arisen due to continuous research in Cognitive Psychology. The Torrance theory (1990) emphasizes the character of the individual, which can be measured gradually to distinguish differences between individuals. It also describes how creativity considers informational shifts and imbalances while ignoring some components or locations unrelated to the circumstance. For example, if learners cannot solve problems, they start looking for supporting data and factors that may impact them. The learner then creates hypotheses based on the data, tests them, and links and analyzes the findings. Torrance focused on the tests he and his colleagues had developed to measure fluency, flexibility, originality, and elaboration of one's creative ability. To keep fear and anxiety out of the testing environment, Torrance refers to his examinations as activities (Torrance, 1990).

Global interest in improving education has increased across all subjects, prompting educators to update curriculums and design modern educational materials to teach thinking and related cognitive skills. The proper environment allows students to adapt to the demands of learning related to technological development and the information revolution (UNESCO, 2015). Ranco & Nemiro (1998) aimed to identify the most critical factors affecting the growth of creative abilities through a survey applied to 143 researchers specialized in creation (Csikszentmihalyi, 2009; Gustafson, 1988; Miller &

Saywers, 1980; MacKinnon, 1962), with ages ranging from 20 to 73. They found that the most critical influences in creative behaviors are education and teaching, followed by cultural and social factors associated with the individual. According to Melvin (1999), creativity can be taught and learned by providing a suitable home and educational environment, leading to increased creative performance. Kurt (2010) emphasizes using technology to reorganize and redesign the classroom, creating an atmosphere that effectively encourages students to think creatively while studying Science and Mathematics. Other studies (Drugova et al., 2021) have explored how technology can help students engage with the work of competent scientists through virtual encounters in natural laboratories and access to and analysis of accurate data. This also provides alternative classroom learning methods that can contribute to creative teaching and learning (Kithenham et al., 2015).

As a comprehensive indicator of creative potential, the study suggests that instructors design a better method to evaluate curriculum outputs to demonstrate the importance of involving students in working on creative projects, stimulating innovation, and allowing them to think outside the box to achieve the ambitions of a nation driven by creation. Al-Mozan (2018) explored the impact of cloud computing applications on project-based learning, knowledge development, performance of digital instructional design skills, and satisfaction of 39 female university students. A quasi-experimental research approach was used, and the study concluded that cloud computing applications in project-based learning have improved student achievement and satisfaction.

The PjBL approach encourages cooperation and shifts classical teacher-led instruction to interactive learner-directed learning. Yustina et al. (2020) investigated the impact of blended learning (BL) and project-based learning (PjBL) on the creative thinking of 76 pre-service teachers while learning Biology. The study found that blended and project-based learning enhances pre-service Biology teachers' creative thinking abilities. Additionally, Wahyudi et al. (2020) investigated the influence of the 3CM (Cool-Critical-Creative-Meaningful) learning model on blended learning to improve students' mathematical creative thinking skills. The study's findings suggest that combining 3CM and blended learning can boost students' creativity in solving mathematical issues. Badr

(2021) evaluated the influence of a proposed project-based blended learning program on high school students' development of 4Cs abilities (critical thinking, creative thinking, communication skills, and collaboration). A one-group pre-post-test quasi-experimental design was adopted in the investigation, with thirty students in the first year of high school participating. Research results found that the project-based integrated learning program helped build 4C abilities for the research team. Ayu et al. (2023) studied how the SAMR framework's application in technology-based projects influences students' creativity. The study involved 175 Indonesian students enrolled in a blended course. The findings suggest that flexibility is highly emphasized as a factor contributing to creativity, whereas meticulousness is less stressed.

The groundwork for this study is established through the preceding literature review. Consequently, the researcher deems it crucial to investigate the impact of integrating blended learning into project-based learning on students' creativity in studying Physics (force and motion). Within this framework, educators can employ various learning strategies through blended learning, allowing for the enhancement of creative thinking skills and the achievement of learning goals. The researcher employs indicators based on Torrance's theory, wherein creativity is characterized as an individual's capacity to address problems from diverse perspectives, considering fluency, flexibility, elaboration, and originality. This study examines the impact of PjBL-BL on each aspect of creativity indicators.

Problem Statement

Despite the importance to other Physics branches and various academic subjects, teaching at the Ashrafieh Secondary School in Jordan still emphasizes memorizing isolated facts and pen-and-paper skills. According to the teachers in Ashrafieh, this approach has left most tenth-grade students unable to understand the concepts of force and motion in Physics and draw correct conclusions. This urges societies to develop the creative thinking abilities of generations, focus on the importance of creative thinking in solving the problems they face, and emphasize the necessity of searching for new ways to discover their abilities. Through discussions with Science teachers regarding students' creative thinking abilities and the extent to which they can be used to solve scientific problems in the future, it became clear that there is a quest for methods that might help students enhance their creative abilities, enabling them to acquire new knowledge and skills. Developing thinking skills is a crucial goal in teaching Physics. However, in our schools, the reality is that teachers often focus solely on teaching information without considering its application or encouraging creative thinking (Ince, 2018).

The Eighth Conference for Research on Giftedness and Excellence in the Arab World (2022) emphasized the importance of motivating teachers and training them in various creative skills to enhance students' abilities and productivity. The conference emphasized the importance of encouraging practical applied research, utilizing its findings, and integrating them into the educational process. Additionally, it advocated for fostering a culture of creativity, innovation, and entrepreneurship in education through programs that develop students' entrepreneurial skills.

Therefore, there is a need to implement new strategies that concentrate on teaching students the basics, gradually incorporating curricula adapted through innovative teaching methods. This will transform the classroom into a place that inspires and stimulates ideas. Creative thinking, utilizing technological applications, and integrating them with teaching strategies within the classroom, such as blended learning, can be an enjoyable method to achieve educational goals. It helps develop creative thinking to produce projects related to real-life situations. This approach allows students to integrate their learning, knowledge, and skills by engaging in the planning stage with their classmates. The process ends with evaluating the project results and comparing them with the objectives set, while the teacher's role in this teaching style remains directive.

Study Question

The research question driving this research is:

"What is the impact of project-based learning within blended learning in teaching Physics on creative thinking among tenth-grade students in Jordan?"

Study Importance

The significance of this study rests on the benefits that students derive from understanding Physics, particularly force and motion and its related concepts. These abilities support the growth of their capacity for invention, concept visualization, and cause-and-effect creation. Students may develop their technical abilities while investigating and responding to work-based scenarios, such as designing, planning, preparing, and producing components or assemblies.

The practical and project-based approach to learning and assessment also helps develop essential personal skills, including time management and self-performance monitoring. Furthermore, this study is vital since there has been a noteworthy dearth of prior research on the effects of teaching Physics, particularly force and motion, on fostering creative thinking among Jordanian basic school students. The researcher is unaware of any prior studies in this area in Jordan.

Study Objective

The study aimed to investigate the impact of project-based learning within blended learning on creative thinking among tenth-grade students in teaching Physics, particularly force and motion.

Study Terminology

Blended learning:

It integrates e-learning and face-to-face learning with different learning and teaching methods based on the learning theories appropriate to the students' educational setting. This is done to increase the effectiveness of teaching and learning processes (Abueita, 2013). Procedurally, this educational program integrates face-to-face instruction between the teacher and learner with e-learning to investigate the impact of project-based learning within a blended learning model on the creative thinking of tenth-grade students in Physics, specifically in the topics of force and motion.

Project-based learning:

It is a comprehensive approach to classroom instruction that engages students in investigating real-world problems by creating their own artifacts (Solomon, 2003). Procedurally, it is defined as a learning method that follows the model adopted in this study, where students identify project objectives, plan and design solutions, experiment, implement their ideas, and present their projects under teacher supervision to address questions and solve problems.

Creative Thinking:

It means becoming aware of issues, deficits, knowledge gaps, missing pieces, and disharmony, recognizing how challenging it is to find answers, and making educated assumptions. Additionally, it entails developing hypotheses on the shortcomings, testing and retesting them, perhaps revising and retesting them, and presenting the results (Torrance, 1990). In Physics, creative thinking is procedurally defined as the ability to move beyond conventional problem-solving methods, adopting innovative and unconventional strategies that enhance understanding and contribute to knowledge development in the field. It is assessed through the score a learner achieves on the Torrance Test of Creative Thinking (TTCT) Figural Form B.

Tenth Grade:

In Jordan, the basic education stage lasts for ten years, beginning with the basic grade at the age of six and ending with the tenth grade at sixteen. The secondary education stage continues for an additional two years.

Methodology

This study employs a quasi-experimental design utilizing the pretest-posttest equivalent group design with two groups: one following the Projects-based Learning (PjBL-BL) approach and the other following traditional learning. The study involves administering the Torrance Creative Thinking Test (TTCT) Figural Form B as a pre-application measure, followed by applying TTCT after teaching both groups. The Torrance Creative Thinking Test (TTCT) is a battery of tasks designed to measure various indicators of creativity, including fluency, flexibility, originality, and elaboration of ideas.

Methodology Tools

The researcher used the Torrance Test of Creative Thinking (TTCT) Figural Form B because it was appropriate for the setting and the age of the study's population. It seeks to identify innovative thinkers among learners. Learners of all ages can take the creativity test to measure their level of inventiveness. It has been used for 40 years in longitudinal studies by Torrance (1990), translated into several languages, and has a substantial predictive value. Many studies conducted in Arab countries used TTCT, such as Suleiman and Abu Hatab (1973) in Egypt, Shanti (1983) in Jordan, and Saifaddin (2017) in Saudi Arabia.

Suleiman and Abu Hatab (1973) codified the TTCT on a sample of students (ages 12-15 years) in Egypt. They found criterion validity with the estimates of teachers and peripheral comparisons, and all were significant at a level of (0.01).

Saifaddin (2017) examined the test's psychometric properties among secondary school and college students. The findings supported the test's validity and reliability. The test's reliability coefficient was (0.85). As shown in Table 1:

Table 1

Test stability coefficient values

Test components	Stability coefficients between the first and second application
Fluency	** 0.91
Flexibility	** 0.87
Originality	** 0.82
Total	** 0.86

**** significant at a level of 0.01**

The correlation coefficient was calculated and found to be 0.285-0.917 to find the validity of the hypothesis composition. As shown in Table 2:

Table 2

Correlation coefficients between the indicators of the Torrance test for formal innovative thinking

Test components	Originality	Elaboration	Fluency	Flexibility	Total
Originality	**1.00	**0.561	**0.688	**0.419	0.795
Elaboration		1.00	**0.523	**0.285	**0.917
Fluency			1.00	**0.500	**0.748
Flexibility				1.00	**0.535
Total					1.00

**** significant at a level of 0.01**

Reliability and Validity of "TTCT" for This Study

There are different ways to measure the reliability and validity of a test. One way to do this is to calculate the "internal consistency" of the test using a measure called "Cronbach's alpha." The Cronbach's alpha tells us how consistent the test results are across different people. This study applied the creative thinking test to an exploratory sample of 20 10th-grade students at Ashrafieh Secondary School in Jordan.

To measure the validity of a measure, the rule of thumb is to look at the item-to-total correlations and the inter-item correlations. There is a weak correlation if the item-to-total correlations are between 0.10 and 0.29. If the item-to-total correlations are between 0.30 and 0.49, then there is a medium correlation. The construct validity is satisfied if the item-to-total correlations are between 0.50 and 1.00.

Hajjar (2018) emphasized that the process of establishing internal consistency, reliability and validity of constructs proposed to describe a given scale of a particular model requires determining the following measures:

Cronbach's alpha: This measure assesses the degree of internal consistency.

Inter-Item Correlation: An acceptable value should be > 0.30.

Item-Total correlation: A proper value should be > 0.50

Table 3

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardised Items	N of Items
0.830	0.982	5

Table 3 shows that the TTCT Figural B used to measure the construct is reliable because Cronbach's alpha is more significant than 0.7 (Nunnally, 1967). Next, the researcher studied the "inter-item correlation" to see how the items are related to each other in Table 4:

Table 4

Inter-Item Correlation Matrix

	Fluency	Flexibility	Elaboration	Originality	Total
Fluency	1.000	0.901	0.814	0.886	0.932
Flexibility	0.901	1.000	0.923	0.921	0.979
Elaboration	0.814	0.923	1.000	0.886	0.947
Originality	0.886	0.921	0.886	1.000	0.960
Total	0.932	0.979	0.947	0.960	1.000

The construct validity calculation is shown in Table 4, and correlation coefficients between the test's overall creative score and the creativity markers (fluency, flexibility, originality, and elaboration) were calculated. The item-to-item correlation matrix demonstrates that values greater than 0.3 are acceptable (Nunnally, 1967).

Torrance Tests of Creative Thinking (TTCT) Measure

The TTCT consisted of three non-verbal activities: a picture construction activity, a picture completion activity, and a repetitive figure activity. The researcher assigned ten minutes for each activity as follows:

Activity 1: Participants were asked to construct an integrated picture of an oval form (similar to a bean) and to create a title for the picture. The purpose of this exercise was to elicit feedback on originality and elaboration.

Activity 2: This activity had ten incomplete drawings, and participants were required to add borders and titles to each picture. The expected responses for this activity should exhibit originality, elaboration, flexibility, and fluency.

Activity 3: This activity consisted of 36 circles, and participants were instructed to draw shapes or images within the circles and add titles. The main objectives of this exercise were to assess originality, elaboration, flexibility, and fluency of responses.

The researcher assessed the four abilities: originality, elaboration, flexibility, and fluency.

Scoring Methods

Originality: Originality was corrected based on the scarcity of the prevalence of the idea in the study sample. For the first activity, scores were assigned as follows: (5 or more = zero, from 4.99 - 4 = 1, from 3.99 - 3 = 2, from 2.99 - 2 = 3, from 1.99 - 1 = 4, and less than 1 = 0). As for the second and third activities, originality was corrected as follows: (5 or more = 0, from 4.99 – 2 = 1, and less than 2 = 3).

Elaboration: The researcher awarded one point for each idea or addition to the original form, its borders, or the surrounding space. The response needed to have meaning and value or be correctable. The degrees were collected in the three activities.

Fluency: For the first and second activities, fluency is the number of students' responses. Unclear or irrelevant responses were excluded. The researcher awarded one point for each response. The scores were added to represent the skill of fluency.

Flexibility: Flexibility is the number of thoughts or shifts in thinking a student makes while responding to the activity. The responses were categorized, and one score was given for each idea or response. The scores were added to represent the flexibility skill.

Six correctors scored the TTCT to calculate the reliability and correction degree, and the results achieved high correlations in Table 5.

Table 5

Pearson's correlation coefficient for the scorers' stability for the three activities

Indicators	Value
The stability of the correctors for the first activity	
Originality	**0.608
Elaboration	**0.703
The stability of the correctors for the second activity	
Originality	**0.906
Elaboration	**0.807
Flexibility	**0.910
Fluency	**0.770
The stability of the correctors for the third activity	
Originality	**0.709
Elaboration	**0.909
Flexibility	**0.927
Fluency	**0.602

**** Correlation is significant at the 0.01 level (2-tailed).**

Educational Material

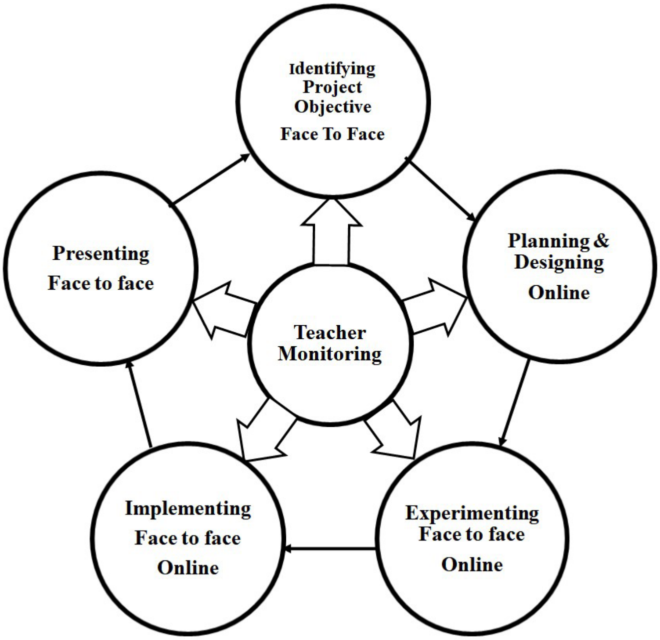
The general objective of the educational material is to foster the design and creation of projects by enhancing students' comprehensive knowledge and specialized understanding of Physics fields (motion in one dimension, and movement in two dimensions) and force (Newton's first law of motion, Newton's second law of motion and third law of motion). The teacher evaluates students' comprehension through specific assignments in certain mandatory modules. The assessment is based on practical applications, allowing students to apply their knowledge, understanding, and skills.

Plan and Frame Projects

The researcher adopted a model based on the Abueita's work (2013) and developed a teacher guide to organize student-centered lessons and classroom activities. The aim is to minimize the teacher's time at the front of the classroom while maximizing student engagement and practice opportunities. This approach encourages students to focus on hands-on projects to enhance their creativity, become comfortable using materials, and prioritize developing simple projects.

Figure 1

The PjBL-BL stage consists of 6 stages entered



The Science of Physics and Project-Based Learning within Blended Learning

The science of Physics is concerned with measurement, its tools, and accuracy, all of which contribute to achieving exact quantities. The project-based learning strategy is considered one of the most appropriate strategies for teaching Physics at the basic stage; it deals with the concepts and laws of motion (motion in one dimension, and movement in two dimensions) and force (Newton's first law of motion, Newton's second law of motion and third law of motion). This strategy achieves the desired goals through several phases that the learner completes to reach the required knowledge (Goldstein, 2016). The stages are as follows:

In the first two weeks (Identifying Project Objective Stage - Face to Face): The teacher explained the research objectives, obtained the student's approval, and introduced the objectives of the teaching materials. The teacher then divided the students into five groups. The teaching/learning process in the implementation of PjBL-BL started with questions derived from the objectives of the educational material. The teacher presented the students with many projects and allowed them to choose the project that suited them according to their inclinations and desires. At this stage, the teacher considered that the projects presented to them stemmed from the student's needs and inclinations, which motivated them to work in a team spirit and ensured that the projects were linked to their experiences and life situations.

In the second two weeks (Planning & Designing Stage - Online): The students collaboratively designed the project plan online using the tools of Moodle. The teacher's role was to monitor the students and the progress of the project plan. Several considerations should be taken into account during the planning stage:

- Define project objectives to guide the selection of activities and educational methods that align with achieving these objectives.
- Determine the role of individuals within the group and establish the methods to implement the project.
- Specify the techniques and methods to be employed during the project implementation.
- Establish a clear time frame for the project implementation.

In the third two weeks (Experimenting Stage - Face to Face + Online): After selecting the project and formulating the work plan, the teacher directs and guides the students to study and analyze the project. They help the students determine the appropriate methods and means for implementation, by what is stated in the project plan. This occurs before the actual work begins in the project implementation phase. In the monitoring process, the teacher records the activities. In the assessment process, the teacher assesses the outcome by measuring the students' standards and providing feedback.

The fifth two weeks (Implementing - Face to Face + Online): In this stage, students implement their design, run it, and get feedback for improving a product. In the actual practice phase of implementation, the teacher primarily focuses on monitoring, supervising, directing, counselling, and motivating students to work. They also discuss any difficulties the students encounter and may modify the course of the subject as needed. On the other hand, the student's role is central and pivotal in executing all plan elements and making necessary amendments if required.

The seventh two weeks (Project presentation Stage - Face to Face): Students apply the tools of the study. Students present project prototypes, document reports, and explain and discuss the objectives of their projects. At this stage, the student's achievements during the project presentation are evaluated, and the students assess the project using the following questions:

- To what extent did the project provide the opportunity to enhance our expertise by utilizing online resources, references, and books?
- To what extent did the project offer opportunities for training in creative thinking?
- To what extent did the project contribute to gaining new insights and directions in our field?

The Lesson Plans for the Control Group

The control group received traditional instruction such as taking notes, reading assignments, some exercises with secondary sources, and summative assessments for mastery of content.

Study Sample

The individuals of the study are students in the basic stage of the tenth grade at the Ashrafieh Secondary School in Jordan in the first semester of the academic year (2022/2023). The researcher randomly assigned students into two groups. The experimental group consisted of 26 students, and the control group consisted of 30 students. The school has been selected purposely due to the school's management and the teacher's collaboration with the researcher. The school has labs and provides computers and the internet for the staff and students. The same teacher teaches the two groups with a B.S. in Physics and seven years of teaching experience.

Equivalence of the Groups in the Study

Due to the difficulties of modifying some experimental parameters that impact the research outcomes, the researcher used the "TTCT" to engage in creative thinking to ensure the equality of the experimental and control study groups. The researcher conducted a *t*-test and processed the test findings to compare two sample means from the same population and determine if the two sample means were equal or not. The statistical results are as in Tables 6 and 7

Table 6

Means and Standard Deviations to compare two samples means equivalence

	Group 1 & 2	N	Mean	Std.
	1.00	26	11.2308	5.98202
Fluency	2.00	30	11.3000	5.73645
	Total	56	11.2679	5.79809
	1.00	26	13.4231	6.28123
Flexibility	2.00	30	12.9000	5.89184
	Total	56	13.1429	6.02549
	1.00	26	11.2308	5.98202
Fluency	2.00	30	11.3000	5.73645
	Total	56	11.2679	5.79809

Cont. Table 6

Means and Standard Deviations to compare two samples means equivalence

	Group 1 & 2	N	Mean	Std.
	1.00	26	11.2308	5.98202
Fluency	2.00	30	11.3000	5.73645
	Total	56	11.2679	5.79809
	1.00	26	13.4231	6.28123
Flexibility	2.00	30	12.9000	5.89184
	Total	56	13.1429	6.02549
	1.00	26	12.5769	7.18428
Elaboration	2.00	30	11.3667	6.23385
	Total	56	11.9286	6.65748
	1.00	26	9.1154	4.24572
Originality	2.00	30	8.8000	4.21328
	Total	56	8.9464	4.19272
Total	1.00	26	55.9615	27.48451
	2.00	30	53.6000	25.60792
	Total	56	54.6964	26.27818

Table 7

t-test for the comparability of the experimental and control groups in the pre-test average scores

Dependent Variable	t	df	Sig. (2-tailed)	Mean Difference
Fluency	-0.044	54	0.965	-0.06923
Flexibility	0.321	54	0.749	0.52308
Elaboration	0.675	54	0.502	1.21026
Originality	0.278	54	0.782	0.31538
Total	0.333	54	0.741	2.36154

The results in Table 7 show no significant difference in the two groups' performance on the creative thinking pre-test at the significance level of $\alpha = 0.05$. The t-test of creative thinking yielded a total value of $t(54) = 0.333$, $p > 0.05$, showing that the groups were equal.

Study Variables

First, the independent variable represents the (PjBL-BL) strategy and the regular learning strategy.

Second, the dependent variable is represented by “Creative Thinking” measured using “TTCT Figural Form B.”

Study design

Experimental group	Pre-Application (O1)	Experimental appl. (X)	Post-appl. (O2)
Control group	Pre-Application (O1)	Regular Appl. (-)	Post-appl. (O2)

- (O1) Pre-application of the measurement of creative thinking using “TTCT Figural Form B” at the end of the first semester.
- (X) Experimental Application (PjBL-BL Application).
- (O2) The measurement of creative thinking using “TTCT” at the end of the first semester.
- (-) Control Application (without project-based learning).

Results

The researcher calculated the means and standard deviations of the experimental and control groups to determine the effectiveness of project-based learning. The descriptive statistics for the “TTCT” data are presented in Table 8:

Table 8

Means and Standard Deviations of Score Differentials Post-measurement

Indicators	Group	N	M.	SD	SD error
Fluency	1.00	26	15.57	7. 5	1.46
	2.00	30	11.76	5.5	1.00
	Total	56	13.53	6.7	0.898
Flexibility	1.00	26	17.42	7.9	1.56
	2.00	30	12.60	5.7	1.05
	Total	56	14.83	7.2	0.969
Elaboration	1.00	26	14.42	7.1	1.40
	2.00	30	10.0	5.8	1.06
	Total	56	12.05	6.8	0.908
Originality	1.00	26	11.80	4.8	0.951
	2.00	30	8.23	4. 2	0.760
	Total	56	9.89	4.8	0.641
Total	1.00	26	71.15	31.5	6.19
	2.00	30	50.46	24.4	4.46
	Total	56	60.07	29.6	3.95

The results in Table 8 reveal that the overall mean performance of the experimental group, who used PjBL-BL on the test indicators of creative thinking, was M = 71.15 (SD = 31.586), which was higher than the mean performance of the control group, M = 50.46 (SD = 24.456). However, the mean scores alone did not indicate whether the performance differences were statistically significant. Table 9 presents the t-test results comparing the two groups' performance.

Table 9

Post-analysis results of the t-test for two groups on "TTCT"

Dependent Variable	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Partial Eta Squared
Fluency	2.188	54	0.033	3.81026	1.74173	0.081
Flexibility	2.608	54	0.012	4.82308	1.84904	0.112
Elaboration	2.545	54	0.014	4.42308	1.73815	0.107
Originality	2.967	54	0.004	3.57436	1.20460	0.140
Total	2.759	54	0.008	20.68718	7.49830	0.124

Table 9 shows a statistically significant effect due to the variable efficacy of utilizing PjBL-BL, with the value of t for Total Post Creative being t (54) = 2.759, $p < .05$, $\eta 2 = .124$. According to the results of this inquiry, PjBL-BL had a favorable influence on enhancing students' performance in creative thinking abilities such as fluency, flexibility, originality, and elaboration. The "TTCT" scores demonstrate the significance of this method and its relevance to the Physics topic.

The researcher attributed the study's positive results to the effect of blended learning, which attracted students' attention by providing multiple sources and media containing colors and images. This helped the students to organize their information and ideas skillfully, led to a sense of satisfaction and pleasure, increased their motivation, and enabled each student to attempt to achieve the best possible performance by self-reliance and intention. Blended learning, incorporating interactive online materials and project-based activities, can capture students' interest and engagement. Projects related to Physics topics can make learning more exciting and practical, encouraging students to think creatively in problem-solving and project design. Blended learning assignments also helped students keep learning and stay engaged outside class time. The experimental group showed a degree of self-responsibility towards learning, research and discovery, which increased their creativity. The ability of blended learning to provide multiple channels of collaborative communication for students to utilize helped them to understand concepts related to project design, including sharing and interacting with smarter classmates. Therefore, it can be concluded that blended learning provides diversification and integration in furnishing educational activities and academic content. Blended learning enhances face-to-face classroom instruction by fostering collaboration and extending cooperation beyond the classroom. Students work together to apply knowledge from lectures and textbooks, with the teacher serving as a facilitator. Blended learning widgets strengthen this collaborative aspect by enabling students and teachers to comment on and discuss drafts, both inside and outside the classroom (Yustina et al., 2020; Al-Mozan, 2018; Almualid, 2019). This process allows students to analyze feedback, refine their editing strategies, and collectively identify the strongest sections. All student comments are compiled into a single document, providing a comprehensive basis for discussion and analysis.

In a PjBL-BL Physics class on motion and force, the teacher noted that posting materials and activities on the platform helped maximize the effectiveness of the 50-minute class session she frequently teaches. Employing a blended learning strategy has proven to be a time- and effort-saving approach, offering significant benefits for project-based learning. Numerous studies highlight its advantages, including those by Bahtiar and Ibrahim (2022), Wahyudi et al. (2020), and Abueita (2013).

The PjBL-BL assessment tools help students learn more about their creative thinking abilities and their skills in using information technology and communication. The study found that when students learn in a blended way, using both online and face-to-face instruction, they can better develop their creativity, self-confidence and social skills.

The design of creative project activities in PjBL-BL includes listing objects that meet specific criteria, identifying similarities between distinct items, proposing alternative uses for common objects, and analyzing the potential consequences of hypothetical scenarios (Kithenham et al., 2015; Drugova et al., 2021). These activities help evaluate three key indicators of creative thinking: fluency (the number of responses generated), originality (the uniqueness of responses based on statistical frequency within the sample), and adaptability (Torrance, 1990). These strategies align with the constructivist theory proposed by Biggs (1996).

The researcher attributed the decrease in some indicators of creative thinking in the control group to the lack of utilization of technology and the tools provided by blended learning to improve students' imaginative abilities, particularly the flexibility aspect. Within the control group class, the students had to memorize a subject, do the task, and focus on theoretical knowledge. This limitation hindered their ability to visualize and reason, stifling the spark of creativity, particularly originality. It was challenging to make creative learning happen inside the control group class. Creative learning requires collaborative development and creativity on the part of the students and the capacity to work together creatively to create new thoughts, modern theories, unused items, and new information.

Moreover, when the teacher taught Physics content and applied blended learning to make students design the project, she associated teaching creative thinking skills with technology content while implementing PjBL-BL. She provided students with an incentive to think creatively.

The findings are in line with those of other empirical studies in relevant literature, such as Kilpatrick's (1951), which suggests that educators should foster an environment where students feel comfortable discussing their work with classmates and accepting the opinions of others to enable them to think and express their views democratically. The cognitive psychologists Ranco & Nemiro (1998) and Melvin (1999) identified the most essential variables of creative behavior education and experience, which give the individual the appropriate environment at home and school. They also stated that invention can be taught and developed through practice and instruction. PjBL-BL activities foster creative thinking by encouraging students to categorize objects, identify similarities, explore alternative uses, and analyze hypothetical scenarios. Creativity is assessed through fluency (idea generation), originality (uniqueness of responses), and adaptability (flexibility of thought).

The findings of this study are congruent with those of previous empirical studies, such as Bahtiar & Ibrahim's (2022) study, that students can perform all the creative thinking indicators in comprehending the background and problem-solving within blended learning. The study of Ali et al. (2019), as well as the studies of Al-Mozan (2018), Almualid (2019), Yustina et al., and Wahyudi et al. (2020) showed that social interactive verbal and non-verbal behaviors influenced learners' creativity.

In summary, blended learning is when students use the internet to learn new things, which helps them use different resources to understand things better. It is essential to pay attention to how students learn and what they learn about.

Conclusion

Based on the findings of this study, the researcher concluded that PjBL-BL has an active role in promoting and growing creative thinking, resulting in more unique and different thoughts that contribute to societal growth and development. The impact of students' creativity cannot be solely attributed to technology; as instructional learning also plays a role. However, adapting technology in a PjBL-BL approach can enhance students' creative skills, with the level of modification being a determining factor. Teachers can utilize technology efficiently in project-based learning to encourage and explore students' creativity. Educational practices with technology should focus on complex activities such as creating information and solving problems to develop students' competencies. PjBL-BL enables students to work on projects together using traditional and blended learning methods. The study found that students in project-based learning are more creative and enthusiastic than those in conventional education, indicating that project-based learning within blended learning can positively impact learning.

Recommendations and Suggestions

- Applying PjBL-BL, including it in the curriculum plans, and equipping schools with educational labs equipped with all the requirements for practical implementation.
- Considering employing the principles of theoretical constructivism in the creation of related educational courses due to their importance in enhancing students' teaching and learning processes.
- Considering revising the design of science learning courses and curriculum, particularly Physics, and introducing integration to build a wide range of scientific skills and mental capabilities.

- Conducting experimental studies to determine the impact of project-based learning in blended learning (PjBL-BL) allows students to apply Physics concepts practically in their projects, and enhances their understanding of the subject. The blended learning approach provides a platform for students to access multimedia content, simulations, and virtual laboratories, allowing them to apply theoretical Physics knowledge in simulation experiments.

Limitations

This study has several limitations that need to be acknowledged. Firstly, the study was conducted only at one school, limiting the generalizability of the findings to other schools with different facilities. Secondly, the study only involved tenth-grade students aged 15-16, so the results may not apply to other age groups. Thirdly, the two groups working separately but communicating with each other could ask the same teacher for help, which may have affected their performance. Fourthly, the data was collected during the first semester of the 2022/2023 academic year, and the findings might be outdated as the facilities could have changed since then. Finally, while the study tools used were determined to be valid and reliable, the psychometric characteristics may change over time, leading to potential inaccuracies in the results.

References

Abueita, J. (2013). Studying educational systems for blended learning: Towards the design of a proposed model. *Journal of Educational Sciences*, Cairo University, *21*(4), 515-534.

Al-Mozan, A. (2018). Cloud computing applications in project-based learning and their role in developing the knowledge and performance of instructional design skills for digital content and satisfaction with them among female university students. *North Journal of Humanities*, *6*(1), 85-142. https://search.mandumah.com/Record/1136358

Almualid, N. (2019). The effectiveness of project-based learning via the web in developing achievement and self-regulation skills in physics for secondary school students. *Arab Journal of Specific Education*, *3*(8), 37-68. DOI: 10.33850/EJEV.2019.42390.

Arantes, J., & Lino, R. (2018). Combining project-based learning and community-based research in a research methodology course the lessons learned. *International Journal of Instruction*, *11*(1), 47-60. https//doi.org/10.12973/iji.2018.1114a.

Auger, W. F., & Rich, S. J. (2007). *Curriculum theory and methods perspectives on learning and teaching.* Mississauga, Ontario. John Wiley & Sons. https://books.google.jo/books?id=0inEEAAAQBAJ.

Ayu, H.D., Saputro, S., Sarwanto, & Mulyani, S. (2023). Reshaping technology-based projects and their exploration of creativity. *Eurasia Journal of Mathematics, Science and Technology Education, 19*(1), em2217. https://doi.org/10.29333/ejmste/12814.

Badr, B. (2021). The effect of a proposed blended project-based learning program on developing the 4Cs skills for secondary stage students. *Journal of Education*, *2*(92), 50-107. DOI: 10.12816/EDUSOHAG.

Bahtiar, B., & Ibrahim, I. (2022). Using blended learning, the science literacy profile is based on students' creative thinking skills during the COVID-19 pandemic. *International Conference on Madrasah Reform 2021 (ICMR 2021),* 102-110. Atlantis Press. https://www.atlantis-press.com/proceedings/icmr-21.

Biggs, J. (1996). Enhancing teaching through constructive alignment. *High Education, 32,* 347–364. https://doi.org/10.1007/BF00138871

Borich, G. (2016). *Observation skills for effective teaching research-based practice, 7th ed*. Routledge. https://doi.org/10.4324/9781315633206

Drugova, E., Veledinskaya, S., & Zhuravleva, I. (2021). The role of instructional design in promoting digital Pedagogy. Review of the book: Beetham H., Sharpe R. (2020) Rethinking pedagogy for a digital age. *Voprosy Obrazovaniya, Educational Studies Moscow, 4,* 333-354. https://doi.org/10.17323/1814-9545-2021-4-333-354.

Edutopia. (2007). https//www.edutopia.org/project-based-learning-guide-importance. Retrieve 3/23/2022.

Ince, E. (2018). Overview of problem-solving studies in physics education. *Journal of Teaching and Learning*, *7*(4), 191-200. DOI:10.5539/jel.v7n4p191

Kilpatrick, W. (1951). *Philosophy of education*. The Macmillan Company. https://doi.org/10.1080/00131725109341440.

Kitchenham, B. A., Budgen, D., & Brereton, P. (2015). *Evidence-based software engineering and systematic reviews, 4*. CRC press.

Kurt, S. (2010). Technology use in elementary education in Turkey: A case study. *New Horizons in Education*, *58*(1), 65-76. https://josietippett.files.wordpress.com/2014/02/ej893713.pdf

Nunnally, J. (1994). *Psychometric theory* (3rd, ed.). McGraw-Hill.

Ranco, M., Nemiro, J., & Walberg, H. (1998). Personal explicit theories of creativity. *Journal of Creative Behavior*, *23*(1), 1-17. https://www.academia.edu/24262660

Saifaddin, H. (2017). Psychometric characteristics of the Torrance test for innovative. *Humanities and Social Sciences, 1*(5), 55-73. DOI: https://doi.org/10.26389/AJSRP.N220917

Solomon, G. (2003). Project-based learning: A primer. *Technology & Learning*, *23*(6), 20–26. @article {solomon2003project).

Suleiman, A., & Abu Hatab, F. (1973). *Torrance tests for creative thinking Instruction booklet.* Cairo Anglo Egyptian Library. https://www.anglo-egyptian.com/ar/index.php.

Tynjälä, P. (1999). Towards expert knowledge? a comparison between a constructivist and a traditional learning environment in the university. *International Journal of Educational Research, 31*(5), 357–442. https://doi.org/10.1016/S0883-0355(99)00012-9

Taylor, I. A., & Getzels, J. W. (Eds.). (2007). *Perspectives in creativity*. Aldine. https://doi.org/10.4324/9781315126265

UNESCO. (2015). *Towards a global common good? Rethinking Education.* United Nations Educational, Scientific and Cultural Organization. UNESCO Publishing. https://unevoc.unesco.org/e-forum/RethinkingEducation.pdf.

Talent and Excellence in the Arab World. (2022). Eighth Conference for Research, University of Jordan, 19-20/7/2022. https://rb.gy/yutkol

Torrance, E. (1990). *Torrance Tests of Creative Thinking: Directions Manual: Figural A and B,* Illinois: Scholastic Testing Service Inc. https://www.sciencedirect.com/topics/psychology/torrance-test

Wahyudi, W., Waluya, S.B., Suyitno, H., & Isnarto, I. (2020). The impact of 3CM model within blended learning to enhance students' creative thinking ability. *Journal of Technology and Science Education, 10*(1), 32-46. https//doi.org/10.3926/jotse.588

Yustina, Y., Syafii, W., & Vebrianto, R. (2020). The effects of blended learning and project-based learning on pre-service biology teachers' creative thinking through online learning in the Covid-19 Pandemic. *Journal Pendidikan IPA Indonesia*, *9*(3), 408–420. https//doi.org/10.15294/jpii.v9i3.24706

Zeitoun, A. (2013). *Methods of teaching science.* Dar Alshorouk. https://books.google.jo/books?id=X9vGvgEACAAJ

أثر التعلم القائم على المشاريع ضمن التعلم المدمج في التفكير الإبداعي لدى طلبة الصف العاشر

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المملكة الأردنية الهاشمية

الملخص

الأهداف: هدفت الدراسة الحالية إلى الكشف عن أثر التعلم القائم على المشاريع ضمن التعلم المدمج (PjBL-BL) في تنمية مهارات التفكير الإبداعي لدى طالبات الصف العاشر اللواتي يدرسن الفيزياء. **المنهجية:** واستخدم المنهج شبه التجريبي، وطبقت الدراسة على عينة تتكون من شعبتين، إحدهما يستخدم التعلم القائم على المشاريع ضمن التعلم المدمج PjBL-BL، والآخرى تستخدم طريقة التدريس التقليدية كمجموعة ضابطة. وقد طُبق اختبار تورانس للتفكير الإبداعي (النموذج ب) على المجموعتين لقياس الاختلافات في التفكير الإبداعي بين المجموعتين. **النتائج:** أظهرت نتائج الدراسة أن هناك فروقاً دالة إحصائيا في مستوى التفكير الإبداعي لصالح مجموعة التعلم القائم على المشاريع ضمن التعلم المدمج PjBL-BL، مع تأثير PjBL-BL الإيجابي على مهارات التفكير الإبداعي. وتشير هذه النتيجة إلى أن دمج التعلم القائم على المشاريع ضمن التعلم المدمج يمكن أن يعزز تعلم مفاهيم الفيزياء من خلال توفير فرص للتطبيق العملي. **الخلاصة:** تدعو الدراسة إلى مراجعة مناهج الفيزياء للمهارات العلمية المتنوعة، وتحث الدراسة كذلك على إجراء المزيد من البحوث في كيفية تطبيق التعلم القائم على المشاريع ضمن التعلم المدمج، لتعزيز فهم الطلبة لمفاهيم الفيزياء والتطبيق العملي للمعرفة النظري.

الكلمات المفتاحية: التعلم القائم على المشاريع، التعلم المدمج، التفكير الإبداعي، طلبة الصف العاشر.

أستاذ مشارك بقسم العلوم التربوية.

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