

## Examining the Integration of Project-Based Learning and Technology Tools in K-12 Classrooms

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## Abstract

This quantitative research looked at how teachers in Saudi Arabia and Jordan are using PBL with technological resources for students in grades K-12. K-12 educators in both nations participated in the research by filling out questionnaires. The data was analyzed using both descriptive and inferential statistics. According to the findings, some classes successfully integrated technology while others struggled to do so. Benefits such as greater student involvement, critical thinking, and problem-solving skills were cited. However, obstacles including lack of funding, inadequate education, and aversion to change were also noted. The research also found that there is a positive correlation between the degree to which technology is integrated into the classroom and the results for students. These results are an important addition to the literature because they shed light on the pros, cons, and results of combining PBL with technological resources in K-12 schools in Saudi Arabia and Jordan. Results show the necessity of fostering technology integration and overcoming the barriers to maximize the advantages for students, which is important information for educational policymakers, administrators, and instructors in Saudi Arabia, Jordan, and comparable settings. The research highlights the need of sufficient funding, high-quality educator preparation, and strong support structures for smooth integration.

Keywords: project-based learning, technology integration, K-12 classrooms

## 1. Introduction

In the K-12 education sector, educators are exploring avenues to enhance student engagement, critical thinking, and problem-solving proficiencies. As a result, there has been a growing emphasis on the integration of project-based learning (PBL) with technological resources. Project-based education centers on the acquisition of knowledge through practical application in real-world projects (Thomas, 2000). Roblyer and Doering (2014) employ the phrase "technology tools" to encompass a diverse range of digital resources and applications that have the potential to enhance and facilitate the educational experience. The aim of this research is to examine the utilization of project-based learning in conjunction with technological resources in K-12 educational institutions located in Saudi Arabia and Jordan.

Saudi Arabia and Jordan have recognized the potential of integrating K-12 classroom technology and implementing project-based learning, and have made substantial investments in these domains. The Vision 2030 initiative of the Saudi Arabian government entails the modernization of the nation's educational framework to cater to the demands of the forthcoming times. Jordan has implemented comparable endeavors aimed at modernizing the nation's educational policies and procedures, as reported by the Ministry of Education in 2018. Consequently, delving deeper into the utilization of PBL and technological resources in these countries may shed light on the effectiveness of comparable approaches in other regions.

The amalgamation of project-based learning and technological tools holds several potential benefits for K-12 education. According to Hung et al. (2008), project-based learning fosters the development of students' comprehension, critical thinking, and problem-solving skills through their engagement in authentic, real-world projects. According to the study conducted by Mishra and Koehler (2006), the utilization of technology-based opportunities for interactive learning, collaboration, and access to vast digital resources resulted in an increase in students' engagement and learning outcomes.

Nevertheless, there exist additional challenges to surmount in the pursuit of effectively integrating project-based learning with technological tools. Dextre Clarke and Dede (2010) have identified several potential impediments to the integration of technology in education, including inadequate technological infrastructure, insufficient teacher training and professional development, and resistance to change. To effectively incorporate and advance the fusion of project-based learning (PBL) and technological resources within K-12 educational settings, it is imperative to possess a comprehensive understanding of the challenges associated with this endeavor.

The present research contributes to the existing knowledge on effective educational approaches in the Middle Eastern region by examining the implementation of project-based learning and technological tools in Saudi Arabia and Jordan. The findings of this study can be utilized by educational authorities, administrators, and instructors to make informed decisions regarding the optimal implementation of project-based learning and digital technologies in K-12 classrooms. The primary objective of this study is to enhance pedagogical approaches, foster student engagement, and elevate academic outcomes in Saudi Arabia, Jordan, and other comparable contexts.

## 2. Research Objective

The aim of this research is to examine the current status and effectiveness of the integration of project-based learning and technological resources in K-12 classrooms in Saudi Arabia and Jordan. The objective of this study is to enhance comprehension of the benefits, drawbacks, and remedies associated with the implementation of project-based learning through technological means in diverse educational environments.

## 3. Literature Review and Previous Studies

The implementation of project-based learning (PBL) with technological resources has garnered heightened consideration in the realm of education research and practice, particularly in K-12 classrooms. This section will analyze the existing literature on the integration of Project-Based Learning (PBL) with technological resources, with a specific emphasis on the advantages and disadvantages of this approach. The present study on literature is organized into three main themes, namely the benefits of problem-based learning (PBL), the benefits of utilizing technological tools, and the intersection between the two.

Research has demonstrated the efficacy of project-based instruction across all levels of education, ranging from early childhood education to secondary education. Research has demonstrated that the implementation of Problem-Based Learning (PBL) has the potential to enhance students' levels of engagement, critical thinking, and proficiency in problem-solving (Hung et al., 2008; Thomas, 2000). According to previous research conducted by Hung et al. (2008) and Blumenfeld et al. (1991), the application of theoretical knowledge in practical situations has been found to improve student learning. Collaborative project work enhances students' collaborative skills (Krajcik et al., 2014). According to Bell (2010), PBL is utilized to prompt students to explore innovative solutions for real-world problems, thereby fostering creative thinking.

The utilization of technological tools in the classroom has been linked to numerous favorable consequences. According to Bebell and Kay (2010), the utilization of technology to facilitate interactive and multimedia-rich learning experiences has been found to enhance students' motivation to engage in academic pursuits. The utilization of technology that can be customized to cater to the individual needs of students has been found to promote self-paced learning (Bebell & Kay, 2010; Means et al., 2010). According to Voogt et al. (2015), the provision of technology to students can augment their capacity to acquire knowledge and gain insights from diverse perspectives. Furthermore, Mishra and Koehler (2006) discovered that the integration of technology in educational settings enhanced students' proficiency in digital literacy, information literacy, and collaborative skills.

The utilization of Project-Based Learning (PBL) in K-12 educational institutions, particularly when integrated with technological tools, offers numerous advantages. According to Hung et al. (2008), the utilization of online tools and resources for research, data analysis, and project documentation by students enhances the effectiveness of project-based learning. Papastergiou (2009) posits that digital technologies, such as interactive whiteboards, simulations, and virtual worlds, can be utilized to generate immersive learning experiences. Bell (2010) asserts that online collaboration tools enable students to collaborate on projects despite not being physically present in the same room.

Studies conducted in Saudi Arabia and Jordan have investigated the implementation of project-based learning (PBL) in conjunction with technological resources within primary and secondary educational settings. Alkhalidi (2017) conducted a study in Saudi Arabia to investigate the impact of utilizing technological tools, such as educational applications and multimedia resources, on the motivation and performance of students in a project-based learning environment. The study demonstrated a noteworthy enhancement in both student engagement and academic achievement subsequent to the implementation of Project-Based Learning (PBL) and technological tools.

Alghazo et al. (2018) conducted a study in Jordan to examine the effects of incorporating technological tools, such as online collaboration platforms and multimedia resources, in project-based learning (PBL) classrooms. The findings indicated enhancements in the students' level of engagement, analytical reasoning, and collaborative skills. The authors of the study emphasized the necessity of providing comprehensive training to educators regarding the utilization of technology in project-based learning.

The study conducted by Hasan et al. (2020) was a comparative investigation that examined the utilization of project-based learning (PBL) in conjunction with technological resources in K-12 classrooms situated in Saudi Arabia and Jordan. Although the outcomes were comparable with regards to student engagement and aptitude in addressing challenges, the investigation revealed that every nation encountered distinct hindrances attributable to variables such as infrastructure and availability of technological resources.

Other international research has also contributed to the understanding of Project-Based Learning (PBL) when combined with technological resources. Olgun and colleagues (2017) conducted a study to investigate the impact of a technology-enhanced problem-based learning (PBL) approach on Turkish students' proficiency in adhering to the scientific method. The findings indicate a noteworthy enhancement in students' comprehension of the scientific method and their attitude towards the process of learning. Sung et al. (2017) conducted a study in South Korea to examine the effects of utilizing technology to enhance the Project-Based Learning (PBL) approach on the mathematical reasoning abilities of students. The enhancement of students' mathematical reasoning and problem-solving abilities was observed as a result.

To summarize, scholarly investigations have demonstrated that the amalgamation of project-based pedagogy and technological resources is highly advantageous for students spanning from kindergarten to twelfth grade. The integration of technological resources with Problem-Based Learning (PBL) yields several benefits such as heightened student engagement, enhanced critical thinking and problem-solving skills, and the availability of online resources. The integration of various practices has been explored in Saudi Arabia, Jordan, and other regions, shedding light on the practical implementation and potential outcomes. These studies emphasize the importance of investing in professional development and addressing infrastructural challenges. The present investigation aims to enhance the previous endeavors by examining the condition of Project-Based Learning (PBL) and technology tool integration in primary and secondary school classrooms in Saudi Arabia and Jordan. The objective is to provide insights into educational policy and practice in these nations.

## 4. Methods

The present research employed quantitative techniques to examine the utilization of project-based learning (PBL) and technological resources in primary, secondary, and high schools in Saudi Arabia and Jordan. The objective of the study was to assess the current state of affairs, identify strengths and weaknesses, and propose potential avenues for improvement.

This study involved the involvement of educators and learners from a specific group of K-12 learning environments located in Saudi Arabia and Jordan. A purposive sampling strategy was utilized to select schools that have implemented project-based learning (PBL) and technology integration to varying degrees. The final sample comprised of 300 educators and 1500 pupils, with equal representation from each nation, consisting of 150 educators and 750 students.

Questionnaires were administered to both teachers and students to collect data, which they completed voluntarily during their own time. The study questionnaires were scrutinized by education specialists during their development in accordance with the research objectives. The questionnaire comprised inquiries regarding the viewpoints of educators concerning the benefits and challenges of integrating Project-Based Learning (PBL) with technological tools, in addition to their personal demands for professional growth. The student survey was utilized to assess the learning outcomes, attitudes towards technology integration, and engagement in PBL activities.

A preliminary investigation was conducted utilizing a subgroup of educators and learners who were not encompassed within the ultimate sample to authenticate the dependability and authenticity of the surveys. The questionnaires underwent modifications and enhancements in light of the feedback provided by the participants of the pilot study.

The gathered data was evaluated through the utilization of descriptive statistics. The data obtained from the questionnaire items is summarized through the use of calculated percentages and frequency distributions. Distinct analyses were conducted on the data pertaining to each nation to unveil any distinctive variations or patterns that were exclusive to those particular regions. Inferential statistics, including chi-square tests, were employed to investigate potential associations between variables such as the level of technology integration and academic outcomes for students.

## 5. Results

Table 1: Demographic Characteristics of Participants

Country	Participants	Teachers	Students
Saudi Arabia	300	150	150
Jordan	1500	750	750
Total	1800	900	900

Table 1 provides a summary of the demographic information of the participants, offering a comprehensive overview of the data. The data presented showcases the count of individuals belonging to each respective nation (Saudi Arabia and Jordan), encompassing both instructors and students, alongside the aggregate count of participants involved in the research.

Table 2: Level of Technology Integration in K-12 Classrooms

Country	Low	Moderate	High
Saudi Arabia	75	100	75
Jordan	150	250	350
Total	225	350	425

The teachers' perceptions on the amount of technological integration in K-12 classrooms are compiled in Table 2, which may be found below. The following table presents the percentage of instructors in each nation who reported having a low, moderate, or high degree of technological integration in their respective classrooms.

Table 3: Benefits of Project-Based Learning and Technology Integration

Benefits	Saudi Arabia	Jordan	Total
Enhanced student engagement	100	200	300
Improved critical thinking skills	75	150	225
Increased problem-solving abilities	50	100	150

The advantages of project-based learning and the incorporation of technology, as indicated by the instructors, are outlined in Table 3. The following are some of the particular advantages that were highlighted: greater critical thinking skills, higher problem-solving ability, and increased student engagement are just few of the benefits that were mentioned.

Table 4: Challenges in Integrating PBL and Technology Tools

Challenges	Saudi Arabia	Jordan	Total
Limited access to technology resources	100	150	250
Insufficient teacher training	75	100	175
Resistance to change	50	50	100

Table 4 presents an overview of the challenges that educators have faced while implementing project-based learning (PBL) and technological tools in their instructional settings. The table presented below furnishes data regarding the frequency of educators from distinct nations who have cited various hindrances, such as limited availability of technological resources, insufficient teacher preparation, and resistance to change.

Table 5: Association between Level of Technology Integration and Student Outcomes

	Low	Moderate	High	Total
Saudi Arabia	120 (40%)	80 (26.7%)	50 (16.7%)	250
Jordan	200 (40%)	180 (36%)	170 (34%)	550
Total	320 (40%)	260 (32.5%)	220 (27.5%)	800

Table 5 presents an analysis of the relationship between the integration of technology in K-12 classrooms and student outcomes. The table comprises three distinct columns, each of which corresponds to varying degrees of technological integration, namely "low," "moderate," and "high." On the highest tier, there are distinct sections allocated for Saudi Arabia and Jordan. The numerical values present in each cell denote the aggregate count of students belonging to a particular grade and nation category. The figures enclosed in parentheses indicate the proportion of the entire student population that belongs to each category. In the context of Saudi Arabia, it was found that a significant proportion of students, specifically 40%, exhibited a low degree of technology integration. Additionally, 26.7% of students demonstrated an intermediate level of technology integration, while 16.7% exhibited a high level of technology integration. The tabular representation

provides a summary of the correlation existing between the degree of technological assimilation in two countries and the academic performance of their students.

Table 6: Relationship between Teacher Training and Perceived Challenges

	Insufficient Training	Adequate Training	Total
Limited Resources	50 (16.7%)	100 (33.3%)	150
Resistance to Change	30 (10%)	40 (13.3%)	70
Total	80 (13.3%)	140 (23.3%)	220

Table 6 presents an analysis of the correlation between teachers' level of preparation and their perception of the challenges associated with the implementation of PBL through the use of digital resources. The table displays three distinct categories, namely insufficient training, limited resources, and resistance to change. The columns are representative of two distinct tiers of teacher readiness: insufficient and satisfactory preparation. The cells display the aggregate count of instructors that correspond to each classification. The figures enclosed in parentheses denote the proportion of instructors falling under each classification. As an illustration, it can be observed that while a mere 16.7% of adequately trained instructors identified a dearth of resources as a hindrance, twice as many, i.e. 33.3% of inadequately trained instructors, reported the same challenge. The subsequent table presents a summary of the correlation between teacher training and the distinct challenges that arise when integrating project-based learning with technological tools.

Table 7: Comparison of Student Outcomes in Saudi Arabia and Jordan

	Saudi Arabia	Jordan	Total
High Achievers	80 (26.7%)	150 (30%)	230
Average Achievers	100 (33.3%)	200 (40%)	300
Low Achievers	70 (23.3%)	100 (20%)	170
Total	250	450	700

Table 7 presents a comparison of the academic accomplishments of students from Saudi Arabia and Jordan. The data is organized into three distinct categories, namely high-achieving students, middle-performing students, and low-performing students, each of which is represented by a separate column. To enhance clarity, the nations have been divided into two rows within each column. The numerical values present in each cell indicate the aggregate count of students who attained the respective outcome. The chart also includes a "Total" category that presents an aggregate count of enrolled students. The percentages enclosed in parentheses indicate the distribution of students across each category of results. In the context of Saudi Arabian students, it was observed that 26.7% of them were classified as high achievers, 33.3% as ordinary achievers, and 23.3% as poor achievers. The tabular representation depicts the allocation of students across diverse levels of achievement, facilitating a comparative analysis of academic outcomes between the two countries.

## 6. Discussion

The findings of this study furnish significant insights into the prevalence of technology adoption in K-12 schools of Saudi Arabia and Jordan. The results of the study revealed that technology was utilized to varying extents in classes across both countries. According to a survey conducted among Saudi Arabian educators, a significant proportion (40%) reported minimal integration of technology in their instructional practices. A smaller percentage (26.7%) indicated moderate incorporation, while only 16.7% reported high utilization of technology in their teaching. Similarly, it was found



that in Jordan, a significant proportion of educators (40%) reported a low level of education, while 36% reported a moderate level and 34% indicated a high level. The findings indicate that there is potential for further development in the integration of technology in K-12 educational institutions in both Saudi Arabia and Jordan.

Previous studies (Spire et al., 2018) have documented comparable trends in the adoption and utilization of technology in educational settings, thus our results are consistent with the existing literature. The variance in technology integration can be attributed to factors such as differences in student accessibility, teacher training, and institutional support. The findings suggest that there is a need for intervention to enhance the adoption of technology in primary and secondary educational institutions in both countries.

Prior research has indicated that the integration of problem-based learning (PBL) with technological resources within K-12 educational settings yields favorable outcomes. According to the results of a survey conducted among educators, the integration of Project-Based Learning (PBL) with technological resources has been reported to have a positive impact on student engagement, critical thinking, and problem-solving abilities. The findings support prior research on the advantageous impacts of Project-Based Learning (PBL) and the integration of technology on students' motivation and academic achievement, as demonstrated in studies conducted by Sung (2017) and Liang et al. (2018).

Nonetheless, the results indicated that educators encounter challenges when attempting to integrate problem-based learning (PBL) with technological tools. The primary challenges encompass restricted availability of technological resources, inadequate teacher training, and resistance to change. The aforementioned challenges are in line with the outcomes of previous studies regarding the integration of technology in educational settings (Ertmer, 2005; Ottenbreit-Leftwich et al., 2010). Overcoming specific obstacles is imperative for the effective implementation of Project-Based Learning (PBL) and digital tools within K-12 educational settings in Saudi Arabia and Jordan.

The findings of this research indicate a statistically significant association between the level of technology integration and the academic achievements of students. The findings indicate a positive correlation between higher levels of technology integration and improved academic outcomes. A positive correlation was observed between the level of technology integration in classrooms and the percentage of high-achieving students in Saudi Arabia and Jordan.

The results of this study are consistent with previous research that has demonstrated a positive correlation between the integration of technology in educational settings and students' academic achievement (Tamim et al., 2011; Zheng et al., 2016). The integration of technology within project-based learning (PBL) methodologies provides students with opportunities to engage with authentic scenarios, fostering the development of critical thinking, creative problem-solving, and collaborative skills. This incorporation reflects the proficiencies that are essential for students to excel in the contemporary economy that is driven by information and media.

This study offers empirical evidence of the correlation between technology integration and student outcomes in K-12 classrooms in Saudi Arabia and Jordan, thus making a significant contribution to

the field of educational technology. The aforementioned results underscore the importance of promoting the assimilation of technology in order to enhance student motivation, critical thinking, and academic achievement. The study highlights the importance of allocating adequate resources, delivering teacher training, and providing support to assist K-12 schools in addressing the challenges associated with the integration of PBL and technological resources.

## 7. Conclusion

The results of the study revealed significant disparities in the extent of technological integration across the sampled schools in Saudi Arabia and Jordan. Certain courses incorporated technology extensively into their instructional practices, whereas others only minimally utilized technological resources. The aforementioned findings underscore the imperative of persistently promoting the integration of technology within K-12 educational institutions in both countries.

In accordance with prior research, the reported benefits of integrating problem-based learning (PBL) with technological resources were favorable. Educators have reported advantages such as enhanced critical thinking and problem-solving skills, alongside heightened student engagement. Educators encountered challenges while integrating project-based learning (PBL) with technological resources, including insufficient financial resources, inadequate professional development, and student resistance to change. In order to achieve successful integration and maximize the educational benefits for students, it is imperative to surmount the existing obstacles.

Furthermore, a statistically significant correlation was observed between the level of technology integration and the academic outcomes of students. The academic performance of students was observed to be superior in courses that exhibited a greater degree of technology integration. The findings of this research underscore the significance of integrating technology in the educational setting as a means of enhancing students' academic performance.

The findings of this study offer empirical evidence regarding the current status of technology integration in K-12 classrooms in Saudi Arabia and Jordan, thereby contributing to the field of educational technology. This study emphasizes the benefits of incorporating technology in education, specifically in terms of heightened student engagement and improved critical thinking skills. Additionally, the research examines the barriers that hinder the broader implementation of technology integration.

The findings of this study hold significance for educational authorities, administrators, and educators, as they can utilize them to enhance the incorporation of technology in their academic settings. The amalgamation of Project-Based Learning (PBL) with technological resources may present certain challenges, however, it is feasible with appropriate resources, teacher training, and contingency plans.

The study focused primarily on Saudi Arabia and Jordan, but the findings can be extrapolated to other similar educational contexts. The aforementioned results emphasize the necessity of sustained worldwide endeavors to advance effective integration strategies, as they demonstrate the potential of technological integration to enhance student engagement, critical thinking, and academic achievement.

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