



THE IMPACT OF ONE-TO-ONE TECHNOLOGY IMPLEMENTATION ON STUDENTS' ACADEMIC PERFORMANCE AND MOTIVATION: A COMPARATIVE ANALYSIS

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Abstract

One-to-one technology integration has revolutionized classroom dynamics, transitioning from traditional methods to digitally-driven approaches. Concurrently, game-based learning and real-time response systems have emerged as prominent tools for enhancing student motivation and learning while also influencing instructional and assessment procedures. This study examines the influence of one-to-one technology implementation on students' academic performance and motivation in Pakistani classrooms. The investigation focused on comparing two fifth-grade classrooms, one with traditional teaching methods and the other with one-to-one technology implementation to determine the effects on students' learning outcomes. The research was conducted in a Pakistani school as part of a technology pilot program funded by a local welfare organization. The study analyzed data from unit tests and game-based educational assessments to assess academic performance and motivation, respectively. The results indicated a significant impact of technology on students' academic performance and motivation. However, it was noted that these positive outcomes could not be solely attributed to technology usage. The study highlights the potential of technology to enhance the teaching-learning process when thoughtfully integrated into classroom practices as the successful integration of technology into educational settings can significantly enhance student engagement, academic performance, and overall eagerness for learning, yielding substantial benefits for schools. The implications of this study are crucial for the design of educational programs with one-to-one technology implementation and for faculty development plans to effectively promote the integration of technology within the classroom setting.

Keywords: *One-to-One Technology, Technology Integration, Game-based Learning, Kahoot!, Academic Performance, Motivation, Pakistani Classrooms, Technology Pilot Program, Student Learning Outcomes*

INTRODUCTION

In recent times, the integration of technology in education has witnessed a substantial rise, garnering the attention of educators and researchers. One-to-one technology implementation, exemplified by the adoption of Chromebooks, iPads and the use of shared Google Docs (Cook et al., 2017), has transformed classroom dynamics, moving away from traditional methods towards more digitally-driven approaches. Alongside this shift, game-based learning and real-time response systems have gained traction, playing a significant role in students' learning, instruction, and assessment processes (Qian & Clark, 2016). To support student learning, many educational institutions have taken proactive steps by providing low-cost personal computers or notebooks (Burns & Bozeman, 1981). The impact of technology extends beyond mere data analysis, as it serves to optimize the learning process for students in the various fields of education (Traynor, 2003). Moreover, technology has brought about a pedagogical evolution in special education settings, enabling students with various impairments to actively engage in learning through web-based teaching and interactive practices (Burdette, Greer, & Woods, 2013).

The advent of the Internet has furthered independent research opportunities for students, offering convenience, organization, and relevance in academic pursuits (Bouck, Okolo, & Courtad, 2007). With web-based technologies proving their efficacy across subjects like language, arts, and mathematical



problem-solving, technology holds the potential to positively influence academic motivation by empowering students and providing greater control over their education (Grisham & Wosley, 2006). However, it is essential to acknowledge that the mere use of technology may not be enough to foster academic motivation, as emphasized by Jacobs (2013). Instead, instructors should focus on integrating technology resources that connect students to a larger community or purpose, amplifying their academic motivation. Leong and Alexander (2013) highlight that students who perform below their peers tend to prioritize the use of technology tools for teaching and homework, valuing the fast feedback and instructional support it offers.

For technology to have a meaningful impact on academic motivation, it must be relevant and useful, especially for students with unique needs or requiring extra attention from teachers. Rowell and Hong's research (2013) demonstrates a close link between academic motivation and achievement. Highly motivated students not only perform better academically but also exhibit positive attitudes toward studying, enjoying the learning process. Conversely, a lack of motivation significantly contributes to underachievement, underscoring the importance of cultivating and sustaining students' motivation in the educational journey (Rowell & Hong, 2013). Timely and positive feedback on students' progress plays a pivotal role in encouraging them to take on more challenging tasks, ultimately leading to increased overall accomplishment (Akomolafe et al., 2013; Rowell & Hong, 2013). As we explore the impact of one-to-one technology implementation on students' academic performance and motivation, it is crucial to consider these interconnected factors to shape effective educational practices and enhance students' learning experiences.

LITERATURE REVIEW

Over the past decade, significant changes have occurred in classrooms, with a particular focus on providing instruction that caters to student comfort, interest, and learning effectiveness. To address this challenge, educators have developed unique approaches, leveraging technology due to its rapid growth in society. Technological integration and certain real-time game-based systems have opened new opportunities for learning and instruction (Qian & Clark, 2016). It offers a promising avenue to create more engaging, participatory, and productive teaching and learning experiences for both teachers and students (Dornish & Michele, 2013).

In an effort to cultivate an effective learning atmosphere for students, educational institutions are increasingly emphasizing the integration of technology in classrooms. The prevalence of smart devices, video games, and laptops has transformed students into technology learners. The educational landscape now includes digital tablets, smartphones, and laptops as part of one-to-one technology initiative, which is being adopted in classrooms across the world (Penuel, 2006). This shift towards technology integration extends beyond an enrichment class to a core aspect of the curriculum, as stated by Puckett (2013), "Technology integration has become an integral part of the learning experience in each core subject, rather than a standalone weekly session" (p. 6). Research indicates that the use of innovative pedagogical practices involving technology has transformed both instructors and students into competent participants in the learning process (Francis et al., 2010). Combining technology with the instruction has shown positive outcomes for educators' performance (Frye et al., 2010), underscoring the success of technology integration in revolutionizing education. Despite the optimistic outlook on technology integration, some research questions the actual impact of incorporating technology in educational settings. While instructors may perceive technology integration as beneficial for student achievement, this perception does not always translate into observable changes in their teaching practices or performance (Hsu et al., 2013). This discrepancy indicates that a single factor alone cannot account for why some instructors effectively use technology in their lessons while others do not.

The Effect of Technology Integration on Teaching Performance

The integration of technology in classroom instruction has become mandatory in many states across the world following the introduction of K12 Education package. This integration allows educators to complement traditional teaching methods with technology-based tools and services and to improve their teaching performance which is indicated by multiple studies (Adedokun-Shittu, & Shittu, 2014; Cook et al., 2017; Franklin, & Bolick, 2007; Keppler, 2012; Potter, & Rockinson-Szapkiw, 2012). A



relevant study was conducted by Hero (2019) to investigate how technology integration affects the teaching performance of instructors in community high schools under the Division of City Schools in Valenzuela City. The research included 100 social studies educators who participated in a survey combining descriptive and correlational analysis. The study found that instructors demonstrated a wide range of technology integration and received high ratings across all seven teaching performance parameters. Regression analysis revealed that using technology in the classroom had a positive impact on the quality of instruction, with productivity and professional practice being the most significant predictors among the six aspects of technology integration. Recognizing the potential of technology, the National Council for Social Studies encourages teachers to incorporate technology-enhanced activities that align with the curriculum and improve overall teaching performance. Consequently, an increasing number of teachers have immersed themselves in technology infusion to enhance their effectiveness as social studies educators. This integration of technology has played a pivotal role in significantly improving the productivity and performance of instructors within the classroom setting for improving students' learning outcomes (Keppler, 2012; Potter, & Rockinson-Szapkiw, 2012).

The Effect of One-to-One Technology Integration on Students' Academic Performance and Motivation

Many studies have claimed positive effects of one-to-one technology on students' academic performance and motivation (Ashraf, 2020; Beleckas, 2016; Cheung, & Slavin, 2013; Harris, & Al-Bataineh, 2015). With reference to this, a relevant quantitative study was conducted by Harris, & Al-Bataineh (2015) focusing on fourth-grade students attending a Title 1 primary school in Central Illinois. The study aimed to determine whether the implementation of one-to-one technology had any influence on students' academic success and motivation to learn. In this, data were collected through Pearson enVision Math Topic Tests, the results of the Discovery Education Assessment, and attendance records. The findings suggested that technology can indeed play a role in enhancing students' academic achievement and their desire to actively participate in the classroom. These results have significant implications in light of the ongoing technological revolution in educational institutions. Increased access to technology for students and enhanced opportunities for professional development among instructors can serve as catalysts for improved academic performance of students (Harris, & Al-Bataineh, 2015).

Game-based Learning and Kahoot

In recent times, the concept of integrating game-based learning to enhance students' motivation and engagement has garnered significant interest among researchers and educators. The wealth of studies supporting the beneficial impact of games on the learning process has spurred a rising number of researchers to dedicate their efforts to creating educational games that can effectively improve students' academic performance within school settings (Qian & Clark, 2016). In the field of education, gamification techniques are utilized to incorporate game mechanics into academic settings, aiming to enhance motivation and, consequently, the overall teaching-learning experience (De-Marcos et al., 2017; Muntean, 2011). Icard (2014) highlighted the effectiveness of game-based learning as a valuable approach to actively involve students in reviewing class content. Encouraging critical thinking, problem solving, and active engagement among students is crucial for optimizing their learning experiences (Icard, 2014). Recognizing that students possess diverse learning styles and capacities, educators are compelled to adapt their instructional methods to cater to individual learning needs. As technology continues to play an increasing role in classrooms, educators must explore the potential benefits of incorporating various resources into their teaching practices. However, finding suitable and captivating learning games that effectively engage students can be a daunting task (Chien-Hung et al., 2014; Dellos, 2015). To address this challenge, technology innovators have endeavored to blend academic content with enjoyable elements. Icard (2014) emphasized the importance of creating competitive learning experiences that entice students, making them more receptive to the educational value of games. Furthermore, digital games, such as Kahoot!, offer opportunities for students to develop essential skills like handling success, coping with failure, and honing critical thinking and problem-solving abilities (Icard, 2014). Educators can effectively engage students by integrating Kahoot! into their instructional practices for introducing



new content or revisiting previous material. Moreover, the platform allows data collection, which can be analyzed in Excel to assess students' comprehension and progress (Thomas, 2014). The versatility of Kahoot! extends to its application in various assessment formats and projects, including formative assessments, diagnostic assessments, benchmark assessments, research projects, and presentations (Thomas, 2014).

STATEMENT OF THE PROBLEM

With the increasing technological sophistication, educational authorities and administrators all over the world are seeking ways to utilize technology in classrooms to provide more engaging and effective teaching learning strategies. In the contemporary landscape of education, there has been a notable shift towards modernization with considerable integration of technology as an all-time whole school approach. Nevertheless, it is worth noting that traditional educational environments and traditional teaching approaches continue to hold significant prominence, and certain educational initiatives, such as one-to-one technology, have not gained widespread recognition within Pakistan (Bilwani, & Zehra, 2016; Salam, Jianqiu, Pathan, & Lei, 2017). Several factors contribute to this lack of acceptance for technology integration, including challenges related to time management, alternative assessment methods, and limited availability of resources and training.

Another important aspect is the relatively recent emergence of the concept of one-to-one technology within Pakistani schools which accentuates the challenges faced in this context. Moreover, it is pertinent to underscore the considerable lack of research in this particular domain, specifically concerning the population of Pakistani schools, particularly those under public or locally funded school systems. This lack of available and retrievable studies further compounds the complexity of the situation at hand. In the Pakistani context, significant strides have been made in addressing external obstacles to technology integration within pre-service teacher education and private school systems. Despite this progress, a noticeable technology divide still remains. It is evident that some teachers' current classroom practices for incorporating technology do not align well with their teaching styles, leading to a gap in their technological and pedagogical expertise (Gulab, Javaid & Khokhar, 2017; Ruggiero & Mong, 2015). In light of this, addressing these gaps would be crucial for fostering positive developments in the country's educational system.

PURPOSE OF THE STUDY

The study aimed to contribute valuable insights that can shape the future direction of one-to-one technology integration and its potential to improve students' academic performance and motivation in educational contexts. Essentially, the objective of the research was to explore the impact of technology integration on students' academic outcomes and motivational levels, comparing the two different classroom settings: one with traditional teaching methods and the other with one-to-one technology implementation. The study aimed to investigate whether there are significant differences in student achievement and motivation when technology is utilized, as evidenced by the unit test scores and participation records in specific game-based educational assessments.

RESEARCH QUESTION

The research question that guided the study was:

RQ: What is the impact of one-to-one technology usage on students' academic performance and motivation in a comparative analysis between the Traditional Classroom and the Implementation Classroom, specifically concerning differences in students' performance as measured through unit tests and game-based educational assessments, respectively?

METHOD AND PROCEDURE

Instrumentation

This study investigated the impact of one-to-one technology implementation on the academic performance and motivation of participants in a locally funded school. One-to-one technology implementation involved providing each student in a classroom, school, or school district with a laptop, computer, or digital mobile device to be used as a learning tool under the student's control. The main objective of this quantitative research was to determine whether technology contributed to improved academic performance and motivation among students by assessing the mean scores of



unit tests from the enVision Math series, participation records of students in game-based educational assessments conducted through Kahoot! Math games.

To enhance the investigation of this phenomenon, the study replicated certain research procedures from the study of Harris & Al-Bataineh's (2015), considering that the use of one-to-one technology was relatively new for educators and researchers in this context. The participants in the study were fifth-grade students attending a school in Pakistan. For measuring motivation levels, the study primarily used students' participation records in Math assessments which was administered four times a year, as well as end-of-unit assessments in arithmetic, aiming to identify any significant differences in student performance. The study took place during Periods 1 and 2 of the school day at the participating institution. The research aimed to establish an alignment between educational assessment, student participation, and the positive impact of technology on academic performance and motivation. Since the study utilized Pearson Math's series, an approved material for public schools for the unit tests which served as summative examinations to measure the students' comprehension of a unit that they needed to achieve, the research served as a predictive benchmark using four examinations spread throughout the academic year with a gap of approximately seven to ten weeks between each examination. The objective of these predictive benchmark exams was to estimate how well students would perform in subsequent high-stakes examinations.

Rationale for using Unit Tests and Kahoot!

Unit tests, commonly known as benchmark assessments, play a vital role in the educational assessment process. Their primary purpose is to evaluate students' comprehension of the fundamental concepts and subject matter taught in a curricular unit. Far from being limited to aiding educators in adapting their teaching techniques to cater to individual learning needs, benchmark assessments also empower students to evaluate their own progress and recognize areas that require improvement. Furthermore, instructors benefit from valuable feedback provided by these tests, allowing them to make prompt adjustments to their teaching strategies and course material (Herman, Osmundson, & Dietel, 2010). In the present study, typically conducted after the initial teaching period and intermittently, these unit tests served as a benchmark to measure students' grasp of essential knowledge and pinpoint areas where they might require additional assistance. Ultimately, these unit tests played a pivotal role in nurturing academic growth and achievement of students under investigation.

Kahoot! presents itself as a promising digital game to foster students' engagement and motivation in a fun and challenging learning environment within classrooms (Dellos, 2015). Moreover, Kahoot! also serves as an interactive student response system for understanding Math problems and formulae, engaging learners through interactive Math quizzes, discussions, and surveys, all designed in a game-like format (Byrne, 2013; Dellos, 2015; Kahoot!, 2014; Thomas, 2014). One of the reasons for using Kahoot! in this study was its being a game-based real-time response system that offers customized assessments. The process of creating quizzes, discussions, or classroom assessments was straightforward and consistent across multiple options, with the quiz setup serving as an illustrative example.

Participants

The study involved 40 fifth-grade students from two sections (n=20+20) of a locally funded school named Ideal Public School in District Khoshab, Punjab province, Pakistan. The initiative was additionally funded by a local welfare organization named SVDP¹. Among the participants, 20 students belonged to Section-A of fifth grade, the classroom that implemented technology, while the remaining 20 students were in Section-B of fifth grade, the traditional classroom.

RESULTS

The principal aim of this investigation was to examine the correlation between the utilization of technology and students' academic performance and motivation. To achieve this objective, we collected and analyzed relevant data, which was subsequently presented in tables and figures. The analysis focused on evaluating the effects of one-to-one technology implementation on students' academic performance and motivation. To measure academic performance, we assessed the students' scores on unit tests in both traditional and implementation classrooms. Additionally, we gauged the

motivational aspect of the study by utilizing students' participation records in digital game-based Math assessments.

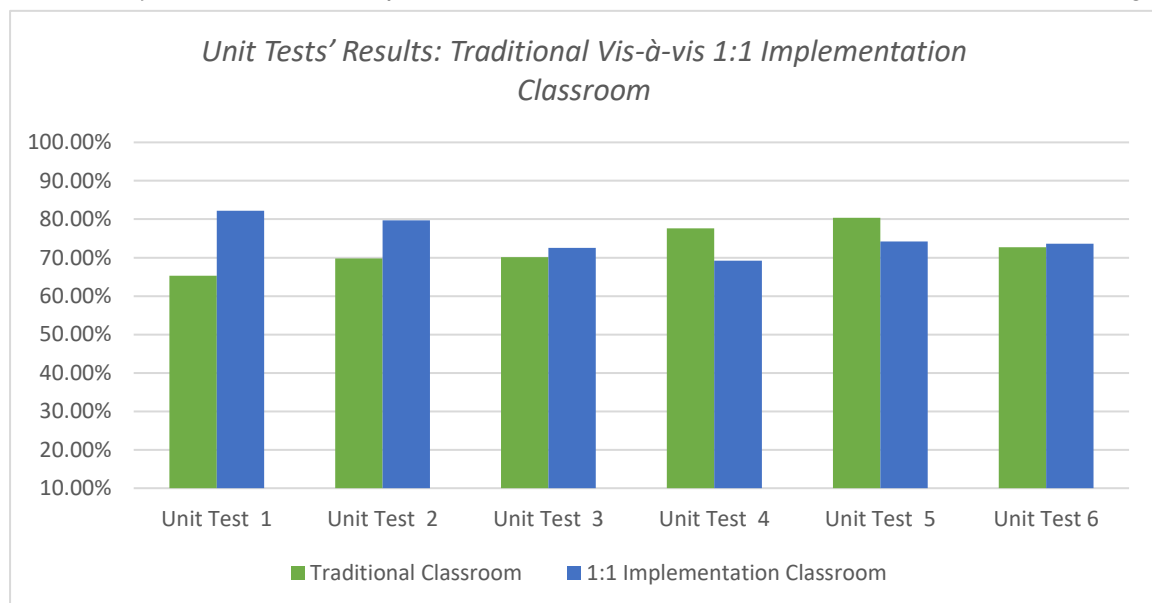
It is crucial to emphasize that the students in both the traditional and implementation classrooms were presented with the same Math items drawn from their curriculum. The key distinction lay in the manner in which these items were addressed: students in the traditional classroom were required to solve the items using traditional pen-and-paper methods, while their counterparts in the implementation classroom employed the Kahoot!, a digital game-based platform.

Table 1 *Comparison of Unit Tests' Results between Traditional and 1:1 Implementation Classroom*

Test Name	Traditional Classroom	1:1 Implementation Classroom
Unit Test 1	65.33%	82.22%
Unit Test 2	69.82%	79.68%
Unit Test 3	70.16%	72.54%
Unit Test 4	77.62%	69.19%
Unit Test 5	80.34%	74.24%
Unit Test 6	72.72%	73.66%

Table 1 presents a comparison of the percentage of results in unit tests conducted in classrooms with and without technology implementation. As depicted in Table 1, there was a noticeable difference between the scores achieved on the unit tests in the Traditional Classroom and those obtained in the Implementation Classroom. This variance was attributed to the different teaching methods used in the two classrooms.

On Unit Test 1, 2, 3, and 6, the scores obtained in the Implementation Classroom were higher than those achieved in the Traditional Classroom. However, on Unit Tests 4 and 5, the scores obtained in the Traditional Classroom were notably higher than those obtained in the Implementation Classroom. Figure 1 visually illustrates the comparison of Unit Tests scores between the two classroom settings:



Traditional Classroom and 1:1 (One-to-one Technology) Implementation Classroom.

Figure 1. *Comparison of Unit Tests' Results between Traditional and 1:1 Implementation Classroom*

Table 1 *Comparison of Math Assessments' Results between Traditional and 1:1 Implementation Classroom*

Math Assessment	Traditional Classroom	1:1 Implementation Classroom
A	60.55%	58.45%
B	66.52%	71.45%

C	69.78%	76.24%
D	77.7%	84.88%

Moving on to student motivation, Table 2 presents a comparison of percentage of students' performance on Math Assessments in classrooms with and without technology implementation. It shows that students in the Implementation Classroom scored better on Assessment B, C, and D compared to students in the Traditional Classroom. However, for Assessment A, the students in the Traditional Classroom obtained higher scores than those in the Implementation Classroom. Figure 2 also demonstrates the comparison of students' scores on Math Assessments between the two classroom settings.

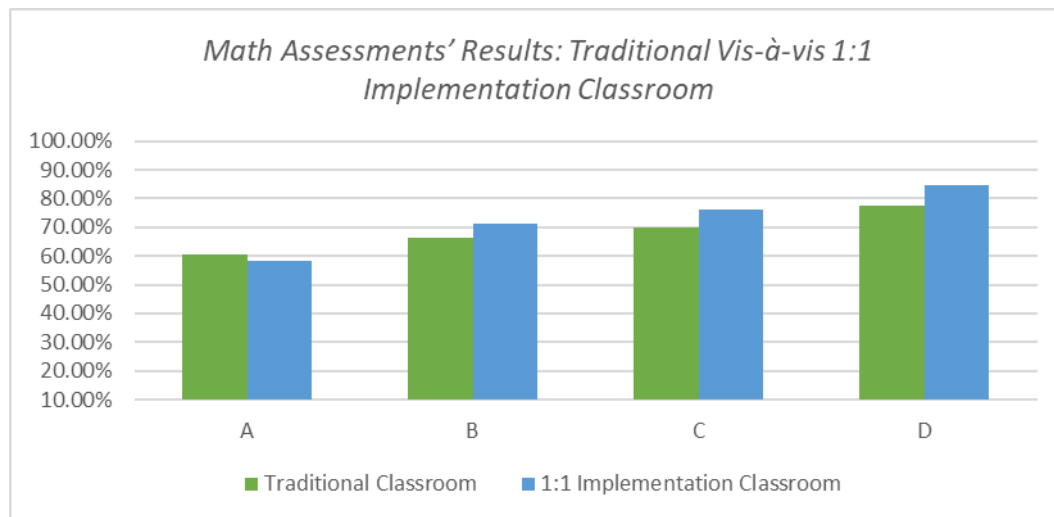


Figure 2. Comparison of Math Assessments' Results between Traditional and 1:1 Implementation Classroom

DISCUSSION

The discussion has revolved around the implementation of technology in education, specifically the introduction of laptops or digital mobile devices to students, commonly known as One-One Technology Implementation. The study aimed to investigate the impact of this one-to-one technology implementation on students' learning outcomes in the classrooms where both teachers and students were relatively new to the technology being used, as they were part of a technology pilot program funded by SVDP and carried out in a local school.

The main objective was to explore the influence of one-to-one technology on students' academic performance. The research findings indicate a significant impact of technology on students' academic performance and motivation, suggesting that the use of technology can indeed enhance the teaching-learning process. The study's analysis revealed improvements in unit test scores as well as positive trends in students' participation in classroom Math Assessments (A, B, C, D). However, it is essential to note that these positive outcomes cannot be solely attributed to technology usage. While certain instances, particularly in Assessments B, C, and D, suggest a positive correlation between technology integration and better academic outcomes, the overall data challenges the notion that technology inevitably leads to better academic performance and motivation. Other factors may also have contributed to the observed improvements, and a more nuanced examination of the role of technology in the classroom environment would be necessary to establish a clearer cause-and-effect relationship.

In terms of game-based assessments, Kahoot!'s key advantages in this study was that students could access pre-made or impromptu quizzes without needing an individual account, simply by using a web browser on devices like Android devices, or Chromebooks which were provided to them by the

researchers and SVDP. Conversely, teachers were required to create an account to generate quizzes on Kahoot!. Nevertheless, the quick and effortless accessibility of Kahoot! proved beneficial for both students and educators during this investigation.

CONCLUSION AND IMPLICATIONS

The integration of technology into educational settings has emerged as a crucial factor influencing students' academic outcomes and motivational levels. Moreover, the research findings shed light on the profound implications that technology adoption has on the overall instructional process. The implications of the present study are of considerable importance for the design of educational programs, workshops, faculty development plans, and knowledge action cell sessions. These initiatives aim to effectively promote the integration of technology within the classroom settings. In addition, an imperative consideration in the utilization of one-to-one computer technology is to ensure that students gain first-hand experience with such tools, comprehending their full educational potential. In this regard, educators should actively partake in ongoing professional development initiatives to optimize their teaching skills, particularly with respect to the effective integration of technology. Nonetheless, it is crucial to acknowledge that technology employed for student learning cannot simply replace traditional teaching methods, given the swift adoption of technology across educational institutions. While technology can indeed offer advantages, it does not invariably simplify the role of instructors. Therefore, educators must continually evolve as learners, discerning the most effective educational approaches and selecting appropriate technological tools that align with the specific needs of their students and classrooms. The selection of programs, materials, and projects must be judiciously tailored to engage students and nurture their enthusiasm for learning. The successful implementation of such strategies will significantly enhance student motivation, academic performance, and overall eagerness for learning, thereby yielding substantial benefits for schools.

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¹Disclosure

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