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Efficiency of Digital Technology Use in Schools

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Abstract

Digital technologies in education are increasingly garnering much interest. Teachers and instructors play a fundamental role in ensuring that student-centered learning is the highlight of the application of digital technologies. The research focuses on the efficiency of digital technology in schools, with teachers as a mediating factor. Through the Technological Pedagogical and Content Knowledge (TPACK) framework, teachers' competence and engagement play a critical role in technology application and digital technologies' overall efficiency. In the study, we will conduct a quantitative research on the efficiency of digital technology use in schools.

Keywords: Digital Technology, Teachers, Education, Technology Application, Efficiency

Efficiency of Digital Technology Use in Schools

Introduction

Teachers employ digital technologies in storing, transmitting, creating, processing, displaying, and exchanging information digitally. Teachers use digital technology for student learning and interaction purposes (Spiteri & Rundgren, 2018). Teachers also use it to communicate with students through e-mails, create lessons through PowerPoint presentations, and manage the classroom in Canvas. As institutions adopt technological interventions, instructors must demonstrate integrated knowledge and competency in content, teaching, and technology under the TPACK model.

Teachers and instructors are on the ground level when it comes to ensuring that student-centered learning is effective using digital technologies. An effective application of digital technologies entails enhanced student interactions, managing students and classes, and promoting equitable digital technology access and uses among students. Therefore, it is vital to review whether the behaviors of teachers and instructors meet the TPACK framework and yield efficiency (Wetzel & Marshall, 2011). Applying the TPACK framework is critical in translating theory into practice and determining digital technology's efficacy. Student engagement, equitable access to technology, or other indicators evidence the efficiency of digital technologies. The goal is to conduct a systematic review to understand if teachers demonstrated any of the three or combinations of the several components of TPACK in digital technology and if any of those methodologies were efficient.

Research Question

What is the efficiency of teachers' use of digital technology in schools?

Literature Review

The Efficiency of Digital Technologies

Haleem et al. (2022) note that digital technology has transformed education and is effective in facilitating learning. Digital education has created a paradigm shift within the educational industry by making student life easier, applying learning software and tools, and increasing research interest. Digital technologies make it simple for instructors to teach and collaborate. Digital technology improves teaching productivity through advanced technological aids, quick assessments, better planning, more resources, and practical learning. Speteri and Rundgren (2020) affirm that effective digital technology in school focuses on student-centered learning.

Digital technologies are effective in enhancing student interaction during distance learning. Nkomo et al. (2021) note that digital technologies effectively create student engagement that supports distance learning and teaching. Digital technologies create spaces where students can interact, engage, and learn. Digital technologies such as videos, social media, and interactive and collaborative learning technologies effectively improve student interaction. Technological advancement in education creates online libraries where teachers, students, and researchers can interact, thus replacing the physical space. Ultimately, these online libraries are effective as they provide a solution to assessment methods, curriculum evaluation, specialties on topics, and teaching pedagogy. Girlando and Eduljee (2016), in a 64-undergraduate-student survey, determined that students were satisfied with using digital technologies. Students using several digital technologies for learning, such as videoconferencing, iPads, screen sharing, and Canvas, determined that educational technologies were effective. The students noted that digital technologies allowed proper time management, more interesting and enhanced learning, new

study strategies, and new forms of instructor feedback. They did not view the technologies as a distraction. Dias and Victor (2022) found that using digital technologies often distracts students in classrooms. Dias and Victor (2022) noted that students get distracted through texting, emailing, social media, surfing the internet, and gaming.

TPACK and Instructors Competence

Teachers' knowledge and attitudes are major influencers of their behavior and orientation towards the application of technology. Teachers need different knowledge and competencies to incorporate technology into student learning activities (Zhang & Chen, 2021). The TPACK framework provides seven knowledge competencies for teachers to incorporate technology in student instruction. TPACK frameworks seek to untangle the interwoven nature of technology and skills and understand how they might benefit digital learning. TPACK affects how teachers behave and their intentions with technological integration in the real world. Harris and Hofer (2016) note that TPACK is a critical theory in explaining teachers' engagement with technology and the flourishing of student outcomes. Harris and Hofer (2016) note that TPACK is important in conceptualizing applied knowledge and shaping teachers' and university leaders' beliefs in technological tool development. Pamuk (2011) notes that teachers must embody the principles of TPACK to achieve technological efficiency in the classroom. According to Pamuk (2011), teachers must develop competencies in pedagogical content knowledge when integrating technology into their student learning. The article insists that teachers must become competent in pedagogy content knowledge before considering incorporating technology in the classroom. Maor (2017) states that applying TPACK in designing assessments, courses, and learning activities increase student confidence.

Digital technologies are effective in education as they gauge teachers' and instructors' competence. Caena and Redecker (2019) highlight that digital technologies align teachers' competencies to empower learners. Through the lens of the European Framework for the Digital Competence of Educators, digital technologies can improve teachers' competencies at three levels. First, Speteri and Rundgren (2020) note that student achievement depends on the instructor's competence. Instructors need to be competent through training and following guidelines; failure to develop appropriate expertise in digital technologies might result in students' inability to cope with technology. The factors influencing a teacher's competence are the instructor's skills, attitudes, and knowledge, as well as the institution's culture. First, the teacher's skills reflect their acquaintance with evolving technologies, computer proficiency, and promotion of inquiry learning among students (Speteri & Rundgren, 2020). Second, the teacher demonstrates proficiency in developing and enforcing curriculum, tracking student performance and assessment, and learner centers objectives. Third, using digital technologies among teachers becomes effective with the teacher's attitudes, including innovation, motivations, self-efficacy, perceptions, and abilities (Speteri & Rundgren, 2020). The school culture comes into play through the institution's establishment of collaborative learning in the digital space, leadership, infrastructural development, and an open learning environment.

Theoretical Framework: Technological Pedagogical Content Knowledge Framework

Digital technology has gained fame in recent years in its involvement in students' education in the classroom and outside class. It has enhanced collaboration among peers and increased understanding of course concepts. Therefore, institutions and teachers must strive to adopt some form of technological innovation in the classroom for its immense benefits (Schmidt et al., 2009). The TPACK framework encompasses technological, content, and pedagogical knowledge as the theory that could provide direction for educational technology adoption in class. The basis of the TPACK framework is understanding how content and pedagogical knowledge influence what's being taught and how the instructor delivers the content as a foundation for educational technology.

The TPACK is a powerful theory as it has these complex interacting constituents encompassing the transactional relationship among content, dynamics, incoming technology, and pedagogy. The TPACK framework has several components: Technology knowledge deals with understanding the several technologies applied in education, such as interactive whiteboards, the internet, and others. Content knowledge entails a deeper understanding of the subject matter, or content, taught and involves teachers' knowledge of what they teach (Graham, 2011). Finally, pedagogical knowledge implies understanding methods, processes, and teaching systems, including lesson plan management, class management, and assessments.

The TPACK framework entails designing and evaluating the instructor's capacity and efficiency toward applying digital technology. TPACK seeks to provide a framework for teachers to incorporate digital technologies in classrooms to teach students and develop the knowledge that could be used in students' education. Joo et al. (2018) note that teachers' applications of the TPACK framework positively impact the perceived ease of using technology

among teachers and the usefulness of technology use during learning. TPACK enables teachers to master content knowledge, thus mastering the methods and process of digital learning. Zhang et al. (2021) note that teachers' TPACK is influenced by the ability to use technology in online instruction and evaluative attitudes. The teacher's evaluative attitudes positively impact technology use in the classroom. On the other hand, affective attitudes didn't have an impact on technology use, and therefore, it's critical to develop a new dyadic angle on technology use attitudes. Brinkley-Etzkorn (2018) notes that the TPACK model provides a useful conceptual framework for training teachers how to teach online. Developing competencies in teaching instructors play a significant role in improving the efficiency of digital literacy. According to Joo et al. (2018), teachers who employed the TPACK theory in technology developed more self-efficacy and increased their ability to use and see the usefulness of technology in teaching. In retrospect, teachers who follow the TPACK framework in teaching strategies have developed much more competencies in technology use, thus increasing its efficacy.

Hypothesis

H_0: There is no efficacy in using digital technologies in schools.

H_1: There is efficiency in using digital technology in schools.

Research Methodology and Analysis Report

Study Design

The purpose of this study is to find out the efficiency of teachers' use of digital technology in schools. The null hypothesis of the study is that there is no efficiency in using digital technologies in schools and the alternative hypothesis of the study is that there is efficiency in using digital technologies in schools. The primary data of this study will be collected through a survey and the secondary data of this study will be obtained after receiving approval from the institution.

In this project, we shall conduct a survey of university students from the Singapore Institute of Management (SIM). We have chosen this school as it offers a wide range of courses that use digital technology in their lessons. We will be conducting a survey on students enrolled in the following courses: Introduction to management, Macroeconomics, Business information systems, Business statistics. These data will be collected at the end of the semester which lasts for about 6 months. The survey will be done on Qualtrics and an email with the link to the survey will be sent to the students enrolled in the four specific courses at the end of each semester. The list of survey questions is included in the appendix. For the research data, we are going to the SIM student service to get the data for our statistics sample of the students' test scores without their personal information.

Population and Sample

The students from the Singapore Institute of Management make up the population of the study. The main selection criteria is the course of study of the student. The course of study chosen includes Introduction to Management, Macroeconomics, Business Information Systems

and Business Statistics. These courses were chosen as we feel that it would make a good comparison of the efficiency of using digital technologies in classrooms. Introduction to Management and Macroeconomics courses does not require heavy usage of digital technology as compared to Business Information Systems and Business Statistics courses which require heavy usage of digital technologies. The sampling method used will be stratified random sampling and each stratum represents a specific course that each student is enrolled into. The survey will be sent to the students taking these specific courses for four consecutive semesters via email. The sample size is expected to be 100 for each semester and there will be a total of 400 responses collected at the end of the duration.

Variables and Measures

The main focus of this study is to identify whether the use of digital technologies is efficient in schools. Thus, the key independent variable is if there is the use of digital technology in the course of study. The measurement of this variable will be dependent on the course of study. If the student is enrolled into Introduction to Management or Macroeconomics, the answer to the key independent variable will be no. If the student is enrolled into Business Information Systems or Business Statistics, the answer to the key independent variable will be yes.

The control variables include instructor performance, course material and structure, student engagement, and hours spent studying the course. For the measure of the control variables, we will be using a Likert scale for the survey answers. The Likert scale consists of a 5-point scale, ranging from one extreme attitude to another. The answers for the Likert scale will be “strongly agree”, “agree”, “neutral”, “disagree” and “strongly disagree”. The control variables will be measured in the form of a survey. The question that measures instructor performance will be “The instructor is effective in delivering content in the classroom.” The question that

measures course material and structure will be “I am able to search for the course materials using digital technology” and “I am satisfied with the structure of the course.” The question that measures student engagement will be “I feel engaged with the lesson when digital technology is being used in the classroom.” The question that measures hours spent studying for the course will be “How many hours do you spend studying this course weekly?” and the answer selection for this question will be “Less than 1 hour”, “2 to 4 hours”, “5 to 7 hours”, “8 to 9 hours” and “More than 10 hours”. The dependent variable is the student’s test scores for the respective course of study. The measurement of this variable is the student’s test scores.

Data Collection Methods

For the primary data, it will be issued and collected through a Qualtrics survey which will be done by students who have completed Introduction to Management, Macroeconomics, Business Information Systems and Business Statistics courses upon the approval from the Singapore Institute of Management.

For the secondary data, it will be obtained from the Singapore Institute of Management upon request. This secondary data will include the list of the student’s test scores for the four specific courses. The data will also include the course material and structure. The data provided by the institute will allow us to cross-reference with the survey responses, to ensure that the students that responded to the survey are trustable and accurate. This data is also reliable as it is obtained from the institute itself, and it is the same institute where we will be conducting our survey.

Data Analysis Methods

We will compare the results of courses that do not require a heavy usage of digital technology and courses that require a heavy usage of digital technology against the student's test scores using a t-test. By using a t-test, we could establish the significance of any differences between courses that do not require a heavy usage of digital technology and courses that require a heavy usage of digital technology using the p-value.

We will also compare the dependent variable and independent factors using a regression analysis. By using regression analysis, we can find out whether independent variables have an impact on the dependent variable. The r-square value also shows us how well the data fit the regression model.

We will also be using the multiple linear regression equation:

$$Y= \beta 0 + \beta 1X1 + \beta 2X2 + \beta 3X3 + \beta 4X4 + \varepsilon$$

where Y is the student's test scores for the respective course of study, β is the constant, ε is the error term from residuals, X1 is the instructor performance, X2 is the course material and structure, X3 is the student engagement and X4 is the hours spent per week on studying the course.

Conclusion

The study's findings will show whether there is a significant difference in efficiency when digital technology is being used in schools. The primary data will be collected through a Qualtrics survey, while the secondary data will be collected from the institution itself. The findings will also show if there is a correlation between the use of digital technology in schools and the test scores of the students. The data analysis methods used in this study will be the t-test, regression analysis and regression linear equation.

The limitation of this study is that there are no other schools involved in the study besides SIM. Another limitation of this study is that the students might not reveal their actual test score in the survey because they might want to keep it private. Students who scored below passing grade might also be unwilling to share their actual test scores in the survey.

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Appendix

Qualtrics survey questions

1. What is your age?

2. What is your course of study?

3. Which academic year are you from?

4. The instructor is effective in delivering content in the classroom.

5. I am able to search for the course materials using digital technology.

6. I am satisfied with the structure of the course.

7. I feel engaged with the lesson when digital technology is being used in the classroom.

8. How many hours do you spend studying this course weekly?

9. I am satisfied with the use of digital technology in the classroom.

10. What is your test score for this course?