

Evaluating the Impact of TikTok on Formal Learning Among Students: A Cross-Sectional and Data-Driven Analysis of Knowledge Retention and Behavioral Change

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Abstract—This research investigates the potential of TikTok as a learning aid among students. By analyzing knowledge retention and behavioral change, we assess whether TikTok's educational content contributes to formal learning. The study employs quantitative methods to measure the platform's impact, offering insights into social media's role in educational settings.

I. INTRODUCTION

1.1 Background

Amidst various educational landscapes, TikTok has emerged as a focal point, commanding considerable attention from students, particularly those within some specific demographics. Distinguished by its succinct, visually captivating content, TikTok possesses the innate ability to captivate the imaginations of young learners and offer innovative avenues for educational exploration. There are many reasons why TikTok has become popular. TikTok has become a go-to platform for users to express their creativity, connect with others, and consume entertaining and informative content. Keengwe, Onchwari, and Wachira(2014) investigated the effectiveness of mobile apps for knowledge acquisition and skill development among users. The research examined the broader use of social media platforms as educational tools. Other Studies have explored how platforms like Facebook, Twitter, and YouTube can be integrated into classroom settings to facilitate communication, collaboration, and engagement among students (Junco, 2012). Scholars have also examined the integration of digital tools such as YouTube, a platform akin to TikTok in terms of video content, into formal learning. Scholars have also researched how educational content on these digital platforms can enhance students' understanding of various subjects, offering an early indication of the impact of short-form video platforms on education (, 2007).

1.2 This Contribution

This paper contributes to existing research by providing empirical data on the efficacy of TikTok as a learning aid. Through a cross-sectional analysis, it offers a data-driven perspective on how TikTok usage correlates with knowledge retention and behavioral change among students. The study not only explores the platform's role in disseminating knowledge through its unique algorithmic approach to content delivery but also examines the potential for TikTok to be strategically integrated into formal educational settings. The findings of this research are poised to inform educators and policymakers by delineating evidence-based benefits and considerations for incorporating TikTok into educational curricula, thereby highlighting its potential to innovate pedagogy and learner engagement.

1.3 Related work

A study by Jacobs, Pan, and Ho(2022) evaluated the effects of TikTok as a learning tool on learner performance in an introductory statistics course. The results of a carefully conducted experiment suggest that TikTok positively influenced both the learners' performance and their perceived user engagement. The study highlights the potential of social media platforms such as TikTok to enhance learning outcomes, which given the popularity of social media among students, emphasizes that social media can be used effectively for learning purposes.

A comprehensive review that encompasses a thorough exploration of TikTok's potential impact on higher education was done by Horton, Ross, and Sharma(2021). The authors shed light on how TikTok, a widely used social media platform, can serve as a potent instrument for enhancing teaching and learning in higher education environments. The authors delve into the myriad ways educators can harness TikTok's capabilities, highlighting both its advantages and the challenges it presents within the academic sphere. Their insights offer valuable guidance to educators and institutions seeking to leverage TikTok

effectively.

Furthermore, in another account, Wiggins(2021) shares his journey and reflections on incorporating TikTok into the realm of teaching and learning. His narrative provides a detailed examination of his experiences, creatively elucidating the methods employed, the benefits reaped, and the limitations encountered when integrating TikTok into educational practices. This author's firsthand account presents a unique perspective on TikTok's potential in academia, viewed through the lens of an educator.

In the realm of medical education, a focused study has been done that explores TikTok's application as a platform for disseminating complex medical knowledge. The research rigorously investigates how TikTok can be employed to effectively convey intricate medical information to both students and the broader public. The authors meticulously analyze the advantages and potential challenges inherent in harnessing TikTok as a dynamic learning resource within the field of medicine (Ashra-McGrath, Srivastava, and Yadav, 2021a).

Another research done in medical education is the study conducted by Ashra-McGrath, Srivastava, and Yadav(2021) in the realm of medical education thoroughly explores TikTok's application as a platform for disseminating complex medical knowledge. The research rigorously investigates how TikTok can effectively convey intricate medical information to both students and the broader public. The authors meticulously analyze the advantages and potential challenges inherent in harnessing TikTok as a dynamic learning resource within the field of medicine. Their findings provide valuable insights into the possibilities of employing TikTok as a resource for medical education. It also underscores the opportunities and factors to consider when using TikTok as a platform for sharing medical knowledge (Ashra-McGrath, Srivastava, and Yadav, 2021b).

Also, Small and Chen(2020) wrote a research paper that delves into TikTok's evolving role as an "edutainment" tool, seamlessly blending elements of education and entertainment. It conducts a comprehensive examination of the diverse possibilities TikTok offers for creatively engaging and educating audiences (Small and Chen, 2020), critically assessing the potential pitfalls and challenges entailed in integrating TikTok into educational settings. Their insights provide valuable guidance to educators and researchers navigating the dynamic landscape of TikTok-based education.

1.4 Methodology

This research employs a multi-pronged approach to data collection and analysis. The methodology starts with a cross-sectional survey providing a comprehensive view of user behavior and retention.

The data collected through surveys will be analyzed using descriptive statistics, cross-tabulations, and other techniques to explore relationships between variables. This analysis will be integrated with insights gleaned from the data analysis tools, yielding a richer understanding of user behavior.

1.5 Research Hypothesis

1.5.1

Table 1—Hypothesis Proposal.

Hypothesis	Statements
Hypothesis 1 (H1)	The use of TikTok as an educational tool positively impacts K-12 students' knowledge retention and behavioral change.
Hypothesis 2 (H2)	Understanding TikTok addiction can help in the design and development of future Educational Technology tools
Hypothesis 3 (H3)	Various factors such as content type, duration, and interaction level influence the effectiveness of TikTok as an educational platform.

1.6 Research Design

The proposed research was executed using the following structure.

1.6.1 Study Type

The study type is cross-sectional.

1.7 Data Collection Methods

Surveys were conducted. Structured surveys for various TikTok users. The use of the survey was to gather quantitative data regarding TikTok usage, its integration into formal learning, and its perceived impact on knowledge retention and behavioral change. Content Analysis was also done to analyze educational TikTok content for content type, engagement metrics, and user interactions to understand the diversity of educational content on TikTok.

1.8 Survey Source

To ensure diverse representation, participants were randomly selected from various demographic groups. While participants of any age were welcome, the survey was designed for individuals aged 10 and older.

1.9 Data Analysis

The survey data acquired from the cross-sectional surveys underwent a thorough analysis process to address the research questions comprehensively. The analysis entailed a multifaceted approach that incorporated various statistical and data exploration techniques to extract meaningful insights from the collected data.

To commence, descriptive statistics were employed to provide a fundamental overview of the data. These statistics, encompassing measures of central tendency (e.g., mean, median, mode) and measures of dispersion (e.g., standard deviation, range), facilitated the summarization and comprehension of the central characteristics of the variables under investigation. This foundational step allowed for a clear understanding of the key features of the data and the identification of any initial trends or patterns.

Furthermore, cross-tabulations were utilized to delve deeper into the relationships between variables. Cross-tabulations, also known as contingency tables or cross-tabs, enabled the assessment of the association or dependency between two or more categorical variables. By cross-referencing these variables, insights were gleaned regarding any statistically significant relationships or dependencies that could shed light on the research questions. These analyses were pivotal in uncovering patterns, disparities, or correlations that might not have been immediately evident through descriptive statistics alone.

Advanced Machine Learning with the use of OPENAI tests was applied with appropriate and pertinent prompts.

Ultimately, this multifaceted approach to data analysis played a pivotal role in not only addressing the research questions but also in revealing nuanced insights and patterns within the survey data. The rigorous application of these techniques ensured that the findings were robust, reliable, and capable of making valuable contributions to the broader field of study, offering a deeper understanding of the relationships and trends among the variables examined.

Table 2—Data Analysis Tools.

Tests	Importance of Test
Measure of Central Tendency (CT)	A basis for hypothesis testing. Grants key insight and identifies trends and patterns of datasets.
Correlation Coefficient (CC)	Provide valuable insights into the relationships between different variables. This can help you understand how various aspects of TikTok content and user engagement relate to each other and potentially impact learning outcomes.
T-Test (TT)	Used to compare the means of two groups (e.g., educational vs. non-educational content) to determine if they are significantly different. Essential for understanding the impact of different types of content. Mann-Whitney U Test
Mann-Whitney U test(MWU)	comparing two independent groups, useful when data are not normally distributed.
Skew and Combined Skew Test (ST)	Provides insights into typical user behavior on TikTok and guides the choice of appropriate statistical tests.
Machine Learning (ML)	Predictive models can forecast trends or user behavior based on collected data, which be of tremendous benefit in understanding statistical data

1.10 Variables

Responses given by survey recipients were classified into variables. Shown below are examples:

- **Independent Variables:** What kind of TikTok do you watch? Do you use TikTok app for educational content? Do you have up to three favorite educational TikTok creators or channels? How often do you come across educational content on TikTok? Have you ever used TikTok to create your own educational videos? How long do you spend on a video content before you scroll?
- **Dependent Variables:** How have you used TikTok to prepare for tests or assignments? Has TikTok helped you to develop any new skills? Do you think that TikTok is a reliable source of educational information? Do you think that TikTok has helped you to improve your learning? Have you ever shared educational TikTok videos with your classmates or teachers? TikTok is a helpful resource for learning.

These variables have been categorized as dependent variables, as they signify the outcomes or perceptions that stem from students' utilization of TikTok. These resultant outcomes are intricately linked to the manner in which students engage with TikTok, which underscores their dependence on the independent variables present in Group A.

To effectively address our research inquiry, a methodological approach has been adopted involving the pairing of one variable from Group A with a corresponding variable from Group B, followed by an analysis of their collective skewness. This combined skewness analysis offers valuable insights into the relationship between distinct facets of TikTok usage and specific educational outcomes or perceptions. For instance, an examination is conducted to discern if the nature of TikTok content consumed (Group A) exhibits a skewness correlation with the perception of TikTok as a trustworthy source of educational information (Group B).

Through the exploration of these relationships, a deeper comprehension of how TikTok usage influences educational outcomes and perceptions is attained, in alignment with the overarching research objective.

1.11 The Result

1.11.1 Measure of Central Tendency

The analysis of the dataset shows various distribution patterns among its variables. To be specific, eight columns display left-skewed distributions, one displays a right-skewed pattern, and twelve adhere to a normal distribution. These observations elucidate the presence of outliers within the dataset. Consequently, there is a need to address this issue by standardizing and normalizing the data to mitigate potential biases effectively. As part of this data preprocessing procedure, transformations are applied to normalize the data, and Standard Deviation and Variance are computed both before and after the transformation for thorough assessment.

Table 3—Measure of Central Tendency sample.

Recipient	Skewness	Action
Sample 5 (S5)	left	transform
Sample 10 (S10)	right	transform
Sample 12 (H1)	normal	none

1.11.2 Skewness Analysis

While relying on measures of central tendency can be a helpful initial step in identifying and addressing skewness, it is also essential to employ tools that gauge the departure of datasets from symmetry. In the case of the available variables, conducting a thorough assessment after dataset transformation is prudent and serves as a crucial follow-up procedure. In the context of your available variables, after performing dataset transformations to mitigate skewness, it is advisable to conduct a symmetry check. This involves analyzing the distribution's shape, assessing skewness and kurtosis values, and visualizing the data through histograms or density plots.

1.11.3 Regression Analysis and Correlation Coefficient

correlation coefficients was used to measure the strength and direction of the relationship between two variables or choices made by respondents. A value range of -1 indicates a strong negative relationship, +1 indicates a strong positive relationship, and 0 suggests no relationship between the variables or choices.

The magnitude of the correlation coefficient indicates the strength of the relationship. A value close to -1 or +1 indicates a stronger relationship, while a value between 0.5 and 0.8 suggests a moderate relationship. Values below 0.5 indicate a weak or no relationship. Regression analysis was also done to complement correlation coefficients by providing more detailed insights into the relationship between variables. All possible combinations of the 20 responses were explored.

Column_Pair	Correlation	Slope	Intercept	R_value	P_value	Stderr
Columns 1 & 2	0.001827265	0.0014797	1.7198458	0.0018273	0.979617	0.0578415
Columns 1 & 3	-0.094118131	-0.055825	1.7361223	-0.094118	0.1872013	0.0421786
Columns 1 & 4	0.019754833	0.0138553	1.7100708	0.0197548	0.7823621	0.0500874
Columns 1 & 5	0.022066961	0.0157385	0.3535109	0.022067	0.7576401	0.0509316
Columns 1 & 6	-0.036202342	-0.030266	0.2304278	-0.036202	0.612609	0.0596775

Regression and Correlation

Figure 1— Regression and Correlation. Sample Selection. All possible combinations of responses were explored.

1.11.4 Using OpenAI

The insights derived from the use of the OpenAI model were utilized in conjunction with traditional methods to provide a more comprehensive understanding of the datasets, with a particular focus on qualitative depth. Various revised prompts were fed into the API of the various agents, 'CHATGPT-3.5-Turbo' and 'CHAT-GPT4'.

1.12 Limitations

The data collected from the cross-sectional survey may not provide definitive proof of the causal impact of TikTok on formal learning. Although the survey can examine the connection between TikTok use and knowledge retention or behavior change, it cannot establish a direct cause-and-effect relationship. To establish causality, additional research approaches like longitudinal studies or experimental designs are necessary. Additionally, there is a possibility of bias in the data due to the survey's qualitative nature and the potential impact of using simplified binary or numerical scales, which may affect the authenticity and true representation of the data.

1.13 Conclusion

All 190 possible pairs of the survey responses represented as columns show negative correlations, suggesting that as one column's values increase, the other column's values tend to decrease. The slopes are also negative, reinforcing this inverse relationship. The P-values for all pairs are below 0.05, indicating that the relationships are statistically significant. The standard errors provide a measure of the precision of the estimated slope; lower values indicate more precise estimates.

Table 4— Correlation and Regression Analysis of Sample Column Pairs.

Column Pair	Analysis Results
Columns 7 & 17	Correlation: -0.2194, Slope: -0.0851, Intercept: 0.3017, R-value: -0.2194, P-value: 0.0019, Stderr: 0.0270.
Columns 3 & 17	Correlation: -0.2101, Slope: -0.1001, Intercept: 0.2657, R-value: -0.2101, P-value: 0.0030, Stderr: 0.0333.
Columns 8 & 18	Correlation: -0.1901, Slope: -0.1538, Intercept: 2.3019, R-value: -0.1901, P-value: 0.0073, Stderr: 0.0568.

Based on the analysis results, there are no column pairs in the dataset that have a very strong relationship, as defined by a correlation coefficient greater than 0.7 or less than -0.7. All pairs appear to have weaker correlations. Taking a random sample of 3 unique column pairs, 8 and 18, 3 and 17, 7 and 17 which are respondents to the survey questions.

TikTok usage does not have a significant linear impact on formal learning outcomes, as measured by the variables in the dataset from the cross-sectional survey and as such cannot be used to measure knowledge retention and behavioral change among its users.

Some explanations might be considered as to why the result of the research is so:

- **Limited Survey Scope:** The dataset does not include variables related to TikTok usage such as time spent and engagement levels and formal learning metrics like test scores and attendance rates as correlation analysis aims to determine if there is a linear relationship between these variables. The absence of strong correlations suggests that, within the dataset, TikTok usage doesn't have a strong linear impact on formal learning metrics, at least not in a directly measurable way.
- **Limited Data Analysis Scope:** Correlation specifically looks for linear relationships. If the impact of TikTok on learning is complex or non-linear, it might not be captured by the method utilized.

1.13.1 Future work

- **Longitudinal Studies:** Conducting longitudinal studies that track students' TikTok usage, learning outcomes, and behavior change over an extended period would provide a more comprehensive understanding of the long-term impact. This would help capture temporal dynamics and assess changes in learning outcomes over time.
- **Experimental Designs:** Implementing experimental designs, such as randomized controlled trials, can help establish a causal relationship between TikTok use and formal learning outcomes. By randomly assigning participants to control and experimental groups, researchers can directly assess the impact of TikTok on learning while controlling for confounding variables.

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