# Exploring the Effectiveness of Bite-Sized Learning for Statistics via TikTok

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**Abstract:** A course about business statistics is essential in the curriculum of business degree programs.  Statistics is traditionally a challenging course that may be met with trepidation by many students. A pedagogical approach known as bite-sized learning has gained popularity to alleviate the difficulties associated with comprehending complex concepts. This approach delivers content in manageable increments, reducing cognitive burdens on students. In tandem, instructors can leverage social media platforms to deliver bite-sized content, making the learning process more engaging and accessible. Among these platforms, TikTok, a widely popular social media platform, resonates with students for familiarity and engagement, making it an ideal tool for delivering educational content. This research sought to investigate the effectiveness of implementing bite-sized learning strategies via TikTok within a business statistics course. The study divided students into treatment and control groups, administering pre-tests and post-tests. The treatment group, receiving TikTok supplemental material, demonstrated significantly higher scores than the control group, suggesting the efficacy of bite-sized lessons through

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TikTok in improving student performance. Moreover, the flexibility of using short-form videos as a supplemental tool makes them an effective resource for both in-class environments, and online or distance learning environments in which students can engage with the material at their own pace.

*Keywords:* TikTok, social media, statistics, Microsoft Excel

# Explorer l'efficacité de l'apprentissage en micro-modules pour les statistiques via TikTok

**Résumé:** Un cours de statistiques appliquées aux affaires est essentiel dans le curriculum des programmes d'études en gestion. Cependant, les statistiques sont traditionnellement un cours difficile qui peut susciter de l'appréhension chez de nombreux étudiants. Une approche pédagogique connue sous le nom d'apprentissage en micro-modules (*bite-sized learning*) a gagné en popularité pour réduire les difficultés associées à la compréhension de concepts complexes. Cette méthode propose des contenus en petites unités faciles à assimiler, diminuant ainsi la charge cognitive des étudiants. Parallèlement, les enseignants peuvent utiliser des plateformes de médias sociaux pour diffuser ces contenus en micro-modules, rendant ainsi le processus d'apprentissage plus engageant et accessible. Parmi ces plateformes, TikTok, très utilisés par les étudiants, s'avère être un outil idéal pour transmettre des contenus éducatifs et favoriser l'engagement des étudiants. Cette recherche a cherché à évaluer l'efficacité de l'utilisation de stratégies d'apprentissage en micro-modules via TikTok dans un cours de statistiques appliquées aux affaires. L'étude a divisé les étudiants en deux groupes : un groupe témoin et un groupe expérimental auxquels ont été administré des prétests et des posttests. Le groupe expérimental, ayant reçu des contenus complémentaires de cours via TikTok, a obtenu des scores significativement plus élevés que le groupe témoin. Cela suggère que les leçons en micro-modules via TikTok améliorent les performances des étudiants. En outre, la flexibilité qu'offrent de corutes vidéos en tant qu'outil complémentaire en fait une ressource efficace, que ce soit dans un environnement de classe traditionnel, dans un contexte d'apprentissage en ligne ou à distance, où les étudiants peuvent interagir avec le contenu à leur propre rythme.

*Mots-clés:* TikTok, médias sociaux, statistiques, Microsoft Excel

## Introduction

The technological advancements and the widespread use of social media have fostered a new seamless learning culture and environment. Previously, learning experiences such as in-class and out-of-class, academic and non-academic, curricular and co-curricular, on-campus and off-campus were separate. In contrast, seamless learning seeks to actively engage students in acquiring, expanding, and applying knowledge by interactively creating a continuous learning experience across different scenarios or contexts (Kuh, 1996; Moon et al., 2024). Seamless learning leads to a comprehensive and cohesive understanding amongst learners by connecting experiences across various settings (Casebourne, 2024).

According to Statista (2022a, 2022b), the North American social network penetration rate is 73.9 per cent as of January 2023, with 302.25 million users in the United States in 2022. The rapid increase in social media use has influenced various aspects of people's lives, including learning. Greenhow and Lewin (2015) suggest that in a mobile-triggered learning culture, students use these devices to bridge formal and informal learning in order to consume educational material. According to Freberg and Kim (2018), students use social media mainly to connect with peers, collaborate on coursework, and occasionally communicate with their instructors. Mobile devices and social media platforms offer students access to learning materials, resources, and course content while interacting with their peers and instructors, eliminating the demarcation between formal and informal learning (Greenhow & Lewin, 2015; Olagbaju & Popoola, 2020). The

widespread availability of interactive multimedia-based educational materials, bolstered by modern mobile technologies, has led to a greater emphasis on their use to decrease cognitive loads. Studies have been measuring the effects of learning outcomes based on static versus dynamic learning resources (Heo & Toomey, 2020). According to Ke and Hsu (2015) and Wu et al (2012), there is new empirical evidence demonstrating the effectiveness of mobile learning in facilitating students' learning within higher education environments.

Research on statistical education has long shown that attending statistics classes makes students anxious (Sowey, 2020; Verhoeven, 2006). For students, learning the concepts of probability and statistics could be highly challenging (Garfield & Ben-Zvi, 2007). Many instructors of introductory statistics courses find it challenging to motivate and engage students (Jonsdottir et al., 2021). Calls for modification of the statistics curriculum to incorporate technology and real data while promoting active learning have been made as solutions to this problem (Carver et al., 2016). Ridgway (2016) recommended that statistics teachers should concentrate on technologies that are suitable for the demands of modern data processing. Statistical software such as SPSS, Stata, and JMP have been utilized to help students analyze and comprehend data (Basturk, 2005; Stephens et al., 2014; Jatnika, 2015). However, Mairing (2020) argues that these statistical software programs do not necessarily help students develop a deep understanding of statistical formulas and suggests that Microsoft Excel might be utilized to close this knowledge gap.

Statistical software packages are only a few clicks away from test results, unlike Microsoft Excel, which can be used to demonstrate a step-by-step process. Chaamwe & Shumba (2016) argue that Microsoft Excel can provide technology aspects without erasing the meaning, while also being simpler and quicker than conventional pen and calculator methods. Furthermore, many students have experience with Microsoft Excel, one of the most widely used and accessible spreadsheet programs, even though they may not have necessarily used Microsoft Excel for statistical analysis. The intuitive user interface of Microsoft Excel is a lot less intimidating than professional statistical software. Therefore, anxiety associated with learning a new discipline such as statistics based on Microsoft Excel may be lessened by prior expertise with the program.

This research aims to provide a novel viewpoint surrounding TikTok as one of the most penetrative short-form video platforms. Specifically, it seeks to investigate whether bite-sized learning could be coupled with the platform's unrivalled capacity to capture and maintain the attention of students of the internet-savvy generation, thereby facilitating more effective learning among this demographic. The study explores how bite-sized content delivered through TikTok facilitates learning and suggests the platform could be harnessed to design and implement pedagogical strategies in an educational context. This exploration is particularly pertinent given the deep integration of personal mobile devices and the need for adaptive strategies that resonate with contemporary learners.

# Literature Review

In this literature review, the key findings of existing research on cognitive learning theories, segmentation and bite-sized learning, multimedia learning, and mobile learning will be explored.

## Cognitive Learning

While cognitivism aims to investigate the intricate processes of the human mind, cognitive research focuses on understanding mental activities in the process of learning; in other words, how we learn and process information. Cognitive learning is an important aspect of education and has been widely studied in the fields of psychology, education, and cognitive science (Gkintoni & Dimakos, 2022; Nunez et al., 2019; Mahoney, 1977). Cognitive learning theories are based on the idea that the mind is a complex information-processing system that takes in, organizes, and stores information in the form of mental representations and proposes that learning occurs as a result of the internal mental processes of acquiring, storing, and using knowledge (Anderson et al., 1997; Greeno et al., 1996). Cognitive learning views learning as an active process and includes activities such as memory, attention, concept development, and information processing to form new knowledge or build on existing knowledge (Good & Brophy, 1990; Caffarella & Merriam 1999; Simon, 2001). Therefore, the cognitive approach to learning emphasizes creating meaningful experiences and linking new information to existing knowledge. Effective instruction is built around a student's prior mental framework or schemas (Ertmer & Newby, 1993).

A cognitive approach was used in this research in order to investigate human mental processes. Research in cognition centres on understanding mental activities, such as learning and information processing, throughout the learning process. This cognitive approach is utilized to foster student skill development, emphasizing consistent outcomes rather than abstract conceptual or critical thinking methods.

## Seamless Learning through Segmentation and Bite-Sized Learning

Seamless learning refers to the ability of learners to effortlessly transition between formal and informal learning environments, using technology to integrate the experiences. Segmentation supports the principles of seamless learning by making content more manageable and accessible across different learning environments.

Segmentation in learning refers to the process or learning strategy of dividing complex information into smaller and more manageable parts to improve comprehension and retention (Mayer & Pilegard, 2005). Segmentation can be applied in various ways in learning, including dividing a lecture into smaller segments or presenting a complex concept through multiple examples. By using segmentation, learners are able to tune their focus and process individual parts of the information (segments) more effectively, achieving a deeper understanding and better recall of the learning material. Segmentation also permits time intervals between successive bite-sized segments of instruction known as "bite-sized learning" (Weintraub & Martineau, 2002). This flexibility fosters continuous learning, enhancing knowledge application,

retention, and understanding across different contexts (Hambrock & De Villiers, 2023).

The bite-sized learning approach is based on cognitive learning theory, which considers learning as a process where learners develop knowledge by processing and organizing information (Mayer, 2002). These cognitive processes reorganize the mental operations that create human intelligence, or knowledge (Piaget, 2000). According to Wang and Noe (2010), knowledge is the ability to process information mentally and the skill to carry out activities accordingly. However, knowledge is based on a person's perception of the information (Miller, 2002). Learners process information mentally, leading to the construction and internalization of knowledge. However, there is compelling evidence to suggest that prolonged, continuous sessions have a negative impact on students' capacity for attention and recollection (Burns, 1985; Hattie & Yates, 2013). According to Burns' study, the first five minutes had the greatest impact on learning, and any longer periods had a declining effect. According to Hattie and Yates (2013), learning spread out across multiple brief periods is more efficient for memory retention than learning all at once during a lengthier session. It is evident that restraining students in long and uninterrupted sessions and one-way communication are ineffective teaching methods especially as young students are becoming avid users of online short-video and chat apps.

Bite-sized learning often involves the use of short videos, quizzes, or other interactive elements to engage the learner and help them understand the material. This approach has been shown to make educational content easily

understood and help students retain the information. Carmichael et al. (2018) state that shorter videos increase viewing times and improve learning, as well as having a higher likelihood of repeat viewing. Guo et al. (2014) recommend videos of less than 6 minutes for maximum student engagement, based on their quantitative research into student engagement in video content. When the material is delivered asynchronously, students can learn at their own pace at a time that suits their needs.

Therefore, segmentation and bite-sized learning also facilitate just-in-time learning in promoting informal, self-directed acquisition and utilization of knowledge (Weintraub & Martineau, 2002). Bite-sized learning and just-in-time learning may be used in conjunction because bite-sized materials can be consumed in a timely manner and in short time spans and intervals without interrupting other tasks, whereas full-length materials may suit dedicated traditional learning sessions. While learning becomes fragmented in a media multitasking environment, where students are engaged in multiple media sources or tasks simultaneously (Liu & Gu, 2020), bite-sized learning allows students to switch their attention between information sources and resume their learning shortly afterward. Mayer and Pilegard (2005) state that effective bite-sized learning occurs when multimedia messages are delivered in learner-paced segments, rather than as a continuous module. Therefore, bite-sized learning materials may also provide students with greater control over the learning time schedule, apart from other obligations such as part-time work or care for family members, if used asynchronously or as supplementary material.

While bite-sized videos have been shown to ensure high engagement (Guo et al., 2014), research shows that students perform well in reading tasks with fragmented materials provided that they achieve a sufficient degree of engagement (Liu & Gu, 2020). Other researchers find that students with high reading engagement also actively browse websites for relevant information to assist their learning (Naumann, 2015). In that sense, the time intervals created by bite-sized learning may allow highly engaging students sufficient time for self-directed information search and learning. Bite-sized learning and seamless learning both emphasize flexibility, accessibility, and continuous learning. Bite-sized learning delivers small, easily digestible chunks of information, which fits seamlessly into various learning environments, either formal or informal. This modular content can be accessed anytime, often through mobile devices, enabling a core aspect of seamless learning. Both approaches allow learners to integrate learning into their daily routines, enabling quick transitions between contexts and promoting knowledge retention and real-time application. Seamless learning's focus on fluid transitions between different settings aligns with the nature of bite-sized learning, as students can engage with short, targeted content wherever they are, fostering continuous engagement and deeper understanding.

## Social Media Redefines Instruction and Learning

The concept of multimedia instruction is broadly defined by Mayer (2005) as the presentation of words (spoken or written) and pictures (illustration, photo, animation, and video) that are intended to promote learning. Multimedia

instruction involves the presentation of material in two or more forms with three methods: delivery media view (two or more delivery devices), presentation mode view (verbal and pictorial), and sensory modalities view (auditory and senses). Multimedia learning, therefore, occurs when learners construct knowledge by building mental representations from words and pictures.

The process of multimedia learning is derived from cognitive theories. Multimedia learning is rooted in cognitive theory (Mayer, 2005; Paivio, 1991), drawing upon Paivio's dual coding theory. Paivio's dual coding theory states that humans have two separate memory systems for processing information: a verbal system for processing linguistic information, and a nonverbal system for processing visual and imaginal information. According to the theory, information is encoded and stored more effectively when both verbal and nonverbal codes are used simultaneously.

Multimedia instruction uses the full capacity of the two human information-processing systems, verbal and visual, through the presentation of words and pictures. Therefore, the idea behind multimedia learning is that learners process information more effectively and retain it longer because the different forms of media engage different sensory modalities. Mayer (2002) conducted experiments wherein all of the students retained information better, particularly on problem-solving tests, when presented with a combination of media. Despite the higher engagement level achieved in a multimedia learning environment, the cognitive load remains a concern as researchers suggest the design of digital learning environments should cater to the limitations of human perceptual and

cognitive systems (Homer et al., 2008). Homer's research on the effects of multimedia learning shows that students with low visual preference could experience excessive cognitive loads when learning with video materials. Brame (2016) argues that videos for educational purposes should promote active learning and student engagement but minimize cognitive load. Bite-sized video clips may be a way to address the excessive cognitive load by using smaller and more manageable segments, effectively alleviating the difficulties experienced by them. While bite-sized videos have been shown to ensure high engagement (Guo et al., 2014), the delivery via TikTok platform ensures both engagement and active use of video content (Jacobs et al., 2022).

Mobile learning is the process of using mobile devices to deliver educational content and facilitate learning (Crompton & Burke, 2018). Mobile learning is defined as learning across multiple contexts, through social and content interactions, using personal electronic devices (Crompton & Burke, 2018). This definition highlights the potential benefits of mobile learning as the ability to learn across different contexts and technologies at anytime from anywhere, making it a flexible and convenient form of education. The internet generation of students are long accustomed to an environment with abundant information and entertainment in various formats and across multiple screens and devices competing for their attention (Mizrachi & Bedoya, 2007). The flexibility of mobile learning allows learners to access and engage with educational content at their own pace and in their own time, making it a personalized form of learning. A prime example of an engaging social media

application is TikTok, which has been shown to be a highly engaging video-based mobile application with great potential in education, including chemistry (Hayes et al., 2020), dermatology (Zheng et al., 2021), literature learning (Rajan & Ismail, 2022), and statistical education (Jacobs et al., 2022).

## Research Design and Methodology

The aim of this study is to evaluate the effectiveness of using TikTok videos as a learning tool for introductory-level statistics. Specifically, we aim to test whether students provided access to the TikTok bite-sized videos on statistics learning materials achieve higher scores in direct assessments compared to those who did not receive the intervention. In summary, we propose the following hypotheses:

- **Hypothesis (H1):** There is an improvement in the mean exam scores from pre-test to post-test in both the treatment and control groups.

- **Hypothesis (H2):** The mean improvement in exam scores from pre-test to post-test is greater in the treatment group compared to the control group.

The study will use a direct assessment to determine whether online bite-sized videos enhance the delivery of course materials for problem-solving in a statistics course. Seven TikTok tutorial videos were created to explain the fundamental statistical functions of AVERAGE, STDEV.P, STDEV.S, NORM.S.DIST, and NORM.S.INV, and the data analysis toolpak in Microsoft Excel. These functions represent foundational concepts in statistics and data analysis within Microsoft Excel:

- AVERAGE is a basic arithmetic mean calculation.

- STDEV.P and STDEV.S are used to calculate the standard deviation for populations and samples, respectively.

- NORM.S.DIST and NORM.S.INV are related to the standard normal distribution, which is fundamental in statistical analysis.

Teaching these functions provides learners with essential skills that serve as building blocks for more advanced analyses. The videos were all 60 seconds or shorter and provided step-by-step guides for using the features. A dedicated TikTok account (available on TikTok @bite_size_stats) was created for this research. Figure 1 is a screenshot of the video on t-distribution calculation using Microsoft Excel.
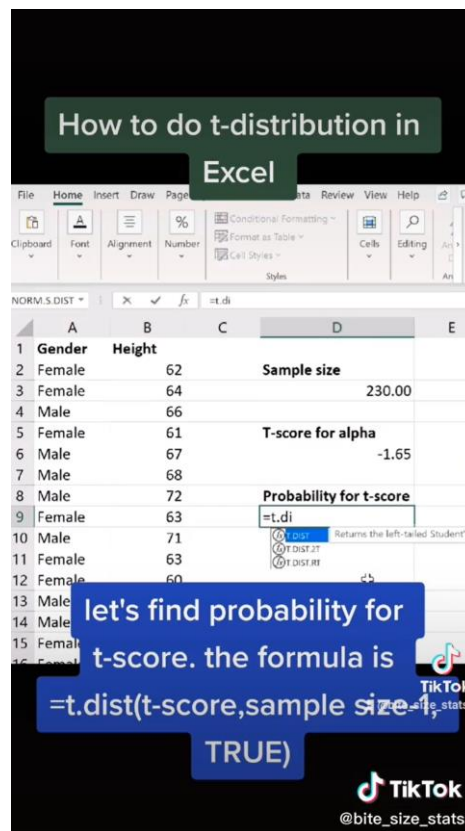


*Figure 1: Screenshot of TikTok Demonstration of t-Distribution*
*Image description available.*

The research context is appropriate for studying the effectiveness of bite-sized learning using TikTok videos because the topics in statistics tutorials are clearly defined, and well-developed problem sets for evaluation are readily available. Most students also have experience with the subject and task requirements from previous statistics courses.

Students were informed of the purpose of the study by the instructor with more details on the introductory page of the survey. Each iteration of the experiment was conducted over a period of four weeks, with pre-intervention and post-intervention assessments. The pre-assessments and post-assessments consisted of the same set of dynamic assessment questions, designed with identical structures but featuring different numerical values to ensure variation. Both assessments were at the same level of difficulty and were scored on a scale from 0 to 100, ensuring that participants could achieve comparable minimum and maximum scores across both tests. This design aimed to make pre-assessment and post-assessment results directly comparable for accurate evaluation.

The experiment allows students a period of time to familiarize themselves and incorporate bite-sized learning materials into their learning routine in order for a thorough evaluation of the effectiveness of bite-sized learning.

## Findings and Results

During the course introductory sessions, students received a lecture on specific statistical topics followed by a pre-intervention exam to assess their understanding of the learning objectives before direct assessment. All students

participated in the direct assessment, which evaluated their knowledge of descriptive statistics, normal distribution, and t-distribution. The pre-intervention exam ensured that students were familiar with the experiment's topics and test format, and it may have stimulated self-directed learning among some students.

For this teaching experiment, two groups were randomly assigned: the treatment group and the control group. The students in both groups received the same instructor-led tutorials before the post-intervention exam. Subsequently, in addition to the instructor-led tutorials, the treatment group received links to bite-sized TikTok videos, covering the same topics but in a different format.

This provided students with ample time to watch and digest the content at their convenience. The control group did not receive these support videos at this stage. Finally, both groups were assigned the post-intervention exam to evaluate their comprehension of the student learning objectives. In an effort to ensure fairness, the control group received the support links to the bite-sized videos after the conclusion of the post-intervention exam.

Even though the linkage is public, contamination caused by information sharing across groups is likely minimal because students usually share entertainment content on social media rather than academic materials. An additional concern may arise from students' access to the internet, as not all may have wide-band connections to access the videos. However, the advantage of bite-sized videos lies in their minimal bandwidth usage for a short duration, requiring neither high-tech devices nor super-fast internet connectivity.

## Direct Assessment Sample

The study's sample consisted of 162 undergraduate students enrolled in the second part of a two-course sequence introduction to business statistics at a university in the United States. The experiment was conducted over four semesters to ensure the results were repeatable. The demographics of the respondents' university level were proportioned as 68.51% junior, 14.47% senior, 14.47% sophomore, and 2.55% first-year student. The genders of the respondents were proportioned as 53.62% self-identified as male, 45.11% self-identified as female, and 1.28% prefer not to disclose.

## Direct Assessment Results

A mixed ANOVA was conducted to compare pre-test and post-test scores between the treatment and control groups, with Student ID included as a random effect to account for individual variability. The analysis of the experimental group revealed a statistically significant main effect of the experimental group (treatment or control) on exam scores, with a p-value of 0.0265. This suggests that there was a meaningful difference in exam performance between students who were exposed to TikTok videos and those who were not, regardless of the time point. A highly significant main effect of time was found ($p < 0.0001$), indicating that students' scores were significantly different between the pre-exam and post-exam assessments across both groups. This demonstrates that exam performance generally improved from the pre-exam to the post-exam phase, reflecting the natural progression of learning over time. The interaction between the experimental group and time was also

statistically significant (p = 0.0006). This finding suggests that the change in exam performance from pre-exam to post-exam was different for the treatment group compared to the control group. Specifically, the treatment group, which watched TikTok videos, exhibited a different pattern of score improvement over time compared to the control group.

*Table 1*. *Mixed ANOVA Results*

| Efficacy Measurement | (Prob >F) |
|---|---|
| Experiment Group (Treatment or Control) | .0265 |
| Time (Pre or Post) | < .0001 |
| Experiment Group* Time | .0006 |

The results from the experiment of Time, with a p-value of < .0001, shows a highly significant difference between pre-test and post-test scores, indicating that scores changed significantly over time for all participants. The Experiment Group (Treatment or Control) with a p-value of .0265 indicates a significant main effect of the experiment group. This suggests that there is a statistically significant difference between the treatment and control groups, implying that the students perform differently on average. Most importantly, the interaction between Experiment Group and Time has a p-value of .0006, suggesting that the change from pre-test to post-test scores differs between the treatment and control groups. This means the effect of time on test scores depends on whether a participant was in the treatment or control group, implying that the treatment had a positive impact over time compared to the control.

# Discussion and Conclusion

This study investigated using TikTok videos as a bite-sized learning tool for introductory-level statistics. While previous studies have made comprehensive investigations of using technologies, such as interactive multimedia, to reduce cognitive loads in learning, the proliferation of personal smart devices and short-video-based social media has provided a new platform to foster learning and transform the learning culture. With students using these tools to connect formal and informal learning, collaborate with peers, and access educational materials, schools and instructors may also play an active role in this new platform.

The study relies on theories of cognitive learning, such as behaviorism, cognitivism, and constructivism, which place an emphasis on the active process of learning through memory, attention, and information processing. To further break down difficult information into smaller, more manageable parts to improve comprehension and retention, segmentation and bite-sized learning based on cognitive learning theory were applied in this study. Moreover, the use of shorter videos and interactive elements can enhance engagement and understanding of educational content, and just-in-time learning allows for informal, self-directed acquisition and utilization of knowledge. Bite-sized learning materials provide students with greater control over their learning schedule and the ability to switch attention between information sources.

This study used seven TikTok tutorial videos as a bite-sized, just-in-time learning tool to illustrate statistical functions in Microsoft Excel. The study uses

direct assessments and self-perceived assessments to determine if bite-sized videos enhance the delivery of course materials. In online and distance education settings, short-form videos can act as an engaging supplement to traditional content delivery methods by providing students with bite-sized, easily digestible learning materials. These videos offer flexibility and enhance engagement, making them particularly useful for asynchronous learning environments where students can access content at their own pace and revisit materials as needed.

The results of the experiment indicate that the difference in student results between the pre-exam and post-exam was statistically significant, demonstrating that the students' statistical understanding improved during the pre-test and post-test periods. Furthermore, there was a significant difference between the treatment and control groups (those who received the videos and those who did not receive the videos). The treatment group significantly outperformed the control group. Our findings indicate that using TikTok as part of a learning intervention was associated with improvements in student performance, as evidenced by the results of the mixed ANOVA. However, it is essential to acknowledge that TikTok served as a supplemental reinforcement tool, rather than a primary medium for content delivery.

## Limitations and Future Work

While this study is one of the first studies to investigate the effectiveness of bite-sized videos on statistics learning material, it has several notable limitations. The investigation is confined to student cohorts enrolled in business

statistics courses at a United States university, which limits the generalizability of its findings to other educational settings. Additionally, the study does not control for external factors such as prior statistical knowledge, motivation levels, or access to supplementary learning resources, which could potentially impact student performance and confound the findings. The research time period took place right after the COVID-19 pandemic, which might have implications for its findings.

While the mixed ANOVA results provide a strong indication of differential effects over time between groups, further studies should incorporate additional control measures to test the relative effectiveness of TikTok against other reinforcement strategies. Future research should also explore whether similar effects are observed with other social media platforms or reinforcement tools, enhancing the generalizability of our findings.

Finally, while this study only included TikTok videos, future research could investigate the potential benefits of combining multiple types of instructional media, such as videos, animations, and simulations, to enhance learning outcomes. Educators could consider pedagogical changes and incorporate TikTok videos, or other social media platforms of similar characteristics, into their classrooms to support traditional teaching methods and promote active learning. Similarly, educators could make use of other social media platforms to enhance student engagement.

Overall, the study's findings underline the need for incorporating cognitive learning theories, such as segmentation and bite-sized learning, into the course

instruction. The findings imply that providing concise, intriguing, and interactive video content can assist learners in acquiring and retaining knowledge, particularly when integrated with real data and technology.

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# References

Anderson, J. R., Reder, L. M., & Simon, H. A. (1997). Situative versus cognitive perspectives: Form versus substance. *Educational Researcher, 26*(1), 18–21. https://doi.org/10.3102/0013189X026001018

Basturk, R. (2005). The effectiveness of computer-assisted instruction in teaching introductory statistics. *Journal of Educational Technology & Society, 8*(2), 170–178.

Brame, C. J. (2016). Effective educational videos: Principles and guidelines for maximizing student learning from video content. *CBE—Life Sciences Education, 15*(4), es6. https://doi.org/10.1187/cbe.16-03-0125

Burns, R. A. (1985). *Information impact and factors affecting recall*. Paper presented at Annual National Conference on Teaching Excellence and Conference of Administrators, Austin, Texas.

Caffarella, R. S., & Merriam, S. B. (1999). Perspectives on adult learning: Framing our research. *Adult Education Research Conference*. https://newprairiepress.org/aerc/1999/papers/10

Carmichael, M., Reid, A.-K., & Karpicke, J. D. (2018). *Assessing the impact of educational video on student engagement, critical thinking and learning: The current state of play* [White paper]. Sage Publishing. https://us.sagepub.com/sites/default/files/hevideolearning.pdf

Carver, R., Everson, M., Gabrosek, J., Horton, N., Lock, R., Mocko, M., Rossman, A., Roswell, G. H., Velleman, P., Witmer, J., & Wood, B. (2016). *Guidelines for assessment and instruction in statistics education (GAISE) college report 2016*. https://commons.erau.edu/publication/1083

Casebourne, I. (2024). Left to their own devices: An exploration of context in seamless work-related mobile learning. *British Journal of Educational Technology*. https://doi.org/10.1111/bjet.13410

Chaamwe, N., & Shumba, L. (2016). ICT integrated learning: Using spreadsheets as tools for e-learning, a case of statistics in Microsoft Excel. *International Journal of Information and Education Technology, 6*(6), 435–440. http://dx.doi.org/10.7763/IJIET.2016.V6.728

Crompton, H., & Burke, D. (2018). The use of mobile learning in higher education: A systematic review. *Computers & Education, 123*, 53–64. https://doi.org/10.1016/j.compedu.2018.04.007

Ertmer, P. A., & Newby, T. J. (1993). Behaviorism, cognitivism, constructivism: Comparing critical features from an instructional design perspective. *Performance Improvement Quarterly*, *6*(4), 50–72. https://doi.org/10.1111/j.1937-8327.1993.tb00605.x

Freberg, K., & Kim, C. M. (2018). Social media education: Industry leader recommendations for curriculum and faculty competencies. *Journalism & Mass Communication Educator, 73*(4), 379–391. https://doi.org/10.1177/1077695817725414

Garfield, J., & Ben-Zvi, D. (2007). How students learn statistics revisited: A current review of research on teaching and learning statistics. *International Statistical Review, 75*(3), 372–396. https://psycnet.apa.org/doi/10.1111/j.1751-5823.2007.00029.x

Gkintoni, E., & Dimakos, I. (2022, July). An overview of cognitive neuroscience in education. *EDULEARN22 Proceedings*, 5698–5707. http://dx.doi.org/10.21125/edulearn.2022.1343

Good, T. L., & Brophy, J. E. (1990). *Educational psychology: A realistic approach* (4th ed.). Longman/Addison Wesley Longman.

Greenhow, C., & Lewin, C. (2015). Social media and education: Reconceptualizing the boundaries of formal and informal learning. *Learning, Media and Technology, 41*(1), 6–30. http://dx.doi.org/10.1080/17439884.2015.1064954

Greeno, J. G., Collins, A. M., & Resnick, L. B. (1996). Cognition and learning. In D. C. Berliner, & R. C. Calfee (Eds.), *Handbook of educational psychology* (pp. 15–46). Prentice Hall.

Guo, P. J., Kim, J., & Rubin, R. (2014, March). How video production affects student engagement: An empirical study of MOOC videos. In *Proceedings of the first ACM conference on Learning@ Scale Conference* (pp. 41–50). https://doi.org/10.1145/2556325.2566239

Hambrock, H., & De Villiers, F. (2023). Proposing a seamless learning experience design (SLED) framework based on international perspectives of educators from five higher education institutions. *Electronic Journal of e-Learning, 21*(1), 52–68. https://doi.org/10.34190/ejel.21.1.2497

Hattie, J., & Yates, G. C. (2013). *Visible learning and the science of how we learn.* Routledge.

Hayes, C., Stott, K., Lamb, K. J., & Hurst, G. A. (2020, July 29). "Making every second count": Utilizing TikTok and systems thinking to facilitate scientific public engagement and contextualization of chemistry at home. *Journal of Chemical Education, 97*, 3858–3866. https://pubs.acs.org/doi/epdf/10.1021/acs.jchemed.0c00511?ref=article_openPDF

Heo, M., & Toomey, N. (2020). Learning with multimedia: The effects of gender, type of multimedia learning resources, and spatial ability. *Computers & Education, 146*, 103747. https://doi.org/10.1016/j.compedu.2019.103747

Homer, B. D., Plass, J. L., & Blake, L. (2008). The effects of video on cognitive load and social presence in multimedia learning. *Computers in Human Behavior, 24*(3), 786–797. https://doi.org/10.1016/j.chb.2007.02.009

Jacobs, A., Pan, Y. C., & Ho, Y. C. (2022, April). More than just engaging? TikTok as an effective learning tool. *UK Academy for Information Systems Conference Proceedings 2022*.

Jatnika, R. (2015). The effect of SPSS course to students' attitudes toward statistics and achievement in statistics. *International Journal of Information and Education Technology, 5*(11), 818–823. https://www.ijiet.org/papers/618-D011.pdf

Jonsdottir, A. H., Lentin, J., Calian, V., Hafsteinsson, E. K., & Stefansson, G. (2021). Using real data for statistics education. *Teaching Statistics: An International Journal for Teachers, 43*(1), 5–12. https://doi.org/10.1111/test.12237

Ke, F., & Hsu, Y. C. (2015). Mobile augmented-reality artifact creation as a component of mobile computer-supported collaborative learning. *The Internet and Higher Education, 26*, 33–41. https://doi.org/10.1016/j.iheduc.2015.04.003

Kuh, G. D. (1996). Guiding principles for creating seamless learning environments for undergraduates. *Journal of College Student Development, 37*(2), 135–148.

Liu, Y., & Gu, X. (2020). Media multitasking, attention, and comprehension: A deep investigation into fragmented reading. *Educational Technology Research and Development, 68*(1), 67–87. https://psycnet.apa.org/doi/10.1007/s11423-019-09667-2

Mahoney, M. J. (1977). Reflections on the cognitive-learning trend in psychotherapy. *American Psychologist, 32*(1), 5–13. https://awspntest.apa.org/doi/10.1037/0003-066X.32.1.5

Mairing, J. P. (2020). The effect of advanced statistics learning integrated Minitab and Excel with teaching teams. *International Journal of Instruction, 13*(2), 139–150. http://dx.doi.org/10.29333/iji.2020.13210a

Mayer, R. E. (2002). Multimedia learning. In *Psychology of learning and motivation* (Vol. 41, pp. 85–139). Academic Press. https://doi.org/10.1016/S0079-7421(02)80005-6

Mayer, R. E. (2005). Introduction to multimedia learning. In R. E. Mayer (Ed.), *The Cambridge handbook of multimedia learning* (2nd ed., pp. 24–25).

Mayer, R. E., & Pilegard, C. (2005). Principles for managing essential processing in multimedia learning: Segmenting, pretraining, and modality principles. In R. E. Mayer (Ed.), *The Cambridge handbook of multimedia learning* (pp. 169–182).

Miller, F. J. (2002). I = 0 (Information has no intrinsic meaning). *Information Research, 8*(1).

Mizrachi, D., & Bedoya, J. (2007). LITE Bites: Broadcasting bite-sized library instruction. *Reference Services Review, 35*(2), 249–256. http://dx.doi.org/10.1108/00907320710749164

Moon, J., Lee, D., Choi, G. W., Seo, J., Do, J., & Lim, T. (2024). Learning analytics in seamless learning environments: a systematic review. *Interactive Learning Environments*, *32*(7), 3208–3225. https://doi.org/10.1080/10494820.2023.2170422

Naumann, J. (2015). A model of online reading engagement: Linking engagement, navigation, and performance in digital reading. *Computers in Human Behavior, 53*, 263–277. http://dx.doi.org/10.1016/j.chb.2015.06.051

Núñez, R., Allen, M., Gao, R., Miller Rigoli, C., Relaford-Doyle, J., & Semenuks, A. (2019). What happened to cognitive science? *Nature Human Behaviour, 3*(8), 782–791. https://doi.org/10.1038/s41562-019-0628-6

Olagbaju, O. O., & Popoola, A. G. (2020). Effects of audio-visual social media resources-supported instruction on learning outcomes in reading. *International Journal of Technology in Education, 3*(2), 92–104. https://doi.org/10.46328/ijte.v3i2.26

Paivio, A. (1991). Dual coding theory: Retrospect and current status. *Canadian Journal of Psychology/Revue canadienne de psychologie, 45*(3), 255–287. https://psycnet.apa.org/doi/10.1037/h0084295

Piaget, J. (2000). Piaget's theory of cognitive development. In K. Lee (Ed.), *Childhood cognitive development: The essential readings* (pp. 33–47). Wiley-Blackwell.

Rajan, S. T., & Ismail, H. H. (2022). TikTok use as strategy to improve knowledge acquisition and build engagement to learn literature in ESL classrooms. *International Journal of Learning, Teaching and Educational Research, 21*(11).

Ridgway, J. (2016). Implications of the data revolution for statistics education. *International Statistical Review, 84*(3), 528–549. https://doi.org/10.1111/insr.12110

Simon, H. (2001). Learning to research about learning. In S. M. Carver, & D. Klahr (Eds.), *Cognition and instruction: Twenty-five years of progress* (pp. 205–226).

Sowey, E. R. (2020). Statistics education that inspires long-term retention of learning: A qualitative model. *Statistics Education Research Journal, 19*(1), 21–28. http://dx.doi.org/10.52041/serj.v19i1.116

Statista. (2022a). *Number of social media users worldwide from 2017 to 2028 (in billions)* [Graph]. https://www.statista.com/statistics/278414/number-of-worldwide-social-network-users/

Statista. (2022b). *Number of social network users in selected countries in 2022 and 2029 (in millions)* [Graph]. https://www.statista.com/statistics/278341/number-of-social-network-users-in-selected-countries/

Statista. (2023). *Global social network penetration rate as of January 2023, by region*. https://www.statista.com/statistics/269615/social-network-penetration-by-region/

Stephens, N. M., Hamedani, M. G., & Destin, M. (2014). Closing the social-class achievement gap: A difference-education intervention improves first-generation students' academic performance and all students' college transition. *Psychological Science, 25*(4), 943–953. https://doi.org/10.1177/0956797613518349

Verhoeven, P. (2006, July). Statistics education in the Netherlands and Flanders: An outline of introductory courses at universities and colleges. In *ICOTS-7 Conference Proceedings* (pp. 60115–2828). International Statistical Institute.

Wang, S., & Noe, R. A. (2010). Knowledge sharing: A review and directions for future research. *Human Resource Management Review, 20*(2), 115–131. https://doi.org/10.1016/j.hrmr.2009.10.001

Weintraub, R. S., & Martineau, J. W. (2002). The just-in-time imperative. *T+D, 56*(6), 50–58.

Wu, W. H., Wu, Y. C. J., Chen, C. Y., Kao, H. Y., Lin, C. H., & Huang, S. H. (2012). Review of trends from mobile learning studies: A meta-analysis. *Computers & Education, 59*(2), 817–827. https://doi.org/10.1016/j.compedu.2012.03.016

Zheng, D. X., Mulligan, K. M., & Scott, J. F. (2021). TikTok and dermatology: An opportunity for public health engagement. *Journal of the American Academy of Dermatology, 85*(1), e25–e26. https://doi.org/10.1016/j.jaad.2021.02.050

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## Image Description

**Figure 1 image description:** Screenshot of Microsoft Excel spreadsheet used to demonstrate t-Distribution. Includes columns of data for gender and height, as well as overall sample size, t-score for alpha, and probability for t-score.

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