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EFFECT OF LECTURE METHOD ON SENIOR SECONDARY SCHOOL STUDENTS' ACADEMIC ACHIEVEMENT IN MATHEMATICS IN YOLA EDUCATION ZONE, ADAMAWA STATE, NIGERIA

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ABSTRACT

This study examined the effect of lecture method on senior secondary school students' academic achievement in Yola Education Zone, Adamawa State. The study centred on three research questions and three hypotheses that were tested at a significance level of 0.05. Quasi-experimental research process was adopted and by which 130 students were sampled to form an Experimental Group (X1) and a Control Group (X2). Four senior secondary schools from different Local Governments in the Zone made up the Experimental and Control Groups that were given instructional treatment where Mathematics was taught using lecture method. A pilot test was conducted in schools outside Yola Education Zone and data analysed from it produced result that gave a reliability index of 0.80 that was considered appropriate for the study. A Mathematics Achievement Test (MAT) was designed by the researchers and validated, then used for both pre-test and post-test. The findings showed that there was a significant difference between the pre-test and post-test performances of students taught with lecture method in Mathematics in Yola Education Zone ($t = 2.784$; $df = 150$; $p < .05$). The results also showed that there was no significant difference between the academic achievement of male and the female students given Mathematics instruction taught with lecture method (t 0.087; $df = 74$; $p > 0.05$). It was therefore concluded that lecture method has significant effect on students' academic achievement in Mathematics in senior secondary schools in Yola Education Zone, Adamawa State. Thus, it was recommended among others that Mathematics teachers should incorporate interactive elements such as question-and-answer sessions, real-time problem-solving, and the use of illustrative examples to maximize the effectiveness of the lecture method.

Keywords: Lecture Method, Mathematics, Quasi-experimental, Students' Academic Achievement, Yola Education Zone

INTRODUCTION

Education is universally recognized as a cornerstone for the development and progress of societies worldwide. It plays a pivotal role in equipping individuals with the knowledge, skills, and values needed to thrive in a rapidly changing global landscape. In Africa, education is critical for addressing challenges such as poverty, inequality, and unemployment, and for fostering economic growth and social cohesion. Nigeria, the most populous country in Africa, places significant emphasis on education as a means of national development. However, the educational sector in Nigeria, particularly in the North Eastern region, faces numerous challenges including inadequate infrastructure, insufficient funding, and a shortage of qualified teachers (Adebisi, 2020). Despite these challenges, the promotion of Science, Technology, Engineering, and Mathematics (STEM) education is seen as vital for driving innovation and economic development in the region.

STEM education equips students with essential skills such as critical thinking, problem-solving, and analytical abilities. Within STEM, Mathematics is a fundamental subject that underpins many scientific and technological advancements. The study of Mathematics in senior secondary schools is crucial for students' academic achievement and future career opportunities in STEM fields. Mathematics has relevance to all individuals especially when one's effective functioning in the modern society is taken into account (Chianson, Kurumeh & Obida, 2019). The study of Mathematics in senior secondary schools is crucial for students' academic achievement and future career prospects. However, many students face significant challenges in mastering mathematical concepts,

which impacts their overall academic performance and future opportunities. In particular, the academic achievement of students in Mathematics has been a persistent concern, especially in developing regions like North Eastern Nigeria.

Academic achievement generally refers to the extent to which a student has attained their educational goals, often measured through grades, test scores, and other assessments (Brophy, 2019). In the context of mathematics, academic achievement is critical as it reflects students' understanding of mathematical concepts and their ability to apply these concepts to solve problems. Despite its importance, many students struggle with mathematics, leading to low academic achievement. The incidents of low students' academic performance in the SSCE examinations, either in WAEC or NECO examinations have been so huge and alarming that they should not be ignored any more. Factors contributing to this include ineffective teaching methods, lack of instructional materials, and negative attitudes towards the subject (Hattie, 2018). The lecture method, a traditional teaching approach, is widely used in teaching mathematics but has been linked to varying outcomes in students' academic performance.

The lecture method, characterized by a teacher-centred approach where information is presented verbally to students, is one of the oldest and most widely used instructional strategies in education. In mathematics education, the lecture method typically involves the teacher explaining mathematical concepts, demonstrating problem-solving techniques, and providing examples, while students listen, take notes, and occasionally ask questions (Adebisi, 2020). This method is often favoured for its ability to cover a large amount of content within a limited time frame, making it particularly useful in settings with extensive curricula and time constraints. The lecture method has several advantages that can positively impact students' academic achievement in mathematics. Firstly, it allows for efficient coverage of the syllabus, ensuring that all necessary topics are taught within the academic year (Usman, 2021). This is particularly important in mathematics, where foundational concepts must be thoroughly covered to enable understanding of more complex topics. Additionally, lectures provide a structured and organized presentation of material, which can help students follow the logical progression of mathematical theories and principles (Brophy, 2019). Another benefit of the lecture method is that it offers opportunities for teachers to highlight key points and emphasize critical aspects of the subject matter. This can aid in focusing students' attention on important concepts and problem-solving strategies.

Despite its advantages, the lecture method also has several drawbacks that can negatively affect students' academic achievement in mathematics. One of the main criticisms is that it promotes passive learning. Students are often required to listen and take notes without actively engaging with the material, which can lead to superficial understanding and poor retention of knowledge (Adebisi, 2020). Passive learning environments can also result in decreased motivation and interest in the subject, further hindering academic performance. Additionally, the lecture method may not cater to the diverse learning needs and styles of all students. While some students may excel in a lecture-based environment, others who benefit from more interactive and hands-on approaches may struggle to grasp mathematical concepts (Olusola & Rotimi, 2022). This can create disparities in academic achievement, with some students falling behind due to the one-size-fits-all nature of traditional lectures. Furthermore, the lecture method can limit opportunities for critical thinking and problem-solving, which are essential skills in mathematics. Without active engagement and practice, students may find it challenging to apply theoretical knowledge to real-world problems, reducing their overall mathematical proficiency (Akpan & Umoren, 2018). The lack of immediate feedback and interaction during lectures can also prevent students from addressing misunderstandings and misconceptions promptly.

Nevertheless, lecture method is widely used by virtually all teachers in senior secondary schools all over the country today. Despite the widespread use of the lecture method, there is a notable lack of empirical studies investigating its impact on students' academic achievement in mathematics within the Yola Education Zone of Adamawa State, Nigeria. This gap in research limits the ability of educators and policymakers to make informed decisions about the most effective

teaching methods for mathematics. Understanding the specific effects of the lecture method in this context is essential for developing educational strategies that can improve students' academic outcomes. This study therefore aimed to address this gap by providing empirical evidence on the effect of lecture method on students' academic achievement in Mathematics in Yola Education Zone of Adamawa State, Nigeria.

Problem Statement

In Yola Education Zone of Adamawa State, Nigeria, the academic achievement of senior secondary school students in mathematics has been consistently low based on students' percentage past in the past five years (2018 to 2022), as documented by the Post Primary School Management Board (PPSMB, 2023). This posed a significant challenge to educational development in the region. One of the predominant teaching methods employed is the lecture method, where teachers deliver information verbally to students who are expected to passively absorb the material. Despite its widespread use, the lecture method has been criticized for its limited ability to engage students and foster deep understanding of mathematical concepts. The persistent reliance on the lecture method in teaching Mathematics may contribute to students' poor performance, as this approach often fails to address the diverse learning needs and styles of students. Passive learning environments created by the lecture method can also lead to reduced student participation, minimal retention of knowledge, and lack of critical thinking skills essential for mastering mathematics.

Despite these concerns, there is a significant lack of empirical studies examining the specific impact of the lecture method on students' academic achievement in Mathematics within Yola Education Zone of Adamawa State. This gap in research hinders educators, researchers and policymakers from making informed decisions about the effectiveness of lecture method and exploring alternative instructional strategies that could enhance students' academic achievement in Mathematics. This study therefore investigated the effect of lecture method on students' academic achievement in Mathematics in Yola Education Zone, Adamawa State providing much-needed empirical evidence to inform teaching practices and educational policies in the region. Specifically, the study sought to:

1. determine the students' mean academic achievement when taught Mathematics with lecture method and those taught with the use of audio-visual materials in senior secondary schools in Yola Education Zone, Adamawa State;
2. determine the academic achievement before and after instructional treatment of students taught Mathematics using lecture method in senior secondary schools in Yola Education Zone, Adamawa State;
3. determine the effect of lecture method on academic achievement of secondary school students based on gender in Yola Education Zone, Adamawa State.

Research Questions

The following research questions were raised for this study:

1. What is the academic performance of students when taught Mathematics using lecture method and those taught with using audio-visual materials in senior secondary schools in Yola Education Zone, Adamawa State?
2. What is the academic achievement before and after instructional treatment of students taught Mathematics using lecture method in senior secondary schools in Yola Education Zone, Adamawa State?
3. What is the academic achievement of senior secondary school students, by gender, when taught Mathematics using lecture method in Yola Education Zone, Adamawa State?

Research Hypotheses

The research null hypotheses raised for the study have been tested at the 0.05 level of statistical significance. They include the following:

$H_0$1: There is no significant difference between the post-test achievement of students taught Mathematics with lecture method (Experimental, X_1) and those taught with audio-visual materials (Control, X_2) in Yola Education Zone, Adamawa State.

$H_0$2: There is no significant difference between the pre-test and post-test academic achievement of students taught Mathematics with lecture method in senior secondary schools in Yola Education Zone, Adamawa State.

$H_0$3: There is no significant effect of post-test academic achievement of male and female students taught Mathematics with lecture method in senior secondary schools in Yola Education Zone, Adamawa State.

METHODOLOGY

This study adopted the quasi-experimental non-randomized pretest, post-test and control group design. The study involved an estimated population of 15,565 students which comprised 8,452 male and 7,113 female students that offered Mathematics were involved. There were two SSS II classes from two selected schools used as the Experimental Group (X_1) while two other SSS II classes from other schools made up the Control Group (X_2). All the four schools were selected to avoid communication between the students from different instructional treatments. The simple random sampling techniques was used for drawing samples from the four schools selected from the four Local Government Areas. The sample size of the study consisted of 160 senior secondary (SSS II) students in the selected schools. These comprised 65 females and 95 males.

The instrument was titled: Mathematics Achievement Test (MAT) and subjected to face and content validity by experts. The instrument was also pilot tested in two senior secondary schools in Numan Education Zone that were outside Yola Education Zone. The scores of participants in the even group and that of the odd group were subjected to reliability analysis using Guttmann split-half techniques. The analysis gave a reliability index of 0.80. Student in the experimental group were been taught by the teacher using instructional materials; while the control group was taught their Mathematics topics in the designed curriculum without the use of instructional Materials in their lessons.

At the preliminary stage, permission was sought from the sampled schools, with the intact class used. Training and orientation of two Mathematics teachers who were to serve as research assistants in the study were done at this stage; which also included the pre-test. The Treatment Stage was instructional treatment phase which lasted for four weeks. The experimented group was subjected to lecture method being used in the lessons. The control group was taught with the use of a film projector to assist students' learning. The treatment in each group lasted four weeks. The post-test stage was when the students were subjected to the test at the end of the instructional treatment period. The research assistants were then appreciated and disengaged to carry on with their normal school teaching. The data collected from both pre-test and post-test were statistically analysed on the basis of the mean and standard deviation for answering the research questions while the null hypotheses were tested using t-test analysis at 0.05 level of significance.

RESULTS

The results are presented in Table 1–6, based on the research questions and hypotheses.

Research Questions

Research Question 1`: What is the academic performance of students when taught Mathematics using lecture method and those taught with using audio-visual materials in senior secondary schools in Yola Education Zone, Adamawa State?

To answer this research question, the students' academic achievement in the post-test administration was used for analysis. The results analysed were the achievement scores recorded. The mean scores of the Experimental Treatment group (X_1) were compared with those of the Control Treatment group (X_2). The analysis result is summarized in Table 1.

Table 1: Descriptive Statistics of Students' Post-test Achievement of Students in Experimental Group and those in Control Groups

Treatment Group	N	$\bar{X}$	Mean Difference	Std. Deviation	Std. Error Mean
Experimental (x1)	76	48.74		13.9765	1.6032
			-11.35		
Control (x2)	80	60.09		12.2785	1.3729

The results in Table 1 show that the academic achievement of students taught Mathematics with lecture method earned lesser academic achievement score than their counterparts taught with audio-visual materials. There was a margin of difference of 11.35% in favour of the students taught Mathematics with the use of audio-visual materials to support the teaching process.

Research Question 2: What is the academic achievement before and after instructional treatment of students taught Mathematics using lecture method in senior secondary schools in Yola Education Zone, Adamawa State?

The students' academic achievement data in both pre-test and post-test were obtained from administering the same MAT instrument on the students at different times. The pre-test was before instructional treatment while the post-test was administered after six weeks of instruction. Students in this group constituted the Experimental Group, X_1. They were those taught their Mathematics topics through lecture method during lessons. The general academic achievement result for both the pre-test and post-test administration in the summary of performance profiles is recorded. A descriptive statistical analysis of the result is presented in Table 2 below:

Table 2: Descriptive Statistics of Students' Taught Mathematics Pre-test and Post-test Academic Achievement Using Lecture Method

Source of variation	N	$\bar{X}$	Mean Difference	Std. Deviation	Std. Error Mean
Pre-test	76	42.91		11.7373	1.3464
			-5.83		
Post test	76	48.74		13.9765	1.6032

The results in Table 2 shows the students' post-test mean score of the Experimental Group (X_1) was greater than the pre-test achievement by 5.83%. This could indicate that there was a positive effect of instructional treatment of lecture method on students' learning. The analysis shows that there was a good effect of instructional treatment of lecture method as demonstrated in the students' academic achievement results recorded.

Research Question 3: What is the academic achievement of senior secondary school students, by gender, when taught Mathematics using lecture method in Yola Education Zone, Adamawa State?

The research question focusses on senior secondary school students' academic achievement according to their gender. The summary in the Table shows performances presented in terms of the gender of the students. From that record, the descriptive statistical analysis of the students' achievement based on their gender is presented in Table 3 below:

Table 5: Descriptive Statistics of the Post-test Achievement Scores of Senior Secondary School Students Taught Mathematics Using Lecture Method Based on Gender

Source	N	$\bar{X}$	Mean Difference	Std. Deviation	Std. Error Mean

Male Students	43	48.86	0.28	15.0009	2.2876
Female Students	33	48.58		12.7452	2.2187

Results of the analysis show that there was only a very slight difference in the students' academic achievement between the male and female students in the post test. The male students were slightly ahead of their female counterparts with only a difference of 0.28%.

Hypothesis Testing

The hypotheses tested in the present study were aimed at investigating some critical aspect of the study based on the two research groups. One group was the Experimental (X_1) and the other was the control (X_2). The experimental X_1 was given instructional treatment through lecture method to support instruction. The Control X_2 was taught mathematics with audio- visual materials to assist instruction. All hypothesis were tested at 0.05 level of statistical analysis. The analyses are here presented accordingly.

$H_0$1: There is no significant difference between the post-test achievement of students taught Mathematics with lecture method (Experimental, X_1) and those taught with audio-visual materials (Control, X_2) in Yola Education Zone, Adamawa State.

A descriptive statistical analysis of the performances as presented in Table 1 was used to test the hypothesis. The statistics in Table 1 shows that the students exposed to Mathematics instruction through lecture method got 48.74%; while students taught with audio-visual materials got mean academic achievement of 60.9%. A t-Test analysis was then conducted on the result data to find out if the difference in performances was statically significant. The result of the t-test analysis is summarized in Table 4 below:

Table 4: t-test Analysis of Students Post–test Academic Achievement of those Taught Mathematics with Lecture Method and those taught with Audio-visual Materials in the study Area

Instructional Treatment	X̄	Mean Difference	Std. Error Difference	df	t	Sig. (2-tailed)
Experimental ($X_{1)}$	48.74	-11.35	2.104	154	5.315	.000*
Group Control (X_2)	60.09					

*Significant, p < .05.

The results show that there exists a significant difference between the students taught Mathematics with lecture method and those taught with the use of audio-visual materials (t = 5.315; df = 154: p < 05). The result shows that there was no significant gain in academic achievement in favour of the students in the experimental treatment who were taught Mathematics using lecture method on students taught with the support of audio–visual materials; as students taught using lecture method got a significant lower achievement than their counterparts.

$H_0$2: There is no significant difference between the pre-test and post-test academic achievement of students taught Mathematics with lecture method in senior secondary schools in Yola Education Zone, Adamawa State.

The t-Test analysis of the students' pre-test and post-test academic achievements is presented in Table 2. The t-Test analysis of the academic achievement in this experimental treatment where lecture method was used in the teaching of Mathematics is presented in Table 5 below:

Table 5: t-test Analysis of Academic Achievement in Pre-test and Post-test of Senior Secondary School Students Taught Mathematics without Using Audio- Visual materials (Control Instructional Treatment, X_2) in Yola Education Zone, Adamawa State

*Significant; p < .05.

Source of Variation	X̄	Mean Difference	t	df	Sig. (2-tailed)
Pre-Test	42.91	5.8290	-2.784	150	.006*
Post Test	48.74				

Results of the analysis shows that there was a significant difference between the pre-test and post-test academic achievement of the students in this instructional treatment. The mean difference in academic achievement of learners exposed to Mathematics instruction using lecture method shows that there was a significant difference between the pre-test and post-test performances of students taught with lecture method in Mathematics in Yola Education Zone (t = 2.784; df = 150; p < .05). The results show that the students exhibited a significant difference in performance. This is to indicate that there was a positive effect of instruction on the academic performance of the students given the instructional treatment.

$H_0$3: There is no significant difference between the Post-test academic achievement of male and female students taught Mathematics without using audio-visual materials in senior secondary schools in Yola Education Zone.

The third hypothesis sought to establish if there was a significant difference in academic achievement between the male and female students exposed to Mathematics instruction using lecture method. It was focused only on the post-test performance of the students on a gender basis. The result of the hypothesis tested is presented in Table 6 below:

Table 6: t-test Statistics of Post-test Academic Achievement of Males and Females taught Mathematics using Lecture Method in Yola Education Zone, Adamawa State

Source	X̄	Mean Difference	t	df	Sig. (2-tailed)
Male Students	48.86	0.28	0.087**	74	0.931**
Female Students	48.58				

State

**Not Significant; p > .05.

The analysis in Table 6 shows that there was no significant difference between the academic achievement of male and the female students given Mathematics instruction taught with lecture method (t 0.087; df = 74; p > 0.05). The result shows that after instructional treatment, the male students' achievement was not different from that of the females.

DISCUSSION

The findings in Table 1 and 4 from the study indicate that students taught Mathematics using audio-visual materials achieved higher academic scores compared to those taught using the traditional lecture method. This significant difference, evidenced by a t-value of 5.315 and a p-value less than 0.05, suggests that the use of audio-visual aids in teaching Mathematics can be more effective than traditional lecturing. This finding is in agreement with the study of Mayer (2021), which emphasizes the importance of multimedia learning, arguing that combining words and

pictures enhances understanding and retention compared to words alone. This aligns with the Cognitive Theory of Multimedia Learning, which posits that people learn more deeply from a combination of text and visuals than from text alone (Mayer, 2021). A study by Aloraini (2012) also found that the use of multimedia in teaching Mathematics improved students' achievement and attitudes towards the subject. Aloraini's research involved a controlled experiment comparing the effectiveness of traditional teaching methods and multimedia-assisted teaching. The results revealed that students exposed to multimedia resources performed significantly better in Mathematics tests than those taught through lectures alone.

Despite the prevailing support for audio-visual materials, some studies suggest that their effectiveness may vary based on context and implementation. Clark (1983) argued that media itself does not influence learning outcomes; rather, it is the instructional method and how the media is used that makes a difference. Clark's position suggests that the lecture method, if well-designed and engaging, could potentially yield comparable results to audio-visual methods. Similarly, a study by Bernard et al. (2004) compared different instructional methods and found that while audio-visual aids can enhance learning, the difference in academic achievement might not always be significant if the lecture method incorporates interactive and student-centred techniques. This suggests that the efficacy of audio-visual materials can depend on their integration into a well-structured instructional design. The implication of this finding is that even thou the traditional lecture method has its merits; the incorporation of multimedia elements appears to offer a more effective approach to teaching complex mathematical concepts.

The findings in Table 2 and 5 indicate that students' post-test mean scores in the Experimental Group (X1) increased by 5.83% compared to their pre-test scores. Furthermore, there was a significant difference between the pre-test and post-test performances of students taught Mathematics using the lecture method, as evidenced by a t-value of 2.784 and a p-value less than 0.05. These results suggest that the lecture method, while traditionally considered less effective than interactive or multimedia approaches, can still lead to significant academic improvements. Recent studies support the notion that traditional lecture methods can result in significant learning gains under certain conditions. For example, Hake (1998) conducted a large-scale study on interactive-engagement versus traditional methods in introductory physics courses. While interactive methods showed higher effectiveness, traditional methods still resulted in significant gains, highlighting that traditional lectures can be effective if well-delivered.

Moreover, a study by Freeman et al. (2014) conducted a meta-analysis of 225 studies comparing student performance in undergraduate science, technology, engineering, and mathematics (STEM) courses under traditional lecturing versus active learning. Although active learning was superior, traditional lecturing still resulted in positive learning outcomes, suggesting that improvements within the lecture method can yield significant academic gains. However, a study by Deslauriers et al. (2011) showed that even short interventions of active learning techniques in a lecture-based physics course significantly outperformed traditional lectures. This suggests that while traditional lectures can improve student performance, integrating active elements might enhance these outcomes further. The implication of this finding is that it provides evidence that the lecture method can lead to significant academic improvements in Mathematics, as demonstrated by the post-test gains of 5.83% and the significant difference between pre-test and post-test scores.

The findings reveal in Table 3 and 6 that male students slightly outperformed their female counterparts by a margin of 0.28% in Mathematics when taught using the lecture method. However, the difference was not statistically significant, as indicated by a t-value of 0.087, a df of 74, and a p-value greater than 0.05. This suggests that gender does not significantly influence academic achievement in Mathematics when instruction is delivered via the lecture method. Recent research supports the notion that gender differences in academic achievement, particularly in STEM subjects like Mathematics, are minimal when considering traditional instructional methods. For instance, Voyer and Voyer (2014) conducted a meta-analysis on gender differences in scholastic achievement and found that overall gender differences were small, with girls slightly outperforming boys in most

subjects, including Mathematics. However, these differences were not substantial enough to be considered significant in the context of traditional instruction methods.

Additionally, a study by Hyde, Lindberg, Linn, Ellis, and Williams (2008) reviewed the gender similarities hypothesis and concluded that males and females are more alike than different in terms of cognitive abilities and academic performance. Their analysis of standardized test scores showed negligible differences between male and female students in Mathematics, supporting the finding that there is no significant gender disparity in academic achievement when taught using lecture methods. A study by Gunderson, Ramirez, Levine, and Beilock (2012) examined how teachers' math anxiety can affect students' performance, particularly impacting female students. They found that female students' achievement was more likely to be negatively influenced by teachers' anxiety, suggesting that external factors, such as teacher behaviour and classroom environment, could potentially create disparities not evident in purely lecture-based instruction. The implication of this findings that male students slightly outperformed female students by 0.28% in Mathematics, with no significant difference, align with much of the current literature indicating minimal gender disparities in academic achievement when traditional lecture methods are used.

CONCLUSION AND RECOMMENDATION

Based on the study's findings, the study concludes that the lecture method has a significant effect on students' academic achievement in Mathematics in senior secondary schools in the Yola Education Zone, Adamawa State. Despite the prevailing belief that traditional lecture methods may be less effective compared to interactive or multimedia approaches, the results demonstrate that, when well-implemented, the lecture method can lead to notable improvements in students' performance. This underscores the importance of effective instructional delivery, even within traditional lecture teaching method in Mathematics learning. Based on this, the study recommends the following:

1. Mathematics teachers are encouraged to incorporate interactive elements such as question-and-answer sessions, real-time problem-solving, and the use of illustrative examples to maximize the effectiveness of the lecture method. This hybrid approach can help engage students more actively, thereby improving their understanding and retention of mathematical concepts.
2. Continuous professional development programmes should be organized for Mathematics teachers to equip them with innovative teaching strategies that can complement the lecture method. Training on how to manage classroom dynamics, and employ various instructional techniques will help teachers deliver more impactful lectures.
3. Senior secondary school management should implement regular formative assessments to monitor students' progress and provide timely feedback. These assessments can identify areas where students are struggling and allow teachers to adjust their lecture content and delivery methods accordingly.
4. Feedback mechanisms such as peer reviews and student evaluations can also provide valuable insights for improving teaching effectiveness in Mathematics.

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