

# Unveiling Effective Learning Strategies: A Randomized Controlled Trial Comparing Audiovisual Mnemonics and Text Reading for Memory Retention in Medical Students

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## ABSTRACT

**Background:** Learning with videos activates one's sensory of sight and hearing, while learning with mnemonics helps one remember things more efficiently. Combining both audiovisual and mnemonic learning helps medical students to retain knowledge and gives better illustration and clarity towards learning compared to learning using text reading alone. This randomized control trial aimed to compare the learning with audiovisual mnemonic and text reading in enhancing memory retention and their satisfaction and engagement towards the study method. **Methods:** A total of 64 students were randomized, with 32 in the intervention group (audiovisual mnemonic) and 32 in the control group (text reading). Memory retention was assessed by employing multiple choice questions. Moreover, satisfaction and engagement towards the studying method was also assessed. Mann-Whitney U test and Fried man test were calculated. **Results:** It was observed that there is no significant difference of memory retention score between audiovisual mnemonic learning and text reading. However, it is worth noting that memory retention significantly improved over time within the audiovisual mnemonic group. **Conclusion:** Employing audiovisual mnemonic strategies seems to offer distinct advantages for medical students, as it improves their memory retention while also enhancing their satisfaction and engagement with the learning approach.

### Keywords:

Mnemonics, text reading, memory, medical students, randomized trial

## INTRODUCTION

A mnemonic is a cognitive strategy which is used to aid memory and enhance the retention of information (Putnam, 2015). Mnemonics can take various forms, such as acronyms, acrostics, visualization techniques, rhymes, and associations. In the context of medical education, mnemonics play a crucial role in helping students remember complex medical concepts, terminology, and procedural steps. Mnemonics capitalize on the brain's ability to remember information more effectively when it is organized in a structured and memorable format (Lewis, 2018). They address the challenge of internalizing fundamental facts in medical education to facilitate critical thinking in patient care by bridging new and existing knowledge, simplifying retrieval (Shabiralyani, 2015). Moreover, research supports the use of mnemonic keyword strategies in aiding students with learning disabilities in vocabulary acquisition (Kondo, 2017).

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Human senses, both auditory and visual, work harmoniously to perceive objects, aid navigation, and shape daily life (Shabiralyani, 2015). Learning statistics show that 94% is attributed to auditory comprehension and 83% to visual perception. The amalgamation of auditory and visual faculties holds paramount importance in the realm of learning and education. Educators frequently employ diverse strategies to instruct their students, with visual aids being a preferred choice due to their capacity to engage learners (Siegel, 2017). The integration of technology brings audiovisual learning to classrooms, motivating traditional learning settings (Al Aqad, 2021). Audiovisual media offers real experiences, simplifying abstract concepts and fostering continuous learning (Fuady, 2018).

Medical education has become more personalized, with students favoring flexible online learning, including video clips, quizzes, and audio resources. It has been proven that audiovisual mnemonic learning in medical education has increased productivity when compared to traditional teaching approaches (Yang, 2014). A study conducted among first-year medical students revealed that those exposed to audiovisual mnemonic learning achieved superior academic performance compared to their counterparts who relied on text reading in the subjects of Microbiology, Parasitology and Pharmacology (Abdalla, 2021). Another study, involving fourth-year medical students in United States, disclosed that mnemonics employing visual imagery enhanced retention of information spanning a 21-day duration (DeMoll, 2015). Moreover, undergraduates found visual learning, especially in Biochemistry, improved memory recall compared to traditional textbook methods (Morisaki 2016). A research study on osteopathic medical students demonstrated that individuals who utilized the audiovisual mnemonic technique retained information more effectively and for a longer duration (Yang, 2014).

Public health, with its complex theories, terminology, and data, necessitates students' ability to simplify and recall essential information. Mnemonic techniques provide a systematic approach for simplifying intricate concepts, enhancing effective learning and precise retrieval of key information (Putnam, 2015; Lewis, 2018). Studies suggest audiovisual mnemonics enhance learning efficiency in medical education, yet further exploration is required to understand their full impact on memory retention and satisfaction when learning public health topics. Therefore, this research was carried out to evaluate the effect of learning with audiovisual mnemonic on memory retention in comparison with text-based learning among clinical year medical students. Additionally, the study gauged the levels of satisfaction and engagement associated with these two learning approaches.

## METHODS

A parallel randomized controlled trial was conducted from December 2022 to January 2023 at Manipal University College Malaysia. The study population involved 121 clinical year students who were attending Bachelor of Medicine and Bachelor of Surgery (MBBS) programme. To determine the necessary sample size, we employed GPower software, using an effect size of 1.34 (Yang, 2014), 80% statistical power, and a 95% confidence interval. The calculated minimum sample size required was 8 participants per intervention arm. However, we extended invitations to all year-3 students through Instagram stories and WhatsApp messages. We included students from diverse genders, ethnicities, and nationalities who were pursuing the year-3 MBBS course. The criterion for exclusion was that students should not have previously studied topics related to public health, specifically epidemiologic research designs. Students who had taken sedative medications on the day of the experiment were also excluded. Student participation in the study was entirely on a voluntary basis. At the outset of the study, students were given a clear explanation of the study objectives and were asked to provide written informed consent. Furthermore, students retained autonomy to participate and had right to withdraw at any point during the study. Students were also provided with the opportunity to acquire further information about the study before deciding to take part. To safeguard privacy, all collected data and the identities of the volunteers were kept confidential. The study received approval from the Research Ethics Committee of MUCM (MUCM/Research Ethics Committee – 087/2022).

Ultimately, 64 students agreed to participate in the study. To create two equal-sized groups, we implemented block randomization with block sizes of 2 and 4 and randomly assigned these students into either the intervention group, which utilized Audiovisual Mnemonic learning, or the control group, which employed text-based reading learning. The control group consisted of 32 students and the intervention group consisted of 32 students.

Prior to commencing the study, the research investigators conducted a briefing for all the students involved in the research. During this briefing, we conveyed the study objectives and procedures in a language that ensured the students' best understanding. Following this, we obtained written informed consent from the students. Additionally, we conducted a question-and-answer session to address any inquiries or uncertainties the students had. After the briefing session, the students of both intervention and control groups took a pre-test consisting of multiple-choice questions (MCQ) with a time limit of 17 minutes on three public health topics specifically epidemiologic research designs. During this session, participant's demographic characteristics such as age, gender, ethnicity, nationality, and other variables such as exercise activities and practice of mindfulness or meditation were also asked.

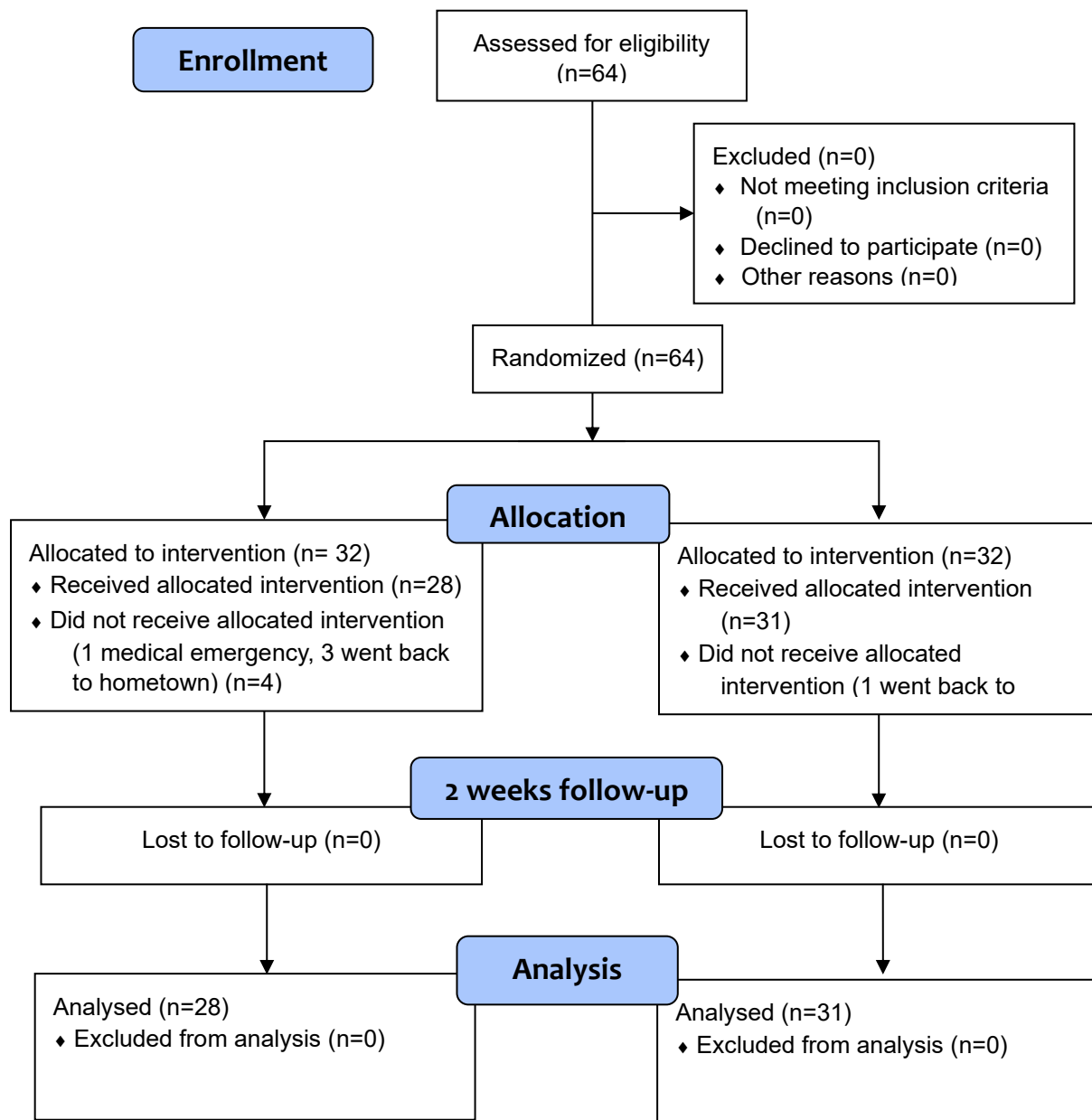
After the pre-test, the intervention group were immediately asked to watch a 15-minute Audiovisual Mnemonic video explaining these topics. The students need to watch the video for two times with a 5-minute break in between. The control group were asked to read epidemiologic research design topics. The content of the topics was developed based on Basic Epidemiology 2<sup>nd</sup> Edition (Bonita, 2006). The control group had two reading sessions each spanning 15 minutes with a 5-minute break in between to read through and understand their material. After the learning period of 35 minutes, both control and intervention group were given an immediate post-test of the same MCQs in the pre-test with a different order. Additionally, follow-up assessments were conducted on the 7<sup>th</sup> and 14<sup>th</sup> days after the intervention. During these assessments, students were tasked with completing the same MCQ test, albeit with questions presented in a different sequence.

We developed 17 multiple-choice questions (MCQs) containing four answer choices in each question. These MCQs were utilized in the pre-test, immediate post-test, as well as the post-intervention assessments conducted on the 7<sup>th</sup> and 14<sup>th</sup> days. The purpose of these assessments was to evaluate the retention of memory. Regarding the validity of MCQ test, the content was assessed by the Public Health expert and we calculated two indices: the difficulty index (DIF-I), which measures the proportion of examinees who answered an item correctly and indicates its level of difficulty, and the discrimination index (DI), which evaluates an item's ability to distinguish between students who possess knowledge in the subject matter and those who do not (Singh, 2021). Students were instructed to select a single correct response for each question. Total score of the test was calculated and higher score indicates better retention of memory.

Following the 14-day post-intervention test, students were also provided the questionnaire to measure their satisfaction and engagement with the learning materials they had encountered. The questionnaire consisted of 12 items, which encompassed the statements regarding the student's capacity to recall information effectively, sustain focus during their designated learning method, evaluate the efficiency and effectiveness of their learning approach in retaining intricate information, and ascertain whether they found the presentation of the learning method uninteresting (Yang, 2014). Each item on the satisfaction questionnaire was assessed using a 5-point Likert scale, ranging from 5 (strongly agree) to 1 (strongly disagree).

The data were entered using Microsoft Excel and analyzed using SPSS version 28. Descriptive statistics, including frequency and percentage, were computed for categorical data, while median and quartiles

were calculated for quantitative data. To compare memory retention, satisfaction, and engagement between the intervention and control groups, the Mann-Whitney U test was applied. The Friedman test was employed to assess changes in memory retention across different time points such as pre-test, immediate post intervention, 7<sup>th</sup>, and 14<sup>th</sup> days after intervention. A Bonferroni correction was applied for pairwise comparison between different timepoints. A significance threshold of 0.05 was set for all statistical analyses.



**Figure 1:** Consort flow diagram

## RESULTS

Table 1 presents the baseline characteristics of the two groups, the audiovisual mnemonic and text reading groups. In the intervention group, 64.3% of the students were female, while in the control group, 54.8% were female. A significant portion of both groups, 78.6% in the intervention group and 71% in the control group, reported using online infographic videos as part of their study materials. Additionally, when it came to prior experience with mnemonic techniques in learning, 82.1% of the intervention group and 83.9% of the control group had previous exposure to such methods. [Table 1]

**Table 1:** Baseline characteristics of students among audiovisual mnemonic group and text reading group.

Variables	N (%)	
	Audiovisual mnemonic (n=28)	Text reading (n=31)
<b>Age</b>		
Median (Q1, Q3)	21 (21, 22)	21 (21, 22)
<b>Gender</b>		
Male	10 (35.7)	14 (45.2)
Female	18 (64.3)	17 (54.8)
<b>Ethnicity</b>		
Malay	1 (3.6)	1 (3.2)
Chinese	3 (10.7)	7 (22.6)
Indian	16 (57.1)	12 (38.7)
Others	8 (28.6)	11 (35.5)
<b>Nationality</b>		
Malaysian	22 (78.6)	22 (71.0)
International	6 (21.4)	9 (29.0)
<b>Exercise</b>		
Everyday	2 (7.1)	5 (16.1)
1-2 times a week	21 (75.0)	21 (67.7)
Never	5 (17.9)	5 (16.1)
<b>Meditation</b>		
Yes	5 (17.9)	7 (22.6)
No	23 (82.1)	24 (77.4)
<b>Studying medicine using online infographic video</b>		
Yes	22 (78.6)	22 (71.0)
No	6 (21.4)	9 (29.0)
<b>Studying medicine using mnemonic</b>		
Yes	23 (82.1)	26 (83.9)
No	5 (17.9)	5 (16.1)
<b>Revision of topics by him/herself at week 1</b>		
Yes	4 (14.3)	2 (6.5)
No	24 (85.7)	29 (93.5)
<b>Revision of topics by him/herself at week 2</b>		
Yes	5 (17.9)	3 (9.7)
No	23 (82.1)	28 (90.3)

Table 2 presents the findings regarding memory retention scores, indicating the absence of statistically significant differences between the audiovisual mnemonic and text reading groups at various assessment time points. Specifically, no statistically significant differences were observed at the immediate post-test ( $P = 0.458$ ), the 7-day post-intervention assessment ( $P = 0.708$ ), and the 14-day post-intervention evaluation ( $P = 0.577$ ). However, a significant difference was evident at the pre-test, indicating that the text reading group had a higher median score ( $P = 0.021$ ). [Table 2]

**Table 2:** Memory retention between audiovisual mnemonic group and text reading group.

Variables	Median (Q1, Q3)		P value
	Audiovisual mnemonic (n=28)	Text reading (n=31)	
<b>Memory retention (score) (0-17)</b>			
Pre-test	5.5 (4, 6.8)	7 (5, 8)	0.021*
Immediate post-test	10 (9, 11.8)	11 (6, 13)	0.458*
At 7-day post intervention	7 (5.3, 10)	7 (5, 10)	0.708*
At 14-day post intervention	7 (5, 9.8)	8(6, 10)	0.577*

\*Mann-Whitney U test

Table 3 presents the comparisons of memory retention scores between different time points in each intervention group. Significantly different memory retention scores were observed within both the audiovisual mnemonic group ( $P < 0.001$ ) and the text reading group ( $P < 0.001$ ). Pairwise comparisons indicated statistically significant differences between the pre-test and all other time points in the audiovisual mnemonic group. In the text reading group, the pre-test and the 7-day post-intervention assessment did not exhibit a statistically significant difference. Conversely, no significant differences in memory retention scores were noted between the 7-day and 14-day post-intervention assessments in either group. [Table 3]

**Table 3:** Memory retention between difference timepoints among audiovisual mnemonic group and text reading group.

Comparison	Median (Q1, Q3)	
	Audiovisual mnemonic (n=28)	Text reading (n=31)
Pre-test	5.5 (4, 6.8)	7 (5, 8)
Immediate post-test	10 (9, 11.8)	11 (6, 13)
7-day post intervention	7 (5.3, 10)	7 (5, 10)
14-day post intervention	7 (5, 9.8)	8(6, 10)
<b>Friedman test repeated measure (P value)</b>	<0.001	<0.001
<b>Pairwise comparison with Bonferroni correction (P value)</b>		
Pre-test vs Immediate post-test	<0.001	<0.001
Pre-test vs 7-day post intervention	0.003	0.403
Pre-test vs 14-day post intervention	0.008	0.044
Immediate post-test vs 7-day post intervention	0.004	<0.001
Immediate post-test vs 14-day post intervention	0.002	0.016
7-day post intervention vs 14-day post intervention	0.756	0.238

Table 4 shows that audiovisual mnemonic group exhibited notably higher median scores in terms of satisfaction in various aspects compared to the control group. Specifically, significant differences were observed in the following areas: satisfaction with the efficiency of study time ( $P = 0.004$ ), satisfaction with the ability to remember complex information ( $P = 0.001$ ), and satisfaction with the intent to use the study method received in the future ( $P = 0.001$ ). Additionally, significant differences were found between the two groups in terms of perceptions of the presentation materials being boring, the method's inability to present information in a memorable fashion, and the method's inefficiency about studying complex information. [Table 4]

**Table 4:** Satisfaction and Engagement between audiovisual mnemonic group and text reading group

Satisfaction Survey Item	Median (Q1, Q3)		P value
	Audiovisual mnemonic	Text reading (n=31)	

	(n=28)		
Using this educational method, I was able to recall the information well	3 (2.5, 4)	3 (2, 3)	0.133*
Studying with this method is an efficient use of my study time	3.5 (3, 4)	3 (2, 3)	0.004*
The presentation of the material did not keep me focused	3 (2, 3.5)	3 (3, 4)	0.264*
Using this method, I was able to remember complex information well	4 (3, 4)	3 (2, 3)	0.001*
The presentation of material was boring	3 (2, 3)	3 (3, 4)	0.005*
The given method failed to present the information in a memorable fashion	2.5 (2, 3.5)	3 (3, 4)	0.041*
I had a satisfying study experience	3 (2.5, 4)	3 (2, 3)	0.111*
This is an inefficient way to study complex information	3 (2, 3)	3 (3, 4)	0.024*
I would look forward to studying more with this type of method	4 (3, 4)	3 (2, 3)	0.001*
Using the given method, I was able to maintain focus	3 (3, 4)	3(2, 3)	0.146*
This study method was ineffective in helping me remember the information presented	3 (3, 4)	3 (2.5, 4)	0.250*
I feel like I am going to forget about many of these topics after today	3 (3, 5)	3 (3, 4)	0.919*

\*Mann-Whitney U test

## DISCUSSION

We conducted a randomized controlled study to assess the impact of audiovisual mnemonic-based learning on memory retention in comparison to traditional text-based learning. Specifically, our investigation centered on comparing memory retention between clinical year medical students who engaged in audiovisual mnemonic learning and those who had text-based reading. Additionally, we explored student's satisfaction and engagement between these two learning approaches.

In our study, it was observed that the audiovisual mnemonic group had lower memory retention scores than the control group during the pre-test phase. However, no statistically significant differences were identified between the two groups at the immediate post-test, the 7-day post-intervention assessment, and the 14-day post-intervention evaluation. This outcome contrasts with the findings of a prior randomized control study conducted among first-year medical students in Malaysia, which demonstrated that students exposed to story based audiovisual mnemonic sessions outperformed those engaged in text-based learning (Abdalla, 2021). Similarly, an experimental study involving Bachelor of Ayurvedic Medicine and Surgery students showed that mnemonics, although not audiovisual, enhanced the learning process and improved students' recall capacity (Tawalare, 2014). Furthermore, research conducted among second-year medical students in India indicated that the use of visual mnemonics led to statistically significant academic improvements (Samuel, 2017). Additionally, a study involving first-year osteopathic medical students revealed that the audiovisual mnemonic group exhibited better performance on free-recall tests compared to the control group (Yang, 2014).

Our study revealed a statistically significant enhancement in memory retention among students who underwent audiovisual mnemonic training, from the pre-test to the assessment conducted 14 days after

the intervention. This aligns with findings from prior research, where the use of mnemonics led to improved learning outcomes, as evidenced by higher scores in post-intervention assessments compared to pre-tests (Yang, 2014; Tawalare, 2014; DeMoll, 2015). However, it is worth noting that while audiovisual mnemonic techniques demonstrated superior immediate-term results, they did not contribute to sustained knowledge retention when evaluated one month after the intervention, as indicated in a study by Morisaki (2016).

Regarding the satisfaction and engagement, the audiovisual mnemonic group expressed higher levels of satisfaction and engagement with their learning approach. This group believed that utilizing audiovisual mnemonic for their studies was an effective use of their study time and enabled them to retain complex information effectively. Additionally, they disagreed with the notion that learning with audiovisual mnemonic failed to present information in a memorable manner, and they expressed an eagerness to continue studying using this specific approach. In alignment with our findings, earlier research also indicated that the cohort utilizing audiovisual mnemonics felt it aided their retention of complex information and served as a more memorable means of conveying content. These studies further suggested that mnemonics simplified the learning process, enhanced its enjoyability, and overall improved the learning experience (Tawalare, 2014; Abdalla, 2021).

We encountered some limitations during our study. Because of time constraint, we were unable to examine memory retention beyond a two-week period. Secondly, the need to schedule the intervention after medical students' demanding clinical activities during the day may have had an impact on the evaluations of memory retention. Finally, the inability to assess the individual learning styles of students could have introduced a potential confounding in our findings.

It is recommended that medical students incorporate audiovisual mnemonic learning into their regular study routines as this approach can enhance the retention of concepts over extended periods and facilitate the application of acquired knowledge in their professional careers. Training sessions or workshops should be provided for students on how to effectively use audiovisual mnemonics. It is advisable to assess the learning styles of individual students to determine if audiovisual mnemonics are well-suited to their preferences. Additionally offering guidance on when and how to incorporate these techniques into their study routines can prove advantageous. We suggest that future research on a larger scale be conducted to gain deeper insights into the effectiveness of audiovisual mnemonic learning, particularly within the realm of Public Health. Given the wide range of topics covered in Public Health, including formula-based and factual topics, we recommend assessing these areas using audiovisual mnemonic techniques over more extended durations and with larger sample size. Moreover, further research on the effectiveness of audiovisual mnemonics in various medical disciplines and among different groups of medical students will contribute to a growing body of knowledge on best practices.

## CONCLUSION

In conclusion, while our study did not reveal statistically significant differences in memory retention between the audiovisual mnemonic and text reading groups, it highlighted the pronounced advantages of audiovisual mnemonics in terms of student satisfaction and engagement. These findings underscore the potential benefits of integrating audiovisual mnemonic techniques into medical education, particularly for enhancing student satisfaction and motivation in the learning process. Further research and exploration of this learning method are warranted to uncover its full potential and application in medical education.

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