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# Visualizing Success: Amplifying Learning Outcomes across VARK Learning Preferences through Visual Notes[†]

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## Abstract

This study investigates the impact of visual notes on learners' learning outcomes, as well as examines whether learners' different learning preferences would moderate such an impact. An experimental design was conducted using 200 university students, with 100 students in the treatment group (with visual notes) and another 100 students in the control group (without visual notes). Furthermore, based on VARK learning preferences, 100 students in the treatment group were divided into five different learning preference groups. The findings reveal that visual notes indeed significantly increase learners' learning outcomes, whereas learning preferences only moderate the impact of visual notes on the lower-level learning outcome but not the higher-level learning outcome, emphasizing the importance of educational material design. This research sets the stage for further exploration of pedagogical practices leveraging visual elements to optimize learning experiences for fostering inclusive learning environments tailored to diverse learner profiles.

**Keywords:** Visual note, VARK learning preferences, Learning outcomes

## Introduction

Throughout the centuries, educators have always been searching for ways to promote effective learning and foster skills retention. Visual notes, a tool that combines written and visual elements to capture and organize information (Rohde, 2012), has gained traction as a potentially powerful learning material (Perry et al., 2017; Pillars, 2016; Zeyab et al., 2020) that can be seen in conferences, and workshops (Neil, 2022; Lindberg, 2018; Sturdee et al., 2018). Due to their adaption in real-time to reflect the speaker's shifting emphasis or the listener's developing comprehension, visual notes hold promise for students to strengthen their understanding of complex concepts (Shambaugh, 1994), deeper recall and retention (Andrade, 2010), and actively engage with course content (Lopatovska et al., 2016). According to the finding of Fernández-Fontecha et al. (2018), visual notes' uniqueness to make the ideational context accessible and evoke a sense of friendliness enhances participant engagement and stimulation. They are often drawn to the vibrant and dynamic presentation, making content more memorable than traditional text-heavy notetaking (Ink Factory, 2021). Therefore, they are very helpful, especially to visual learners who are more commonly found (Felder & Sliveman, 1988).

While learning tools can enhance a learner's ability to acquire and understand knowledge, it is crucial to recognize that each student possesses their own unique learning preferences and styles (Willingham et al., 2015), as not all students will naturally gravitate towards visual notes. Students may prefer alternative methods such as listening to lectures, reading and highlighting text, or participating in hands-on activities. One influential framework developed by Fleming and Mills (1992) that addresses the diversity of learning preferences is the VARK model, which categorizes learners into four distinct types: Visual, auditory, reading/writing, and kinesthetic. The research findings highlight that attributing poor academic performance solely to a student's abilities overlooks the crucial factor of a mismatched teaching style.

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Consequently, Fleming (1995, 2006, 2012), through a series of research studies, has consistently conducted questions to assist students in discovering their learning styles which enable both instructors and students to tailor learning approaches that enhance more effective learning outcomes.

As visual notes encompass both drawings and text, this research aims to investigate the impact of visual notes on learners across different learning preferences on how they influence learning outcomes. While many previous studies have explored the benefits of taking visual notes by enhancing engagement and memory retention, not many studies paid attention to whether learners' different preferred learning styles would cause visual notes to have different levels of beneficial effect on learners' learning outcomes. This research thus strives to fill this gap by analyzing the learning outcomes of different types of learners' learning styles when using visual notes as a learning tool.

To sum up, the purpose of this study is to empirically test the impact of visual notes on learners' learning outcomes, as well as investigate whether learners' learning preferences would moderate the impact of visual notes on learners' learning outcomes. The findings of this study will provide empirical insights for trainers and educators on the potential benefits and best practices for incorporating visual notes as a pedagogical tool for different learning preferences. Using the right tools for the right person, creates a learning environment that accommodates various learning styles, ensuring that all students have equal opportunities to succeed and thrive academically. Moreover, the implications derived from the study can serve as a foundation for further research and HR researchers and practitioners regarding exploring additional strategies and techniques that leverage visual elements to optimize teaching and learning processes among employees.

## Literature reviews

### Visual notes

Visual notes or Sketchnoting are a non-linear composition powerful communication tool that employs a blend of text and imagery to effectively capture and convey key points from various sources such as presentations, meetings, or class lectures. In general, visual notes are created in real-time while actively listening to the content being presented, typically hand-drawn using pen and marker digital drawing tools (Neil, 2022). As Rohde (2012) mentioned that they are ideas, not art, visual notes don't require artistic skills to create one. Hence, several researchers and practitioners encourage people to implement this note in their meetings or classrooms (Araújo et al., 2022; Gonzalez, 2018; Perry et al., 2017; Pillars, 2016; Zeyab et al., 2020). However, in this research, visual notes refer only to the finished note that is commonly used as a summary at the end of conferences or classes.

Despite the advancement of artificial intelligence, this analog tool relying on human skills is still increasingly gaining widespread popularity (Dimeo, 2016; Tran 2021). Visual notes offer a multitude of applications and can be utilized in various ways. The most impactful and common approach is to do visual note-taking as they are empowered to actively participate in the process of capturing and organizing information. Furthermore, the act of creating visual notes enhances individuals' ability to synthesize and distill complex information into clear and concise visual representations (Dalali & Mwila, 2022; Dimeo 2016; Lewis & Sturdee, 2023; Perry et al., 2017; Shabiralyani et al., 2015; Wammes et al., 2016).

Nevertheless, many people feel concerned about their drawing abilities and find it challenging to simultaneously listen and take notes (Dimeo, 2021; Tran, 2021) making the demand for professional visual note-taking services risen significantly (Neil, 2022; Paepcke-Hjeltness & Lu, 2020; Rohde, 2012) Some organizations may train or hire visual note-taker for a position so that they can ensure important information and discussions are accurately documented in an engaging and visually appealing format (Ink Factory, 2022). Leading to the usage of visual notes as summary notes for individuals who did not participate in the original talk or recap after the class, often seen in students before an exam (Rohde, 2012). Although the primary purpose of visual notes is to facilitate during the event, users also find value in shareable resources like hand-drawn infographics (Dadzie et al., 2020; Dalali & Mwila, 2022; Lopatovska et al., 2016). With their rough patterns and interesting additions, possess a unique style that sets them apart from traditional infographics. The raw and spontaneous nature of visual notes, coupled with their unique blend of text and illustrations, adds a level of authenticity and human touch that resonates with readers. This personal touch

sets visual notes apart from more polished infographics, allowing them to stand out and maintain their appeal. (Lupi & Posavec, 2017; Stinson, 2017)

Based on 3M Corporation internal research, it has shown that visual information is processed by the brain significantly faster than text, with individuals absorbing visual content up to 60,000 times faster than written words. Even more, 90 percent of information transmitted to the brain is in a visual format (Trafton, 2014). Shabiralyani et al. (2015) and Pateşan et al. (2018) also confirmed that students and teachers agree that visual aids can help memorize vocabulary. This suggests that visual notes not only capture attention but also serve as "bookmarks" in the brain (Ink Factory, 2021), aiding in memory retention and recall (Udomon et al., 2013; Zeyab et al., 2020).

How visual notes can benefit learners' learning outcomes can be explained by the cognitive information processing model (CIP). The model emphasizes the active role in processing information, with an emphasis on attention, memory, and problem-solving. Our memory functions are like a computer. In response to external stimuli, our brain processes the information received from our senses. (Atkinson & Shiffrin, 1968) Following this, this information can be stored in either a short-term or long-term memory depending on its significance. Craik and Lockhart (1972) also mentioned "the meaningfulness extracted from the stimulus rather than in terms of the number of analyses performed upon it" (p.48). Since short-term memory or working memory has a limited capacity to store, visual notes can help reduce cognitive load by encoding complicated information that may burden our brain to process more. Breaking down complex information into manageable chunks allows individuals to allocate their cognitive resources, leading to improved cognitive performance and comprehension (Rosnov & Roberts, 2005).

In a recent exploratory study by Courneya and Cox (2020), medical students were assigned to create individual visual notes based on their medicine lessons and share them on Instagram, fostering a collaborative learning environment among peers. The findings of the study revealed that students associated enhanced learning and retention with both the process of creating their own visual notes and looking at their classmates' drawings. Furthermore, this activity infused a sense of humor and enjoyment into the classroom setting as well.

Another study by Paepcke-Hjeltness et al., (2017) incorporated visual notes into freshmen engineering classes. The qualitative findings of this study highlighted students' ability to visualize and process research, facilitating a deeper understanding of concepts and improved idea connections. Meaning that visual notes can also support the integration and synthesis of information by visually connecting related concepts and ideas to see the bigger picture, identify patterns, and make connections as it helps visual-spatial working memory, which can assist in understanding and retaining visual information, to navigate and manipulate it more effectively. This process of integrating and synthesizing information enhances higher-order cognitive processes such as critical thinking, problem-solving, and concept formation.

**Learning outcome - Bloom's taxonomy (lower-order thinking skills)**

Bloom's taxonomy is a comprehensive framework that is extensively used in education. Its have been instrumental in formulating clear and measurable learning objectives and outcomes (Thompson & Lake, 2023; Thompson & O'Loughlin, 2014; Virranmäki et al., 2020; Zaidi et al., 2017). Some use it as a guiding blueprint to design courses and develop corresponding assessments (Brame, 2019; Krathwohl, 2002; Radmehr & Drake; Smith et al., 2021; Sharunova et al., 2018; Tyran, 2010). This framework classifies learning into three domains: cognitive, affective, and psychomotor developed by Benjamin Bloom and subsequently revised by his followers to replace the limitation of application by presenting more action verbs and emphasizing the interconnectedness of learning that cannot be neatly compartmentalized (Anderson et al., 2001). Due to the design of the experiment, this study will only focus specifically on the revised cognitive domain in the lower-order thinking skill or basic thinking consisting of Remember (Knowledge) – which involves recalling or retrieving information from memory, such as facts, terms, or concepts, Understand (Comprehension) – learners demonstrate comprehension and interpretation of the information. They can explain ideas, summarize concepts, provide examples, and Apply (Application) – learners use their understanding to analyze and address new problems and perform tasks in real-world situations, as shown in **Table 1**.

**Table 1** Bloom taxonomy's lower order rank.

| Cognitive domain | Description | Action verb |
|---|---|---|
| *Remember* | An ability to recall and remember information | define, describe, identify, list, name, order, recognize |
| *Understand* | An ability to understand and explain concepts | classify, discuss, distinguish, estimate, extend, indicate, review |
| *Apply* | An ability to use information in a new setting | apply, choose, compute, illustrate, modify, practice, solve |

Note. Adapted from "A taxonomy for learning, teaching, and assessing: A revision of bloom's taxonomy of educational objectives, abridged edition" by Anderson et al. (2001).

**VARK learning preference**

Recent discussions have focused on the implications of understanding a learner's learning style in order to encourage and facilitate complex learning processes (Willingham et al., 2015). For this study, the VARK model (Fleming & Mills, 1992) was chosen due to its wide acceptance and its categorization of individuals based on sensory modalities. The VARK model provides a straightforward framework that is easy to comprehend and implement, making it suitable for future applications after the completion of this study. Plus, the instrument was simple and short with 16 updated questions, unlike other assessments (VARK Learn, 2014).

The VARK learning preference model categorizes learners into 4 main preferences based on how they prefer to receive and process information, as shown in **Table 2**. *Visual learners* prefer learning through visual aids as they can grasp information better when it is presented in a visual format. *Auditory learners* excel in learning through listening and verbal communication. They prefer lectures, discussions, and audio materials. Repeating information aloud and participating in group discussions can enhance their learning experience. *Reading/Writing learners* thrive when learning through written texts. They prefer reading information, taking notes, and writing summaries or essays to reinforce their understanding. *Kinesthetic learners* learn best through hands-on experiences and physical activities. They like a tactile and active approach, involving movement, touching objects, and engaging in practical tasks to grasp and retain knowledge (Fleming & Mills, 1992).

Learners who do not significantly show a 40 % VASK test score in any category will be considered to be 'multimodal', meaning that they utilize all modalities situationally. Each preference represents a different mode of learning and indicates the preferred sensory modality through which individuals best understand and retain information (Seyal & Rahman, 2015).

**Table 2** Types of VARK learning preference.

| VARK Learning styles | Fleming's recommendation of studying e-Learning | e-Leaning "Ask and learning" (How to use) |
|---|---|---|
| *V (visual)* | Pictures, videos, posters, slides, flowcharts, graphs, and diagram | Video, PPT |
| *A (audio)* | Discussion topics and ideas, remembering stories and jokes | PPT with audio Podcast |
| *R (reading)* | List, headings, dictionaries, definitions, textbook, and manual | PPT hands-on, Text documented, Published resources |
| *K (kinesthetic-doing)* | Interested in doing, practical real, and relevant | Design assignment, practice exercises |
| *Multimodal* | The mix of the above learning styles and learning objectives | |

Note: Adapted from "Understanding learning styles, attitudes and intentions in using e-learning system: Evidence from Brunei" by Seyal and Rahman (2015).

According to Fleming and Mills (1992), researchers should not conduct research indicating that certain preferences within the VARK model are more effective for individuals as people can adapt and apply the VARK model in different situations depending on the specific learning environment and context, like a Multimodal learner. Note that preferences can be challenging to change over time. Nevertheless, this does not imply that individuals will completely refuse to learn through other methods.

The VARK model acknowledges that individuals have diverse learning preferences and suggests that tailoring instructional methods to match these preferences can enhance learning outcomes. Numerous studies have explored the application of the VARK model in educational settings, investigating its impact on teaching methodologies, curriculum design, and student performance (Liew et al., 2015; Othman & Amiruddin, 2010; Payaprom & Payaprom, 2020).

**Visual notes and learning outcome**

Visual note-taking has been extensively studied as a note-taking practice. When individuals engage in the process of creating visual notes, they personalize their note-taking experience by incorporating their own understanding and cognitive processes (Paepcke-Hjeltness et al., 2017). This approach allows them to actively engage in patternmaking, enhance attentional engagement for memorable learning, deepen their understanding of complex topics through the creation of unique representation conventions, and effectively communicate and explain information to peers (Neil, 2022; Rohde, 2012).

However, limited research has focused on exploring the effectiveness of reading others' visual notes in promoting memory retention and deeper understanding since more and more visual notes have been shared after classes or conferences (Stinson, 2017). A famous study about the Cone of Experience by Dale (1946) indicates that people tend to retain approximately 80 % of what they see and do, in contrast to 10 % of what they hear, 20 % of what they read, and 30 % of what they see. It is clear from these findings that visual stimuli have a significant impact on memory retention, so incorporating visual elements into learning and information processing is imperative. By leveraging the power of visual representation, individuals can enhance their ability to remember and recall information more effectively (Lester, 2016).

Based on numerous researchers that have shown the efficacy of visual aids in enhancing memory retention and understanding (Dadzie et al., 2020; Dalali & Mwila, 2022; Lopatovska et al., 2016), the paper aims to investigate whether visual notes created by others can also contribute to enhanced learning outcomes. The following hypothesis is formulated:

**H1: Visual notes have a significant positive impact on learning outcomes (a) remember (b) understand (c) apply**

**VARK learning preference as a moderator**

"Sketchnoting is not an 'end all' to information synthesis, and not everybody adapts and implements it as quickly as others" (Paepcke-Hjeltness & Lu, 2020, p.63). While visual notes can be a useful strategy for information synthesis, they may not be equally effective by all individuals based on their learning preferences. For example, auditory learners might find it challenging to fully capture visual notes without accompanying audio cues or verbal explanations. Kinesthetic learners, who thrive on hands-on experiences, may not find it as their preferred method of learning since it primarily involves visual and cognitive processes. In addition, Udomon et al. (2013) investigated the impact of different types of stimuli on memory retention and recall and proposed that multimodal stimulation, specifically combining visual stimuli with writing, would be more effective compared to using a single type of stimulus.

Based on the above discussion, different people with different learning preferences may react differently to visual notes as a learning tool, which in turn affects their learning outcomes differently. Therefore, the following hypothesis is constructed to examine whether utilizing visual notes can give different results across different learners, it is hypothesized as followed:

**H2: Learning styles would moderate the positive impact of visual notes on learners' learning outcomes (a) remember (b) understand (c) apply**

## Methodology

This study conducted an experimental design utilizing quantitative methods. Participants were categorized into 2 groups: One with a visual note and another with a report. The group with a visual note was further divided according to the VARK model. This experimental setup enabled a comparative analysis of the different groups' performance.

### Participant

According to the studies conducted by Gall et al. (1996) and Muller and Cohen (1989), it is recommended to have a minimum of 15 participants in each experimental group for an effective result. In line with this recommendation, our experiment involved a total of 200 participants. The treatment group was divided into five groups, each representing a different VARK learning preference, with 20 participants in each group. Additionally, the control group consisted of 100 participants who read a one-page report without visual aids. To ensure consistency among participants, college students were the main subject of this experiment, allowing for control of factors such as age and experience.

### Procedure

Responses were gathered through an onsite setting and filled out the online-based assessments scheduled to take place in July 2023. Since the criteria of this study were only to classify individuals into six distinct categories, to achieve a diverse population, the author utilized simple random sampling techniques**.** Specifically, classes of international college students from various universities were selected, ensuring representation beyond a single country**.** The research framework is depicted in **Figure 1**.

Participants had a five-minute time constraint to read a one-page visual note and report, which they read and captured before proceeding to a follow-up fifteen-minute exam and survey. Before completing the assessment, participants were directed to the official VARK questionnaire website to determine their specific learning preference type. By utilizing the established questionnaire, participants had the opportunity to identify their learning styles accurately and contribute to the overall findings of the study. All responses were anonymous.

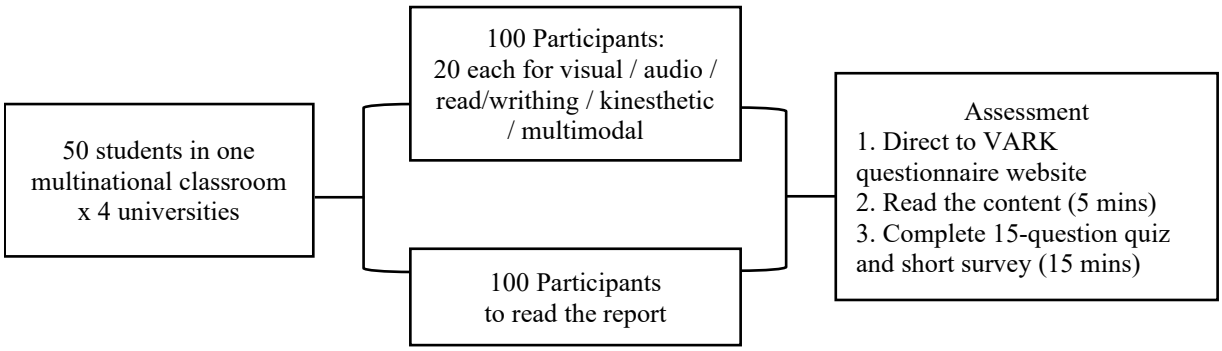


**Figure 1** Experimental procedure.

### Measurement

#### *Visual note*

The one-page visual note used in the assessment contained a condensed summary of a 1-page report as shown in **Figure 2**. The content was chosen to be comprehensible for all participants**.** Referring to research by Brysbaert (2019), the average reading rate for non-technical content is approximately 2 min per page, considering a range of 220 - 350 words per minute. In the experiment, the report contains 787 words which should be given 3 - 4 min. To accommodate participants whose first language is English, an additional minute is provided to ensure sufficient time for reading and understanding the material.

**Taiwan's Transition – *from Garbage Island to Recycling Leader***

Taiwan underwent major political and socioeconomic changes from 1980 to 1989, inevitably resulting in mass migration from rural areas into the capital city: Taipei. With the high level of population concentration came an accumulation of waste. Thousands tons of waste produced daily rendered the city environment toxic. The colossal amount of trash had been discarded without any form of sorting. The decomposition of organic materials resulted in a foul smell throughout the city, which had become a playground for pests such as rats and cockroaches. Garbage was a threat to the people's livelihood and an obstacle to national development.

Taiwan introduced the Extended Producer Responsibility (EPR) in 1988, requiring manufacturers and importers to form associations and bear financial responsibility for recycling. However, only 45 percent of product and packaging waste is covered by EPR schemes. Taiwan's recycling fund acknowledges the complexity of recycling and encourages partnerships between public and commercial entities to reduce waste. In 1997, the "4-in-1 recycling program" was established, involving the government, manufacturers, consumers, and licensed recycling enterprises. Instead of associations, manufacturers and importers now pay recycling fees and collect waste from consumers for recycling. These fees support the Recycling Fund, which subsidizes collection and recycling by licensed enterprises.

Today Garbage Island is no more. Impressively, Taiwan has turned things around in just a couple of decades. The island nation now boasts one of the most effective waste management systems in the world, which requires active participation from its citizens. Instead of having allocated garbage disposal areas, the City of Taipei requires urban dwellers to take their trash out to the garbage truck themselves. The city encourages its people to dispose of their trash at home and to recycle instead. There are fixed routes and schedules for garbage trucks. For instance, garbage collection times in residential areas are early in the morning before people head to work and in the evening when most of them have already returned home. In commercial areas and tourist attractions, garbage is collected during the day and at night. Meanwhile, garbage collection times for universities are in the morning before class. Additionally, there are no public trash cans in residential areas, obliging homeowners to be responsible for their own trash until collection times.

Taiwanese garbage trucks are color-coded. White trucks only accept recyclable items, which are divided into categories: metal containers, aluminum containers, plastic containers, glass containers, electronic appliances, batteries, tires, and light bulbs. Before taking their recyclables to a garbage truck, residents must sort everything into the correct categories and clean the items themselves. Yellow trucks accept nonrecyclables only. Inside this yellow truck are two cans: one is for cooked food waste (rice and bread) to be turned into animal feed while the other is a compost can for raw food waste (fruit and vegetables) to be made into an organic fertilizer for the government to use in city parks or for sale to farmers at an affordable price.

Reports say that Taipei has about 4,000 garbage truck spots. There is even a mobile application that allows residents to see the whereabouts of their garbage trucks and be notified when they are near. Garbage trucks for nonrecyclables come around twice a day, six days a week: morning and evening. Every two days, they are followed by recycling trucks. Beethoven's well-known sonata "Für Elise" or "Maiden's Prayer" by a Polish composer has been broadcasted from garbage trucks to signal when it's time for residents to take out the trash. It's turned trash time into get-togethers for neighbors to meet and greet.

In addition, the "pay as you throw" scheme, which charges the residents from the garbage bag. The more their waste volume goes up, the more expensive they have to pay. Therefore, people need to recycle to reduce bag space.

Taiwan's systematic implementation of waste management and its stringent punitive measures have enabled the once-called Garbage Island to reduce its per capita waste by nearly three folds from 1.14 kg per person per day in 1998 to the latest figure of 0.38 kg per person per day. Even its recycling rate has gone up from 5.9% to 55% in 2015.

The Taiwanese government has come up with a green energy policy. Its citizens are educated about its strict garbage sorting requirements. Recycling has been prioritized. Furthermore, a new regulation obligates restaurants to stop using all plastic containers by 2020. From 2025 onwards, consumers are required to pay an additional fee to use disposable plastic containers. The country is fully committed to banning single-use plastic items by 2030, according to a policy of the Environmental Protection Administration (EPA). With the ability to effectively manage waste, Taiwan has earned the title of a recycling world leader from The Wall Street Journal.


**Figure 2** The report and the visual note.

**VARK learning preference**

Sixteen questions are used to determine the 5 different learning preferences. Previously, they are several versions developed; therefore, as the study would like to use the official VARK website version 8.01 created by Fleming is the most suitable. The respondents indicated the extent to which they agreed with each statement with 4 indicators. Example items include the following:

I need to find the way to a shop that a friend has recommended. I would:

- use a map.
- ask my friend to tell me the directions.
- write down the street directions I need to remember.
- find out where the shop is about somewhere, I know.

***Learning outcome***

Following the updated guidelines of Bloom's taxonomy (Monrad et al., 2021) for multiple questions, as outlined by Allen & The Council of Chief State School Officers (2007), this research has devised a set of 15 quiz questions to assess each stage of learning outcome. The questions are structured as shown in **Table 3**.

**Table 3** List of assessment questions.

| Bloom's Lower Order Rank | Question |
|---|---|
| Remember | What were the consequences of mass migration to Taipei in the 1980s? |
| | What was the purpose of Taiwan's Extended Producer Responsibility (EPR) introduced in 1988? |
| | How much of product and packaging waste is covered by EPR in Taiwan? |
| | What do the color-coded garbage trucks in Taiwan signify? |
| | What progress has Taiwan made in waste management? |
| Understand | What is the main idea of this article? |
| | How can you describe the "4-in-1 recycling program" in Taiwan? |
| | What " can't" you say about Taiwan transformed its waste management system in recent years? |
| | How would you identify the "pay as you throw" scheme in Taiwan? |
| | How has Taiwan reduced its per capita waste and increased its recycling rate? |
| Apply | As a responsible citizen living in a different country, how can you apply the waste management practices adopted by Taiwan? |
| | What would you do if you are a manufacturer in Taiwan, how can you fulfill your responsibility under the Extended Producer Responsibility (EPR) scheme? |
| | Why does recycling change waste reduction behaviors among citizen work? |
| | What examples can you find that he/she have done according to Taiwan waste management? |
| | How would you present the involvement of government, manufacturers, consumers, and recycling enterprises contributing to the success of the 4-in-1 recycling program? |

Note: Adapted from "Bloom's critical thinking cue questions: Cue questions based on Blooms' taxonomy of critical thinking" by Allen and The Council of Chief State School Officers (2007).

### Data analysis

The numerical data were analyzed using IBM SPSS Statistics 26 software. Initially, an independent samples T-test was conducted to compare the three levels of learning outcomes between the control and experimental groups. Subsequently, ANOVA analysis was chosen to explore the moderating effects of learning preference, followed by the Bonferroni Post Hoc test to determine specific group differences and to rectify the family-wise error rate.

## Results

### Profile of sample

As outlined in **Table 4**, the sample for this study comprises 200 university students from international colleges. The respondents included 118 females (59 %) and 82 males (41 %). A vast majority of the participants fall within the age range of 18 to 25 years old (95 %). Consistent with Fleming and Mills (1992), over a quarter of the sample exhibit multimodal learning preferences (33 %), while visual learners (24 %) and kinesthetic individuals (21 %) come in as close runners-up. Conversely, read/write (12 %) and auditory (11 %) learners are comparatively less common.

**Table 4** Profile of sample.

| Variable | Category | Frequency | Percentage (%) |
|---|---|---|---|
| Gender | Female | 118 | 59 |
| | Male | 82 | 41 |
| Age (years) | 18 - 25 | 190 | 95 |
| | 26 up | 10 | 5 |
| Learning Preference (VARK Model) | Visual | 47 | 24 |
| | Auditory | 22 | 11 |
| | Read/Write | 24 | 12 |
| | Kinesthetic/Doing | 41 | 21 |
| | Multimodel | 66 | 33 |

**Independent samples t-test results**

**Table 5** presents the means and standard deviations between a report and a visual note group. It clearly shows that the mean numbers of all three learning outcome variables in the visual note group are significantly higher than that in the report group, suggesting that visual note indeed positively influences learners' learning outcomes. Thus, H1 was supported.

**Table 5** Independent samples t-test result.

| Variable | Mean | | SD | .Sig |
|---|---|---|---|---|
| | Report | Visual note | | |
| Remember | 2.90 | 3.37 | 0.16 | (0.003) ** |
| Understand | 2.16 | 2.66 | 0.15 | (0.001) *** |
| Apply | 2.17 | 2.51 | 0.15 | (0.021) * |

Note. *$p < 0.05$. **$p < 0.01$. ***$p < 0.001$

**ANOVA results**

**Table 6** presents the results of the ANOVA analysis, which compared the learning outcomes of five different learning style learners in the treatment group in order to test the moderating effect of learning preference. The results showed that only the first-level learning outcome (i.e., Remember) has a significant difference among five different learning style learners, whereas the second-level (i.e., Understand) and third-level (i.e., Apply) learning outcomes have no significant differences among five different learning style learners. Therefore, the results support H2a, but not H2b and H2c. This emphasizes the importance of considering individual learning preferences when designing educational materials, particularly when aiming to enhance memory recall.

**Table 6** ANOVA test results.

| Variable | F | .Sig |
|---|---|---|
| Remember | 3.87 | (0.006) ** |
| Understand | 1.29 | 0.281 |
| Apply | 1.12 | 0.352 |

In **Table 7**, it is evident that individuals with multimodal learning preferences outperform those with auditory and read/write preferences, displaying notably higher test results. This observation aligns with findings from Seyal and Rahman (2015) and Udomon et al. (2013), suggesting that individuals with multimodal preferences adeptly utilize all modalities situationally to optimize their learning across diverse formats.

**Table 7** Post hoc comparison results.

| Learning outcome | Learning preference | Between Group | Mean Difference | .Sig |
|---|---|---|---|---|
| Remember | 1. Visual | 2.00 | 0.45 | 1.000 |
| | | 3.00 | 0.35 | 1.000 |
| | | 4.00 | -0.25 | 1.000 |
| | | 5.00 | -0.65 | .471 |
| | 2. Auditory | 1.00 | -0.45 | 1.000 |
| | | 3.00 | -0.10 | 1.000 |
| | | 4.00 | -0.70 | .328 |
| | | 5.00 | **-1.10*** | **.010** |
| | 3. Read/Writing | 1.00 | -0.35 | 1.000 |
| | | 2.00 | 0.10 | 1.000 |
| | | 4.00 | -0.60 | .664 |
| | | 5.00 | **-1.00*** | **.026** |
| | 4. Kinesthetic/Doing | 1.00 | 0.25 | 1.000 |
| | | 2.00 | 0.70 | .328 |
| | | 3.00 | 0.60 | .664 |
| | | 5.00 | -0.40 | 1.000 |
| | 5. Mutimodel | 1.00 | 0.65 | .471 |
| | | 2.00 | **1.10*** | **.010** |
| | | 3.00 | **1.00*** | **.026** |
| | | 4.00 | 0.40 | 1.000 |

## Discussions and implications

### Discussions

This study contributes to a deeper understanding of the role of visual aids in educational and training settings. The finding can be accounted into two main areas: the effectiveness of visual notes in improving learning outcomes and how visual notes affect individual learning preferences.

The first finding, rooted in the significant positive effect of visual notes on learning outcomes across various levels, suggests that the use of visual aids contributes not only to improved retention and understanding but also to better application as a learned material. Drawing upon cognitive processes, this theoretical implication can be further supported by considering how visual information is processed and stored in the brain. Research in cognitive psychology suggests that visual stimuli are processed more efficiently and retained more effectively than auditory or textual information (Baddeley, 2000). Visual notes capitalize on this inherent cognitive advantage by presenting information in a format that aligns with the brain's natural processing mechanisms. The use of images, diagrams, and other visual elements in visual notes facilitates the encoding of information into memory and promotes deeper levels of processing, leading to enhanced understanding and retention (Clark & Paivio, 1991).

Furthermore, the diminished scores observed at advanced levels of learning suggest that visual notes effectively support learners as they engage with more complex concepts and tasks. This finding highlights the importance of visual aids in learning experiences and guiding learners through increasingly challenging content. As noted by Anderson et al. (2001), the higher the level indicates the learner's ability in the Cognitive Process Dimension, as demonstrated through various skills such as listing, summarizing, and classifying, respectively. By forming questions to examine each level, it can describe how well they can capture information. While written formats are recommended for testing, the author contends that employing multiple-choice questions, commonly utilized in examinations, can mitigate scoring biases.

The second outcome arises from the moderating effect of learning preference on the relationship between visual notes and learning outcomes. Partial support for H2, which was significant in first-level learning outcomes (i.e., Remember), underlines the importance of considering individual learning preferences when designing educational materials for recall. This finding aligns with the model made by Fleming and Mills (1992) that multimodal learners can easily adapt their learning to various types of materials, thereby achieving superior scores compared to other preferences such as auditory and read/write.

However, it would be more captivating to investigate how visual learners and multimodal learners perform in comparison.

Although Coffield et al. (2004) and Pashler et al. (2008) assert that labeling oneself as a specific type of learner can be overly restrictive and question the existence of distinct learning styles, Fleming and Mills (1992) argue that individuals have preferences rather than fixed styles. These preferences reflect their inherent inclinations for processing and internalizing information based on cognitive and sensory factors. In line with the VARK model, acknowledging and accommodating these preferences can improve learning outcomes by providing learners with opportunities to interact with information in ways that align with their natural inclinations.

**Managerial implications**

The findings of this study offer valuable insights for practitioners seeking a new pedagogical tool to enhance learning outcomes. Firstly, the study highlights the significant positive impact of visual notes on learning outcomes, with visual notes surpassing plain text reports by nearly 10 %. Given today's information-rich environment, learners often demonstrate a preference for visual formats over text-based content, making visual notes an effective tool for alleviating the burden of data overload. Educators and trainers should strongly consider visual notes in their teaching methods to help students or trainees better remember and understand complex concepts. Beyond that, the study also indicates that once learners grasp the concepts, they can apply their knowledge to real-life situations effectively as well.

While the study only partially supported H2, which addressed the influence of visual notes on learning outcomes under different learning preferences, it confirms the importance of adopting a personalized approach in educational material design. Individuals with multimodal learning preferences exhibit superior performance compared to others and are commonly found. Educators can capitalize on this insight by integrating a variety of sensory modalities into their teaching materials, catering to the diverse learning styles of their students.

Lastly, educators and HR practitioners can foster active learning by encouraging collaborative activities where students and trainees collaborate to create visual notes. This collaborative approach promotes peer-to-peer learning. This could also be an opportunity to assess students' and trainees' ability to synthesize and communicate information visually to promote higher-order thinking skills and creativity, skills that are essential for success in both academic and professional settings. By integrating visual note-taking practices into their daily teaching routine, educators can empower students to apply these skills to real-life scenarios in their future careers, whereas students and trainees should be able to learn more effectively and efficiently in their current positions.

## Limitations

The study's focus on respondents from a university academic setting may constrain the applicability of its findings to real-world training environments. Moreover, by solely assessing short-term learning outcomes immediately after exposure to visual notes, the study overlooks the long-term retention and application of knowledge, thus limiting insights into the sustained impact of visual notes on learning effectiveness over time. Consequently, this study evaluates only the lower levels of Bloom's taxonomy. Additionally, the limited size of each learning preference within the sample may also cause a generalizability concern on the findings of the moderating effect. Therefore, expanding the sample size within each learning preference in the future may provide a better relationship with the learning outcomes.

## Recommendation

Three potential approaches for future research could focus on exploring how different amounts of information affect the effectiveness of visual notes in comparison to traditional reports. Visual notes have the potential to summarize key content, potentially leading to more significant learning outcomes than what the current study achieved with just a single-page report, which could further strengthen the argument for embracing visual notes.

Considering the diverse layout styles associated with visual notes, future studies could explore their effectiveness beyond mere reader preference, aiming to understand how different layouts contribute to overall effectiveness. Furthermore, researchers can test the two hypotheses of this study in other settings such as training programs in different types of businesses, work environments, or cultures.

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