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Exploring the Influence of Sensory Memory on Different Types of Memory in Language Learning

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Abstract

Different types of memory are dynamically applied in the process of learning. Information is processed in understanding specific input of knowledge, leading to the different types of memories activated. The influence of memory in learning will lead to various outcomes, especially in ensuring the success in the process. Further understanding regarding the influence of memories in different types of learning can help educators and learners to strategically plan and practice their teaching and learning. This quantitative study aims to explore the different influence of sensory memory on different types of memory in language learning. 135 participants among higher learning institutions in Malaysia responded to the survey. There are 5 sections in the instruments, specifically on demographic profile, sensory memory, short-term memory, long-term memory, and working memory. Based on the findings, it was revealed that all four types of memories are perceived positively by the respondents, and there is a strong positive relationship between sensory memory and the three aforementioned types of memory in the context of language learning. Future research can be done on exploring the different effects of sensory stimuli (visual, auditory, tactile) on memory across different age groups and educational settings to refine sensory-enhanced learning strategies further.

Keywords: Sensory memory, Types of Memory in Learning, Language Learning.

Introduction

Background of Study

Many theories are proposed with regard to the types of memories within the human brain and their connection with learning processes (Camina & Güell, 2017). In general, most researchers agree to the four main types of memories, namely sensory, short-term, long-term, and working memory. Some researchers also suggest that these memories are stages, as opposed to distinctive types of memory (Stangor, & Walinga, 2019).

In the context of language learning, these types of memories also play a crucial part in ensuring the success of the process. Working memory is found to be vastly applied to language learning, principally to the acquisition and development of vocabulary (Baddeley, 2015). A large body of research has found the evidence leading to the conception and measurement of Working Memory as well as on its relation to first and second language acquisition (SLA), which in turn became the vital foundation for a more comprehensive theoretical framework (Wen, 2015). Kim, Christianson & Packard (2015), found the distinction between short-term memory and working memory in second language learning. It was contended that activities related to the former memory consist of the storage requirement, meanwhile the latter include both storage and processing requirements.

Structure and functions of learners' linguistic knowledge, as well as linguistic role and factors of environment in language development have been the major focuses of previous research regarding second language acquisition. Consequently, this leads to a dearth of studies on the real time process by learners of second language (Wen, 2015). Therefore, studies of how to process language input by learners can provide in-depth information about the L2 learning and the challenges of processing. This in turn will assist researchers and language educators to further comprehend the developmental process of an L2, thus providing more insights on the methods in elevating ESL learning (Chow, Mo & Dong, 2021).

Statement of Problem

Despite the substantial body of research investigating the impact of sensory memory on different types of memory in learning contexts globally, there is a noticeable lack of studies focusing specifically on the Malaysian language learning environment. This gap is significant given Malaysia's unique linguistic landscape, which includes a mix of Malay, English, Mandarin, and Tamil. Most existing studies have concentrated on Western or monolingual settings, such as German (Macedonia et al., 2014), Korean (Jang et al., 2023), Algeria (Zidane, 2016) and Russian (Kosyadinov, 2023), leaving a critical void in understanding how sensory memory influences learning in a multilingual and culturally diverse context like Malaysia. This study aims to fill this gap by exploring how sensory memory impacts learning strategies among Malaysian students, with a particular focus on language acquisition. Insights from this research could inform more effective, culturally adapted learning interventions that leverage sensory memory to enhance language learning in this unique setting.

Objective of the Study and Research Questions

This study is done to explore perception of learners on their use of learning strategies. Specifically, this study is done to answer the following questions;

- How do learners perceive sensory memory in language learning?
- How do learners perceive short-term in language learning?

- How do learners perceive long-term language learning?
- How do learners perceive working memory in language learning?
- Is there a relationship between Sensory Memory, Short-term, Long-term and Working Memory in language learning?

Literature Review

Difficulties in Language Learning

Gan (2013), as cited in Alsalihi (2020), reviewed difficulties in language learning based on the deficiency in language proficiency, spoken practice, communicative abilities, emphatic effect, opportunities to practice the language and error recognition and correction when using the language. As mentioned by Le at el (2024), dealing with interference errors and misconceptions resulting from linguistic similarities and multilingual backgrounds is one of the contributing factors for difficulties in language learning experienced by students. Difficulties in language learning can be addressed by focusing on the specific areas of difficulties encountered by the learners including pronunciation, fluency, vocabulary and grammar while taking into consideration the causes of difficulties namely cognitive (limited working memory, attention span, processing speed, spoken language formulation) and psychological factors (anxiety, fear of making mistakes, lack of confidence) (Ergashevna, 2024). Other than that, the difficulties in language learning could also be associated with the learners' cultural heterogeneity, academic and linguistic levels, structural vulnerability and institutional resources (Garcia et al., 2024).

Information Processing in Language Learning

As suggested by Fourie and Schlebusch (2022), language learners use different ways to process information when learning a language as they are highly influenced by the specific language they are learning. Baxodirjon (2023), further explains two different types of information processing in reference to Clark (1987), and Spada and Lightbown (2019), which are controlled processing and automatic processing. Controlled processing means when a conscious attention is required to perform a task; demand on short-term memory will be signaled. Meanwhile, automatic processing refers to a task without awareness where information in long-term memory will be vastly used. In language learning, the shift from one type of information processing to another is possible; automatic processing to controlled processing, for example from fluency in speaking to less fluency in speaking. Other than that, a language learner could also possess different information processing styles depending on how the information was delivered. In reference to Boers and Littlemore (2000), and Riding and Rayner (1998), Sato and Burden (2020), extended the explanation that learners who perform better at conceptualizing information delivered visually are called imagers or high imagers while learners who might be better at analyzing information delivered verbally are called verbalizers or low imagers.

Past Studies on Information Processing in Language Learning

Many studies have been done to investigate information processing in language learning. A study involving 60 ESL students by John et al (2021), investigating the highly utilised language learning strategies to improve their speaking skills revealed that participants tend to forget their studied materials easily resulted from their failure in bringing them from sensory memory to long term memory initially. Therefore, participants preferred using metacognitive strategy compared to memory strategy in improving their speaking skills. Similarly, in a study

by Pili-Moss (2022), involving 36 native Italian second language learners investigating the extent to which declarative and procedural learning of thematic linking showed that their performance in producing accurate sentence comprehension in the symmetric condition were depending on the meaning relationships between noun phrase positions and noun phrase interpretation. In brief, declarative learning, which is a major component of long-term memory, was required to effectively process the relationship.

Spinu, Hwang and Vasilita (2023), investigated the differences between monolinguals and bilinguals in phonetic and phonological learning and the connection with auditory sensory memory. The study involved 31 monolingual and 31 early bilingual participants who were trained and tested on an artificial accent of English and their auditory sensory memory was assessed based on a digit span task. The experimental procedure using a recording of 40 baseline sentences containing all structures of interest was done to identify a link between phonetic and phonological learning and auditory sensory memory. The findings exhibited enhanced auditory sensory memory and phonetic and phonological learning skills among the bilinguals compared to monolinguals.

Researchers have also paid attention to the role of working memory in vocabulary learning through multimedia input. Teng and Zhang (2023), conducted a study involving 95 EFL students who completed learning under three conditions; (a) Definition + Word information + Video, (b) Definition + Word Information, (c) Definition. The participants then took two Working Memory Test namely reading span test and non-word span test to measure their working memory including complex working memory and phonological short-term memory. A vocabulary knowledge test was administered as a pre-test and post-test procedure. The findings revealed the prominent effects of the Definition + Word Information + Video condition and the significant role of complex and phonological working memory in vocabulary learning and retention.

Conceptual Framework

Figure 1 shows the conceptual framework of the study. This study explores the influence of sensory memory, short-term, long-term and working memory. Learning involves learners storing the information. According to Rahmat (2020), the stored knowledge will be used to make sense of incoming knowledge. The framework of this study is adopted from Miller's (1956), three types of memory (sensory, short-term and long term memory) and also working memory by (Aben et al., 2012).

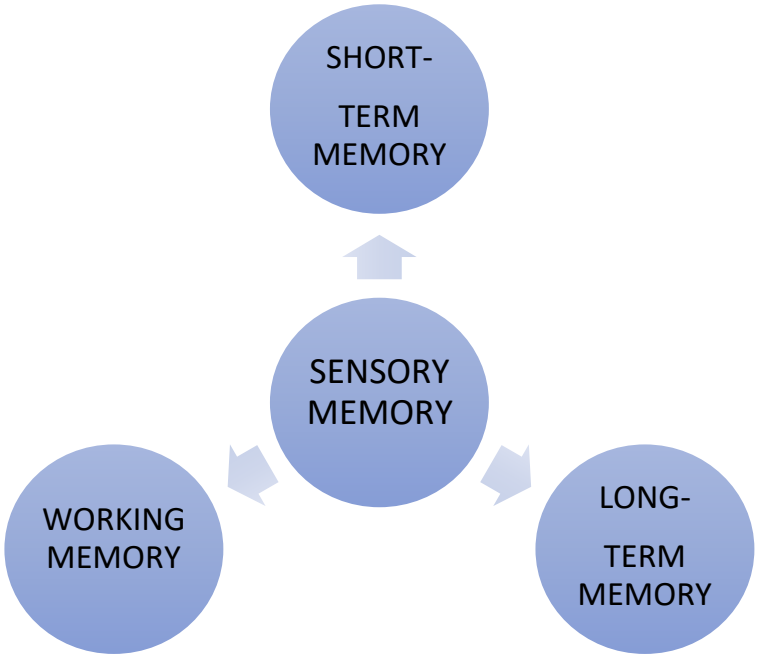

Figure 1- Conceptual Framework of the Study
Influence of Sensory Memory, Short-term, Long-term and Working Memory

Nairne & Neath (2012), in their explanation mention that sensory memory is truthful records of initiating stimuli, and can be technically defined as modality specific. Visual stimuli lead to visual sensory memories, auditory stimuli lead to auditory sensory memories, and so on. Sensory memories tend to last for a few seconds, and are widely thought to result from the processes involved in normal sensation and perception.

As for short term memory, it can be defined as active, but analyzed, contents of mind. Short-term memories, unlike sensory memories, do not necessarily reflect a current or latest input, but instead generally represent meaningful interpretations of what has just occurred, by activating existing long-term memory structures as a collective set. It is also suggested that short-term memories are often represented in the form of an inner voice which probably plays a crucial role in the interpretation and production of spoken language (Baddeley, Gathercole, & Papagno, 1998).

As for working memory, Baddeley (2003), highlights that this type of memory involves the temporary storage and manipulation of information that is assumed to be necessary for a wide range of complex cognitive activities. Baddeley and Hitch (1974), in Baddeley (2003), proposed that it could be divided into three subsystems, one concerned with verbal and acoustic information, the phonological loop; a second, the visuospatial sketchpad providing its visual equivalent, while both are dependent upon the third subsystem, the attentionally-limited control system, which is the central executive. A fourth subsystem, the episodic buffer, has been proposed later. These are described in turn, with particular reference to implications for both the normal processing of language, and its potential issues.

Methodology

This quantitative study is done to explore perception of information processing among undergraduates. A purposive sample of 135 participants responded to the survey. The

instrument used is a 5 Likert-scale survey and is rooted from Miller (1956), and Aben et al (2012), to reveal the variables in table 1 below. The survey has 4 sections. Section A has items on demographic profile. Section B has been divided into 4 sections of Sensory Memory, Short-Term Memory, Long-Term Memory (Miller, 1956) and Working Memory (Aben, et.al, 2012).

Table 1
Distribution of Items in the Survey

SECTION	TYPE OF INFORMATION PROCESSING	TYPE OF MEMORY	SUB-COMPONENT	ITEMS		Crombah Alpha
A	Sensory Memory Miller (1956)	Echoic memory		2	6	.769
		Iconic memory		3		
		Haptic memory		1		
B	Short-Term Memory Miller (1956)	Phonological		2	6	.828
		Spatial		2		
		Visual		2		
C	Long-Term Memory Miller (1956)	Declarative or Explicit Memory	Episodic Memory	2	6	.896
			Semantic Memory	3		
		Non-Declarative or Implicit Memory	Procedural Knowledge	1		
D	Working Memory (Aben,et.al. (2012)	Central Executive		3	7	.874
		Visuospatial Sketchpad		2		
		Phonological Loop		1		
		Episodic Buffer		1		
	Total number of items			25		.945

Table 1 shows the reliability of the survey. According to Hair, Black, Babin, & Anderson (2014), the usage of Cronbach alpha is the best way to assess the reliability of multi-scale measurement of internal consistency and commonly used to assess the consistency of a survey.

The analysis shows a Cronbach alpha of .769 for Sensory Memory. A Cronbach's alpha value of .828 for Short Term Memory indicates a high level of internal consistency among the items measuring short term memory. Apart from that, the result reveals a Cronbach alpha of .896 for Long-Term Memory suggests that the items or questions related to long-term memory in the study have a high level of internal consistency. On the other hand, .874 for working memory shows an excellent distribution of the survey items, thus, revealing a good reliability

of the instrument used. Further analysis using SPSS is done to present findings to answer the research questions for this study.

Findings

Findings for Demographic Profile

Table 2
Percentage for Gender

1	Male	38%
2	Female	62%

Table 2 shows the distribution of gender among the respondents of the current study. Out of 135 respondents, there were 38% of male respondents while 62% were female indicating that female respondents make the majority of the sample in this investigation.

Table 3
Mean for Discipline

1	Science & technology	27%
2	Business & management	65%
3	Social Science & Humanities	8%

The distribution of discipline is presented in Table 3. It can be seen that the majority of the respondents were from the Business & Management field with 65% whereas the least percentage of respondents were from Social Sciences & Humanities with 8%. As for Science & Technology, 27% of the respondents contributed to the sample. From this table, it is noteworthy to point that there is a variety of background in the study which helps with generalisation of the findings.

Table 4
Percentage for Level of Study

1	Pre-Diploma	55%
2	Diploma	20%
3	Degree	25%

As for the distribution of level of study, it can be seen in Table 4 that Pre-Diploma made up the largest percentage with 55% of respondents, followed by Degree with 25% of respondents and Diploma with 20% of respondents. This shows that the findings of the current study are relevant to the undergraduate population regardless of levels.

Findings for Sensory Memory

This section presents data to answer research question 1- How do learners perceive sensory memory in language learning?

Table 5
Mean for -Sensory Memory (3.78)

	Mean
BSMQ1 I understand new words immediately when I HEAR it being said	3.5
BSMQ2 I remember new words immediately after I HEAR it	3.6
BSMQ3 When I SEE new words for the first time, I try to understand it	4.3
BSMQ4 When I SEE new words in for the first time, I try to remember it	4.1
BSMQ5 After learning new words, I will use it in my communication	3.5
BSMQ6 I can remember better things if I can TOUCH them	3.7

Table 5 presents the means for sensory memory in language learning. As shown in the table, item BSMQ3, 'When I see new words for the first time, I try to understand it' has the highest mean which is 4.3. Following this is item BSMQ4, 'When I see new words for the first time, I try to remember it' with the mean of 4.1. These findings show that visual sensory has the most positive influence in processing information. As for item BSMQ6 I can remember better things if I can TOUCH them', the mean is still high which is 3.7. This is followed closely by item BSMQ2, 'I remember new words immediately after I HEAR it' with the mean of 3.6. This suggests that tactile and auditory sensories also influence information processing positively. Another item that falls under auditory sensory, item BSMQ1, 'I understand new words immediately when I HEAR it being said' has the lowest mean which is 3.5, together with item BSMQ5, 'After learning new words, I will use it in my communication' which also has the mean of 3.5. Although these two items have the lowest mean, it is noteworthy that the mean is still relatively high. It can be concluded that sensory memory is prominent in information processing.

Findings for Short-term Memory

This section presents data to answer research question 2- How do learners perceive short-term in language learning? There are 6 items under this research question. The results are as according to Table 6. .

Table 6
Mean for Short-Term Memory (3.62)

	Mean
CSTMQ1 I am able to REMEMBER how to pronounce a new word after I hear it	3.7
CSTMQ2 I am able to REPEAT how to pronounce a new word after I hear it	3.9
CSTMQ3 I can recall different locations of objects	3.4
CSTMQ4 I can recall different relationships of information given to me	3.5
CSTMQ5 I can remember the faces of people I have seen only once	3.6
CSTMQ6 I can remember specific details about objects, building or places	3.6

According to Table 6, The highest mean is 3.9 for item CSTMQ2, 'I am able to REPEAT how to pronounce a new word after I hear it'. This is followed by item CSTMQ1, 'I am able to REMEMBER how to pronounce a new word after I hear it.' CSTMQ5, 'I can remember the faces of people I have seen only once' and CSTMQ6, 'I can remember specific details about objects, buildings or places' with the mean value of 3.6. CSTMQ4 'I can recall different relationships of information given to me' have the mean value of 3.5 and lastly CSTMQ3 'I can recall different locations of objects' have the lowest mean value of 3.4.

Findings for Long-term Memory

This section presents data to answer research question 3- How do learners perceive long-term in language learning? There are 6 items under this research question. The results are as according to Table 7.

Table 7
Mean for -LONG-TERM MEMORY (3.73)

	Mean
DLTMQ1 I can remember information about recent past events	3.7
DLTMQ2 I can remember information about recent or past experience	3.8
DLTMQ3 I easily recall words and their meaning	3.6
DLTMQ4 I easily recall facts about the things around me	3.7
DLTMQ5 I easily recall information that I have memorized	3.8
DLTMQ6 I can easily recall how things are done	3.8

According to Table 7, the highest mean is shared by three items which are item DLTMQ2, 'I can remember information about recent or past experience,' item DLTMQ5, ' I easily recall information that I have memorized' and item DLTMQ6, 'I can easily recall how things are done' with mean value of 3.8. This is followed by mean value of 3.7, which for the items DLTMQ1 'I can remember information about recent past events' and item ' I easily recall facts about the things around me,' The lowest mean is for item DLTMQ3 'I easily recall words and their meaning' with mean value of 3.6.

Findings for Working Memory

This section presents data to answer research question 4- How do learners perceive working memory in language learning? There are 7 items under this research question. The data present several notable findings as it is exhibited in Table 8

Table 8
Mean for -WORKING MEMORY (3.75)

	Mean
EWMQ1 I can direct my attention when I need to	3.7
EWMQ2 I can maintain my task goal when I am working	3.6
EWMQ3 I am able to organize, plan and carry out my tasks efficiently	3.6
EWMQ4 When I want to remember anything, I try to recall what they look like	4.1
EWMQ5 When I want to remember anything, I try to recall the location of the object	4
EWMQ6 I can easily remember words I hear	3.6
EWMQ7 I can easily repeat words I have heard	3.7

Table 8 shows that the highest mean is 4.1 for item EWMQ1, 'I can direct my attention when I need to'. This is accompanied by item EWMQ5, ' When I want to remember anything, I try to recall the location of the object' with the mean value of 4. For items EWMQ1 and EWMQ7, they shared the same mean value of 3.7. On the other hand, EWMQ2, EWMQ3 and EWMQ6 were divided equally with the same mean value of 3.6. The high mean scores of 4.1 and 4 for EWMQ1 and EWMQ5 suggest that the participants are aware of and they are able to regulate

their cognitive processes, which is an important aspect of effective learning and problem-solving.

Findings for Relationship between Types of Memories and Language Learning

This section presents data to answer research question 5- Is there a relationship between Sensory Memory, Short-term, Long-term and Working Memory in language learning? To determine if there is a significant association in the mean scores between Sensory Memory, Short-term, Long-term and Working Memory in language learning, data is analysed using SPSS for correlations. Results are presented separately in table 9,10 and 11 below.

Table 9

Correlation between Sensory and Short-Term Memory

Correlations

		SENSORY	SHORT_TERM
SENSORY	Pearson Correlation	1	.707**
	Sig. (2-tailed)		.000
	N	135	135
SHORT_TERM	Pearson Correlation	.707**	1
	Sig. (2-tailed)	.000	
	N	135	135

**. Correlation is significant at the 0.01 level (2-tailed).

Table 9 shows there is an association between sensory and short-term memory. Correlation analysis shows that there is a high significant association between sensory and short-term memory (r=.707**) and (p=.000). According to Jackson (2015), coefficient is significant at the .05 level and positive correlation is measured on a 0.1 to 1.0 scale. Weak positive correlation would be in the range of 0.1 to 0.3, moderate positive correlation from 0.3 to 0.5, and strong positive correlation from 0.5 to 1.0. This means that there is also a strong positive relationship between sensory and short-term memory.

Table 10
Correlation between Sensory and Long-Term Memory

Correlations

		SENSORY	LONG_TERM
SENSORY	Pearson Correlation	1	.675**
	Sig. (2-tailed)		.000
	N	135	135
LONG_TERM	Pearson Correlation	.675**	1
	Sig. (2-tailed)	.000	
	N	135	135

**. Correlation is significant at the 0.01 level (2-tailed).

Table 10 shows there is an association between sensory and long-term memory. Correlation analysis shows that there is a high significant association between sensory and long-term memory (r=.675**) and (p=.000). According to Jackson (2015), coefficient is significant at the .05 level and positive correlation is measured on a 0.1 to 1.0 scale. Weak positive correlation would be in the range of 0.1 to 0.3, moderate positive correlation from 0.3 to 0.5, and strong positive correlation from 0.5 to 1.0. This means that there is also a strong positive relationship between sensory and long-term memory.

Table 11
Correlation between Sensory and Working Memory

Correlations

		SENSORY	WORKING
SENSORY	Pearson Correlation	1	.720**
	Sig. (2-tailed)		.000
	N	135	135
WORKING	Pearson Correlation	.720**	1
	Sig. (2-tailed)	.000	
	N	135	135

**. Correlation is significant at the 0.01 level (2-tailed).

Table 11 shows there is an association between sensory and working memory. Correlation analysis shows that there is a high significant association between sensory and working memory (r=.720**) and (p=.000). According to Jackson (2015), coefficient is significant at the .05 level and positive correlation is measured on a 0.1 to 1.0 scale. Weak positive correlation would be in the range of 0.1 to 0.3, moderate positive correlation from 0.3 to 0.5, and strong positive correlation from 0.5 to 1.0. This means that there is also a strong positive relationship between sensory and working memory.

Conclusion

Summary of Findings and Discussions

This study is conducted to explore the different influence of sensory memory on different types of memory in language learning. The first four research questions focus on the perception of learners towards sensory memory, short-term memory, long-term memory and working memory in language learning. From the findings of the first research question on learners' perception on sensory memory, the respondents respond positively towards this type of memory, especially on the aspect of understanding new words after seeing it. Based on this, it is worth noting that sensory memory is prominent in information processing, specifically on understanding, remembering, and using new vocabularies in language learning process. Spinu, Hwang & Vasilita (2023), in their study comparing monolingual and bilingual learners also found a correlation between sensory memory and learning skill, specifically on phonetic and phonological aspects.

The second research question highlighted learners' perception of short-term memory in language learning. This type of memory was also perceived positively by the respondents, with the highest score on the aspect of input repetition instantly after receiving it leads to the positive. This suggests that for short term memory, it helps students more in the phonological aspect, followed by visual and spatial memory. A similar finding was also found by Silbert et al (2015), who suggested that phonological short-term memory predicts early word-learning accuracy.

As for long-term memory, which is the focus of the third research question, although not as highly perceived as compared to the first two types of memory, still can be generalized as positive. This type of memory is centered around the aspect of recalling information in the process of learning, which naturally comes after learners fully understand and are able to repeat the input provided to them. In the context of language learning, Baddeley (2017), highlights phonological loop, which comprises a phonological store that is dedicated to working memory and that serves to temporarily hold verbal information as a vital learning device. This will progressively evolve as a supporting system for the language learning process (Buchsbaum & D'Esposito, 2019).

For the third research question, working memory is also perceived positively by the respondents. The finding suggests that participants tend to have a strong ability to direct their attention when needed, as well as a tendency to use spatial memory strategies to remember information. This pattern of results indicates that the participants in this study possess well-developed metacognitive skills, specifically the ability to focus their attention and employ effective mnemonic strategies. Furthermore, the finding highlights the potential connection between attention-focusing and spatial memory techniques. Similarly, Kellogg, Olive, & Piolat (2007), suggest that language production requires phonological or verbal working memory, which is selectively engaged when imaging the referents of concrete nouns. The ability to direct one's attention may facilitate the use of spatial memory strategies, as participants are better able to encode and retrieve information by associating it with physical locations which could be further explored in future research.

The last research question points to the relationship between sensory memory and the three types of memory; short-term, long-term and working memory. Correlation analysis shows

that there is a high significant association between sensory memory and the three aforementioned types of memory. This means that there is a strong positive relationship between these types of memory.

Implications and Suggestions for Future Research

This study investigates the impact of sensory memory on various forms of memory in learning language, utilizing a survey method to gather data from participants across diverse learning environments. The findings indicate that sensory memory significantly enhances both short-term, long-term, and working memory retention, suggesting that educational strategies should incorporate multisensory techniques to improve language learning outcomes. Pedagogically, this research underscores the importance of integrating sensory-based activities in curricula to cater to different learning styles and improve memory consolidation. Aside from pedagogical contribution, this study extends the limited research focusing specifically in Malaysian setting. The unique linguistic landscape in Malaysia that is derived from the harmonious blend of Malay language, English, Mandarin and Tamil provides rich understanding of how sensory memory influences the different types of memory in multilingual setting. Therefore, the findings may serve as the basis for language learning strategies specifically for learners from different linguistic backgrounds.

For future research, the study recommends exploring the differential effects of sensory stimuli (visual, auditory, tactile) on memory across different age groups and educational settings to refine sensory-enhanced learning strategies further. This could include controlled experiments to isolate specific sensory contributions to memory retention and comprehension in educational contexts.

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