Empowering Non-Native Malay Speaking Students: A Computational Thinking Approach to Digital Story Writing

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Abstract
This study explores the integration of digital storytelling and computational thinking in language learning, particularly addressing challenges faced by non-native Malay language learners, focusing on writing skills. While existing research highlights the effectiveness of digital storytelling, its application in non-English languages, like Malay, lacks systematic writing skill emphasis. Through an in-depth document analysis of the past research on digital storytelling and computational thinking in language learning, the study investigates the implementation of computational thinking in systematically constructing Malay sentences for digital storytelling, and development of a model combining computational thinking and scriptwriting for digital storytelling. This study contributes by introducing a method for systematically constructing sentences in Malay and proposing a model that integrates computational thinking into digital storytelling for structured scriptwriting. Emphasizing its potential to transform Malay language teaching, especially in private and vernacular schools, this model combines the proven efficacy of digital storytelling with computational thinking. Future research should focus on developing a specific curriculum for implementing the proposed writing model in effective language learning, particularly for non-native Malay language learners. Further investigations into the effectiveness of these approaches in language learning are essential for continuous improvement and widespread implementation.
Keywords: Computational Thinking, Digital Storytelling, Non-Native Speakers, Malay Language, Writing Skills.

Introduction
The storytelling technique has long been used as an approach in teaching and learning (Sagri et al., 2018). Parallel to technological advancements, the use of digital formats in conveying narratives has sparked a remarkable phenomenon in education (Davy Tsz Kit et al., 2022; Robin, 2008; Sadik, 2008). Past studies have demonstrated the effectiveness of digital storytelling in various contexts, especially language learning (Castillo-Cuesta et al., 2021; Mohammed Al-Amri, 2020; Moradi & Chen, 2019; Parsazadeh et al., 2021). This approach has

proven to be effective in enhancing language learning performance from preschool to higher education levels (Sagri et al., 2018). The use of technology and multimedia in creating a story is seen as an approach with its own reputation in guiding language learning motivation (Mohammed Al-Amri, 2020; Moradi & Chen, 2019).

The four main aspects of mastering the Malay language, namely listening, speaking, reading, and writing, are seen to have their own challenges, especially in writing (Chelliah & Othman, 2022; Nahar, 2020; Jamian, 2001). For example, the essay section questions are often left unanswered by students, alongside the issue of poorly structured sentences (Chelliah & Othman, 2022; Gopal et al., 2022). This problem is more pronounced in private and vernacular schools. It becomes more complicated when various issues arise in terms of motivation and skills, especially for non-native speakers, to speak, read, and write texts in the Malay language while understanding it (Hedzir et al., 2022). According to Nahar (2018), non-native speakers are students who do not use their mother tongue when communicating with others. Studies conducted by Hedzir et al. (2022) and Nahar (2020) indicate that students often neglect their proficiency in the Malay language from the beginning because they are destined to continue their education abroad, where the emphasis is more on the English language. This situation creates a barrier for them to develop an interest in learning the Malay language.

Meanwhile, in current practice, digital storytelling requires good writing skills to produce a coherent and meaningful story. Apart from storytelling techniques without dialogue or narration, script writing is one of the crucial steps during the story production process (Moradi & Chen, 2019; Robin, 2008; Sadik, 2008). Despite numerous studies measuring the effectiveness of digital storytelling in terms of understanding and communication, the focus on systematic writing skills during the creation of a digital story to assist students in learning the language is still fading (Moradi & Chen, 2019; Robin, 2008; Sadik, 2008). Moreover, most past studies have concentrated on English language learning (Mohammed Al-Amri, 2020; Özkaya, 2022; Parsazadeh et al., 2021) rather than other languages, especially Malay. Among the writing strategies explored by researchers like Parsazadeh et al. (2021) is through the computational thinking approach. Computational thinking is a problem-solving approach that involves breaking down a complex problem into smaller, more manageable parts, using algorithms and logical reasoning (Lodi & Martini, 2021). Through this approach, students are guided to break down the writing method into problem-solving steps based on computational thinking, making the writing process easier and enhancing the motivation of non-native language learners in learning the language.

The integration of computational thinking and digital storytelling is still in its early stages, despite the promising potential that has been demonstrated (Parsazadeh et al., 2021). Therefore, there is a need to explore the potential integration of these two approaches in language learning pedagogy to assist non-native Malay language learners in producing digital stories with a more systematic sentence construction method. Through an in-depth analysis of extensive past research on the concepts of digital storytelling and computational thinking in language learning, this study aims to discern a systematic method for constructing sentences. Specifically, the focus is on utilizing the computational thinking approach for scriptwriting in digital storytelling. In addition to identifying this method, the study seeks to contribute by developing a model that integrates the computational thinking approach for the purpose of creating digital storytelling. This model can be adapted as a teaching and learning module in the future. Guided by the objectives of this study, the research questions to be addressed are as follows:

RQ1. How can the method of systematically constructing sentences through the computational thinking approach be implemented in writing scripts for digital storytelling in the Malay language?

RQ2. What model can generate digital storytelling through the combination of the computational thinking approach in scriptwriting?

This research is essential to diversify the methods of teaching the Malay language that can be implemented by teachers in private and vernacular schools in Malaysia. Taking advantage of the proven effectiveness of digital storytelling in language learning, these two approaches are hoped to further solidify the 21st-century language learning revolution.

Literature Review

Challenges in Teaching Malay Writing to Non-Native Students

Teachers of the Malay language in private and vernacular schools face various challenges in continuing their teaching, particularly dealing with students who often perceive Malay as an insignificant language, despite being Malaysian citizens (Hedzir et al., 2022). Teachers constantly grapple with their preparedness to find alternative ways to deliver more creative and engaging writing instruction in line with 21st-century teaching methods (Hasan & Mahamod, 2016). Diverse innovations in teaching and learning must be judiciously employed by teachers to avoid deviating from learning objectives (Isnon et al., 2017). The readiness of multimedia materials, such as Malay language videos and audios, as teaching aids, needs to be carefully curated by teachers. Content messages and the use of inappropriate language should be avoided to ensure that the language influence is consistent with learning goals.

Furthermore, excessive reliance on translation applications during writing without teacher guidance can hinder learning objectives. For instance, while the use of applications like *Google Translate* can encourage students to be more independent (Bahri & Tengku Mahadi, 2016), uncontrolled usage can result in inaccuracies in sentence structure. The existence of artificial intelligence applications like *ChatGPT*, capable of generating professional-level writing, poses new challenges for teachers to assess students' actual achievements (Kohnke et al., 2023). Teachers must continuously provide encouragement to students, discouraging them from easily giving up and promoting the varied use of teaching aids (Mazlan et al., 2020; Jamian, 2001) to facilitate writing methods for easier comprehension. Fundamentally, the mission to produce a new generation of citizens proficient in Malay, regardless of ethnicity, seems like a challenging task in this era.

Challenges Faced by Non-Native Students in Learning Malay Writing

Many students lack proficiency and interest in cooperating, mainly due to a lack of awareness regarding the importance of learning the Malay language for their future (Hedzir et al., 2022; Nahar, 2018). The practice of using the Malay language in private and vernacular schools has drawn attention from several researchers, such as Chelliah & Othman (2022), Hedzir et al. (2022), and Nahar (2020), who have demonstrated that weaknesses in language mastery stem from uninspiring student motivation. This is related to the perception that the Malay language is confusing compared to other native languages in terms of pronunciation (Chelliah & Othman, 2022). According to the study made by Gopal et al. (2022), the use of the native language in conversation, reading, and listening can impact writing skills, particularly in structuring sentences. Additionally, other factors such as uninteresting teaching methods (Nahar, 2020) and the lack of parental encouragement to use the Malay language for other

purposes (Hedzir et al., 2022) also contribute to the weakness in students' language mastery, especially in writing skills.

Writing Skills

In addition to the three aspects of language proficiency—listening, reading, and speaking—the skill of constructing sentences in the Malay language subject falls under the aspect of writing skills (Chelliah & Othman, 2022; Nahar, 2020). According to Haron et al. (2012), writing is an effective language learning process because students are exposed to a more extensive vocabulary. Baharuddin (2012) and Haron et al. (2012) state that constructing a sentence should include vocabulary comprising at least two of the four parts: nouns, verbs, adjectives, and prepositions. Nouns refer to names of objects, people, and places. Verbs are words related to actions. Adjectives function to describe the state or quality of a noun. The combination of vocabulary from these four parts forms a sentence with subject and predicate elements. The subject is the element being described, and the predicate is the explanation of that subject (Baharuddin, 2012). A complete sentence is clear, follows the correct word order, and contains easily understandable meaning (Baharuddin, 2012). Writing skills are seen as a superior skill in language proficiency, alongside listening, speaking, and reading (Gopal et al., 2022). A student's ability to produce well-constructed sentences is an indicator of their mastery of this skill.

Digital Storytelling in Language Learning

Digital storytelling is a technique of delivering stories in a digital format that incorporates visual elements such as graphics and animations, as well as audio elements like sound and music (Gülce Özkaya et al., 2022). This technique has been widely used as a method of teaching and learning across various fields, particularly in language learning (Abdul Razak, 2013; Moradi & Chen, 2019; Rutta et al., 2021). The creation of a digital story involves a meticulous planning process and exposure to various learning experiences such as communication, collaboration, reflection, and the use of technology (Castillo-Cuesta et al., 2021; Smeda et al., 2014). According to Robin (2008), to produce a digital story, seven key elements suggested by the Center for Digital Storytelling are necessary. All the elements listed in Table 3.1 are crucial for creating a story capable of making an impact on the audience.

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The Seven Elements of Digital Storytelling.
Source: Robin (2008)

Element	Description
Perspective	Key points of the story and the author's perspective to be conveyed.
Dramatic Question	The central question that maintains the audience's attention and will be answered at the end of the story.
Emotional Content	A serious issue that touches the audience's emotions personally and effectively, connecting the story to the audience.
Voice	Personalizing the story to help the audience understand the context.
Audio Soundtrack	Music or background sound that supports and enhances the storyline.
Economy	Using sufficient content to tell the story without burdening the audience with irrelevant narration.
Pacing	The pace of the story and how slowly or quickly the plot develops.

Figure 1: The four phases of digital storytelling production.
Source: Moradi & Chen (2019)

In addition to Robin (2008), several steps in building digital storytelling have been studied by other researchers such as Moradi & Chen (2019), Parsazadeh et al. (2021), and Sadik (2008). According to Moradi & Chen (2019), there are generally four main phases to go through in producing digital storytelling, as shown in Figure 1, namely; 1) pre-production, 2) production, 3) post-production, and 4) story distribution. Each phase involves related activities to ensure the direction of storytelling can be effectively guided. The proposed phases by Moradi & Chen (2019) also incorporate the seven elements of digital storytelling emphasized by Robin (2008). The pre-production phase, which involves writing activities specifically, includes elements such as perspective, dramatic question, emotional content, and voice. Meanwhile, the remaining elements, namely audio soundtrack, economy, and pacing, are crucial in the production phase, which involves constructing the story using applications and multimedia.

Unlike the approach taken by Moradi & Chen (2019), Sadik (2008) reports four steps introduced by Bernard R. Robin from the University of Houston in creating digital storytelling. On the other hand, the four phases of digital storytelling production by Moradi & Chen (2019) were found to be related to the four steps introduced by Bernard R. Robin, as summarized by Sadik (2008) in Figure 2. Through the pre-production phase, for example, the first step involves determining the topic and goals of the storytelling. However, other steps are found in different phases that do not follow a specific sequence.
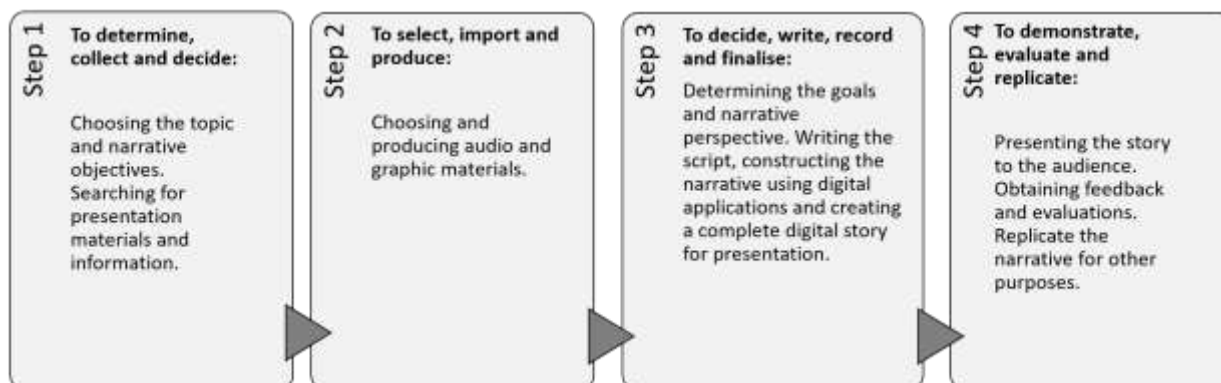

Figure 2: The steps in producing digital storytelling by Bernard R. Robin, University of Houston.

Source: Sadik (2008)
The interaction between students and teachers during the digital storytelling creation process encourages communication using the learned language (Castillo-Cuesta et al., 2021). According to their study, digital storytelling can strengthen writing skills, a key aspect examined through digital storytelling creation. Therefore, the benefits of digital storytelling in language learning can help improve students' language proficiency. This technique serves as a catalyst for students to actively interact with the learned language through the four main language skills: reading, writing, speaking, and listening. Digital storytelling can also stimulate students' creativity by creating stories using various media such as audio, video, images, and text (Smeda et al., 2014). This platform can be used as a space for students to express themselves creatively.

In language learning, digital storytelling has the potential to expose students to learning about the culture and traditions of the language environment through the production of digital stories (Abdul Razak, 2013). Furthermore, student motivation and interest can be enhanced as digital storytelling provides a fun and interactive learning experience (Parsazadeh et al., 2021). The level of students' digital literacy and information retrieval skills can be well-developed (Robin, 2008). Lastly, digital storytelling provides space for students to collaborate with others, fostering social skills such as communication and teamwork in groups (Sadik, 2008).

Computational Thinking in Language Learning
Menurut Click or tap here to enter text. dan beberapa penyelidik lain seperti Click or tap here to enter text., pendifinisian pemikiran komputasi masih belum dapat disimpulkan secara mutlak. Walau bagaimanapun, secara umumnya pemikiran komputasi merupakan sebuah strategi penyelesaian masalah berpandukan empat langkah asas utama iaitu penguraian *(decomposition)*, pengecaman corak *(pattern recognition)*, abstraksi *(abstraction)* dan reka bentuk algoritma *(algorithm design)* Click or tap here to enter text.. Keempat-empat langkah

ini akan digunakan sebagai strategi pembinaan ayat semasa pelajar menulis isi cerita yang akan ditransformasi ke format digital. Walaupun pemikiran komputasi sangat berkait rapat dengan bidang pengaturcaraan komputer Click or tap here to enter text., kemahiran ini tidak akan dilibatkan dalam konteks kajian ini.

The foundation of the computational thinking approach involves problem-solving strategies by identifying patterns and logical contexts of the problem after breaking it down into smaller, more manageable parts (Ballard & Haroldson 2022). The development of this approach has surpassed the conventional association with computer programming. Researchers are now increasingly studying the applicability of computational thinking in various fields. Through a systematic literature review conducted by Acevedo-Borrega et al. (2022), the field of education has the highest number of publications, accounting for 83.49%, equivalent to 100 articles out of 145, followed by the fields of communication, computer science, and engineering. Malaysia is no exception, implementing the computational thinking approach in all primary school subjects, thereby honing problem-solving skills among students (Wang et al. 2022). The current direction of computational thinking research is also turning towards approaches that are not solely coding or programming-based (Kite et al. 2021). This implies that computational thinking is versatile and not limited to computer science disciplines, as it is also applicable in language learning (Parsazadeh et al. 2021; Wang et al. 2022).

The study conducted by Parsazadeh et al. (2021) on the integration of computational thinking concepts into digital storytelling is highly significant for this research. According to the study, the writing and presentation of content can be broken down into four fundamental steps of computational thinking, as shown in Figure 3, namely decomposition, pattern recognition, abstraction, and algorithm design. As a result, students can produce writing that can be adapted into essays, speech texts, and short stories. The study made by Rottenhofer et al. (2022) also opens up space and positive opportunities regarding the application of computational thinking strategies to writing skills through the use of Unified Modeling Language (UML). UML, highly synonymous with the field of Computer Science, is a general modeling language used in system design processes. Through their study, UML techniques have been adapted into language learning and teaching methods for students and teachers respectively.
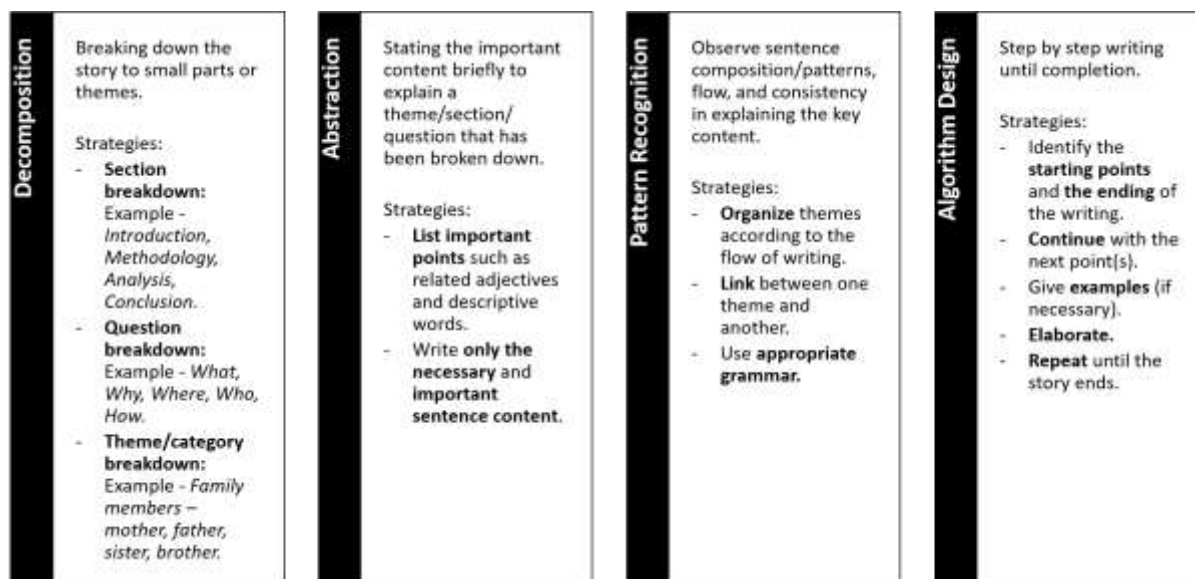
Figure 3: Computational thinking strategies in story writing.
Source: Parsazadeh et al. (2021)

The difference between the two studies by Parsazadeh et al. (2021) and Rottenhofer et al. (2022) lies in how sentence structures are constructed using the four main steps of computational thinking. Parsazadeh et al. (2021) presents a more detailed breakdown, where students need to break down the writing content into smaller themes and provide explanations in the form of key points written under each theme. Sentence composition is identified according to specific patterns, and finally, the writing is developed following a coherent narrative flow. This method is suitable for elementary school students or those with less proficiency and still learning to write. On the other hand, the approach introduced by Rottenhofer et al. (2022) is found to be suitable for middle school students or those with some sentence-building skills. The UML model, as shown in Figure 4, is used during the abstraction process when sentence themes are categorized according to noun categories. Subsequently, related adjectives and descriptive words are connected to explain the respective nouns. Pattern recognition and generalization are steps undertaken to identify grammar elements to complete the construction of correct sentences. Writing is then continued by following the sequence of important content, including writing conclusions and closures if necessary. According to Rottenhofer et al. (2022), in summary, computational thinking has long been used as a writing strategy, where pattern recognition involves establishing grammar rules, algorithms guide the flow of writing content, abstraction involves writing summaries or key point notes, and decomposition deals with breaking down themes such as introductions, conclusions, and so on.

Figure 4: Decomposition and abstraction of the writing theme
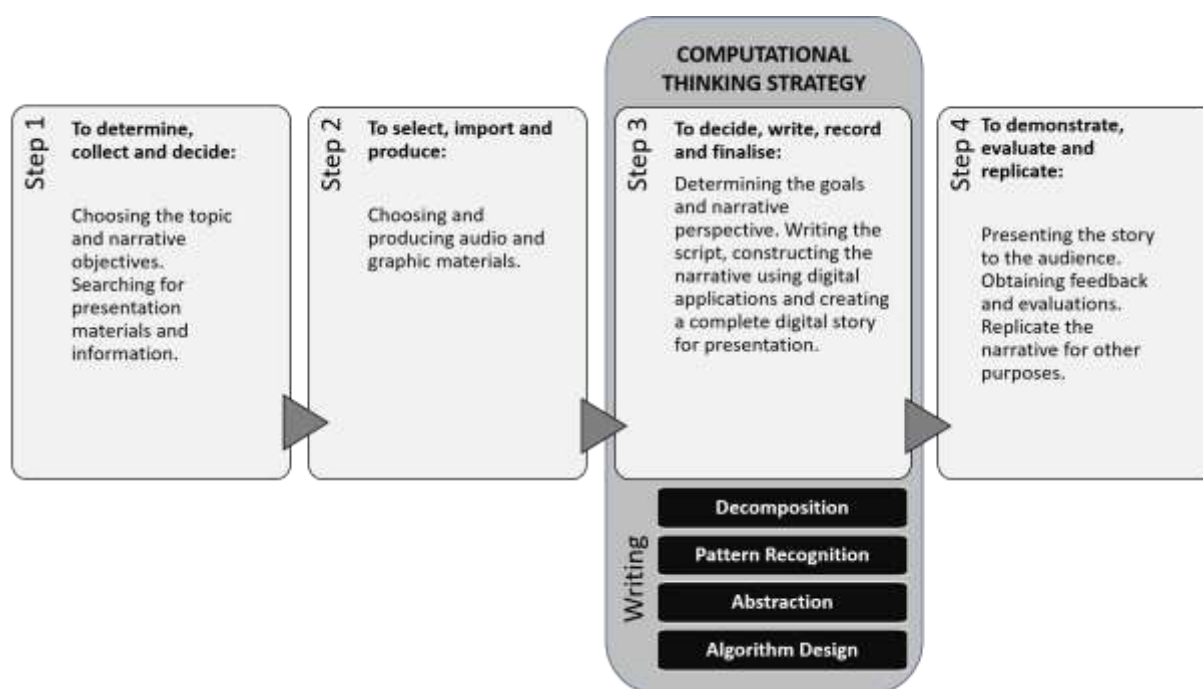**Source: Rottenhofer et al. (2022)**

The method of writing using computational thinking strategies encourages logical reasoning and algorithms during the writing process. This creates achievement and satisfaction when students successfully solve complex language-related problems. A systematic writing method can assist students at the introductory level to be more focused on constructing sentences, thereby reducing anxiety or restlessness about writing (Parsazadeh et al. 2021). Directly,

student motivation can be enhanced for continuous learning, language skill development, and success in language learning. To encourage student creativity, teachers need to foster better computational thinking skills through the use of specific learning platforms, whether involving technological interventions (plugged) or not (unplugged) (Ballard & Haroldson 2022).

Writing Using Computational Thinking Strategies in The Production of Digital Storytelling
The Writing Model
Literature review findings can provide inputs to construct a writing model using the computational thinking strategy in digital storytelling production, as shown in Figure 5 to give an overview of the solutions to the study's issues. This writing model encompasses language learning aspects relevant to digital storytelling and computational thinking approaches. The four steps introduced by Robin (2005) in creating digital stories have been integrated with the four primary steps of computational thinking in writing inspired by Parsazadeh et al. (2021) and Rottenhofer et al. (2022). Guided by the main focus of the study, which is to apply the computational thinking strategy in scripting digital storytelling, the computational thinking strategy is implemented in step 3, specifically in story writing. After that, step 4 will be executed, and the students' understanding of the produced digital storytelling will be evaluated.

Figure 5: The writing model using computational thinking strategy in digital storytelling production.

Assessment of Students
The assessment that can be implemented through this writing model includes assessing students' listening, reading, speaking, and writing skills. The level of students' listening skills can be tested by answering comprehension questions related to the presented story. The students' writing level is measured using the sentence writing rubric construct. Reading and speaking skills can be measured by repeating the storytelling script with correct pronunciation

and intonation. Additionally, students' digital literacy skills can be enhanced by using multimedia applications, providing a more enjoyable learning experience (Robin, 2008).

Overall, the proposed writing model to enhance Malay language learning strategies is believed to have the potential to strengthen and address issues related to Malay language learning by non-native speakers in private and vernacular schools. The digital storytelling approach offers many benefits to students' holistic language mastery. Supported by computational thinking writing strategies, a robust combination through this writing model will help teachers achieve the nation's goal of elevating the status of the Malay language in every stream of the country's education, whether in vernacular or private schools (Hedzir et al., 2022; Nahar, 2020).

Conclusion

An in-depth analysis of current studies and practices in digital storytelling and computational thinking in language learning has revealed several corresponding intersections. It was found that the integration of computational thinking and digital storytelling is still in its early stages, despite the proven potential being promising. Additionally, even though many studies have been conducted to measure the effectiveness of digital storytelling in terms of understanding and communication, the focus on systematic writing skills in the production of a digital story to help students learn the language is still lacking. This study has contributed to address the challenges in Malay language learning for non-native speakers, especially in writing skills, by proposing a writing model to improve teaching and learning methods.

The proposed writing model is built based on an in-depth literature review that covers systematic writing skills through computational thinking strategies, while promoting student motivation and creativity through the digital storytelling approach. As a result, the proposed writing model is useful in diversifying teaching and learning methods for teachers, students, and curriculum developers to enhance the mastery of the Malay language. In particular, teachers need a strong foundation in the knowledge and understanding of computational thinking and digital storytelling to effectively implement this approach, as the performance of students' Malay language skills depends on the proficiency of teachers in using this approach in teaching and learning.

On the other hand, the aspirations of students outlined in the Malaysian Education Development Plan 2013–2025 have emphasized the need for every student to master the Malay language as the national and unifying language (Kementerian Pendidikan Malaysia, 2013). Therefore, the proposed writing model provides a new alternative to assist teaching and learning to be more effective and relevant to students' needs. It is recommended that future researchers develop a specific curriculum for implementing the proposed writing model in effective language learning, especially for non-native students in private and vernacular schools. This includes involving academics, curriculum developers, and school authorities to develop an effective curriculum through the integration of digital storytelling and computational thinking based on the findings of this study. Furthermore, research on both approaches in the field of language is essential to comprehensively understand their effectiveness and suggest improvements for future implementation.

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