Arab World English Journal
INTERNATIONAL PEER REVIEWED JOURNAL ISSN: 2229-9327

Arab World English Journal (AWEJ) Volume 17. Number 2, June 2026 Pp.483-497
DOI: https://dx.doi.org/10.24093/awej/vol17no2.30

Parents and English Teachers' Perception Regarding Hypermedia Reading Strategies Workshop to Improve Pupils' Reading Comprehension

Maslawati Mohamad
Faculty of Education, Universiti Kebangsaan Malaysia
Corresponding Author: maslawati@ukm.edu.my

Vithieya Vermmah d/o Samachalam
Faculty of Education, University Kebangsaan Malaysia
Email:p143264@siswa.ukm.edu.my

Nur Yasmin Khairani
Faculty of Education, University Kebangsaan Malaysia
Email:yasminzakaria@ukm.edu.my

Nur Ainil Sulaiman
Faculty of Education,University Kebangsaan Malaysia
Email: nurainil@ukm.edu.my

Nur Atikah Jalaludin
Faculty of Education, University Kebangsaan Malaysia
Email: nuratiqah.jalaludin@ukm.edu.my

Received:02/03/2026 Accepted:05/18/2026 Published:06/17/2026

Abstract
Environmental awareness is crucial for environmental preservation, and a wealth of information on this topic is available online. However, as English is a second or third language in Malaysia, many lower secondary pupils struggle to comprehend hypermedia content related to environment. To address this, the researchers conducted workshops to equip lower secondary school pupils with essential hypermedia reading strategies. After a series of workshops and a competition, the perceptions of these pupils'parents, and their ESL teachers was carried out to obtain their feedback. A qualitative research design was employed using semi-structured interviews. They were selected through purposive sampling; six teachers and ten parents who had participated in the E-STEM workshop and applied the learnt knowledge to their instructional practices and daily reading activities. The findings indicate that hypermedia tools substantially improve students' engagement, comprehension, and retention of environmental science concepts, helping to simplify complex topics. However, challenges were identified, including variations in students' technological proficiency and the need for more targeted professional development for teachers. Overall, the participants hold positive views toward the use of hypermedia tools for strengthening STEM-related reading comprehension in English. It further underscores the importance of addressing technological and pedagogical barriers to optimize the potential of hypermedia tools in fostering environmental awareness and enhancing language proficiency within the STEM education context.

Keywords: Environmental awareness, hypermedia reading strategies, perceptions, reading
How to cite: (2026). Parents and English Teachers' Perception Regarding Hypermedia Reading Strategies Workshop to Improve Pupils' Reading Comprehension. *Arab World English Journal, 17*(2):483-497. https://dx.doi.org/10.24093/awej/vol17no2.30

Introduction

As environmental issues are becoming increasingly complex, integrating environmental awareness topics such as climate change, pollution, and resource depletion into a country's curriculum is very important. Thus, it is vital to equip learners with appropriate reading skills to develop better comprehension of hypermedia materials on environmental issues. Much of the information on environmental issues is published in media and written in English.

The problem is evident as most Malaysians are non-native English speakers, who often face difficulties comprehending English-language hypermedia materials. Their reading difficulties are attributable to both linguistic and non-linguistic barriers (Aziz et al., 2024). Current studies highlighted that without explicit digital reading scaffolds, many pupils struggle to process the dense, non-linear information characteristic of environmental hypermedia, resulted in cognitive overload (Hassan & Ibrahim, 2026). In addition, as environmental literacy evolves from printed reading materials to hypermedia reading materials, the skills to critically navigate and synthesize multimodal digital content has become an essential skill for current pupils (Tan et al., 2025).

Thus, equipping pupils in workshops, particularly in low secondary schools, with hypermedia reading strategies plays a crucial role in knowledge acquisition, vocabulary expansion, and the development of critical thinking. In addition, these workshops are important in helping students process complex information, manage cognitive load, and navigate the non-linear structures typical of digital environments particularly on topics about environmental awareness.

In this study, the researchers conducted workshops on hypermedia reading strategies. The workshops were conducted at eleven secondary schools in Putrajaya. Putrajaya was selected due to the district's good internet accessibility. Furthermore, the Putrajaya municipal council agreed to fund these workshops. Upon completion of the series, students were tasked with creating a video on the environment and competing against the other eleven participating schools.

Besides the pupils, parents and English teachers were invited to attend. The primary objective was to enable parents to guide, monitor, and support their children in employing those hypermedia reading strategies. Teachers were expected to share and train students on the learned hypermedia reading strategies during English lessons at their respective schools. Therefore, it is important to obtain the perceptions of both parties, the targeted pupils' parents and English teachers, regarding the workshops. The findings are intended to inform and further improve future workshops. Additionally, the results can help disseminate information to community bodies, parents, and school authorities, encouraging them to conduct similar workshops in their respective districts.

These hypermedia reading strategies enable learners to understand, analyse, and retain information effectively, making them fundamental for academic success and lifelong learning (Rusiana et al., 2024). According to Hubbard (2021), reading also supports ESL learners in accessing and comprehending academic content, particularly specialised knowledge within STEM (Science, Technology, Engineering, and Mathematics) disciplines. It is hoped that increasing pupils' awareness of environmental issues will help reshape their mindset and, in turn, encourage positive behavioural changes in protecting their surroundings from pollution and other environmental threats.

In the Malaysian context, the National Policy on ICT in Education 2010 emphasises the role

of ICT to support the development of a knowledgeable, innovative, and creative society by leveraging technology in teaching and learning at all levels. Furthermore, the Malaysia Education Blueprint 2013–2025 identifies Shift 7: Leverage ICT to scale up quality learning across Malaysia as one of its strategic thrusts, with waves of implementation targeting device access, network infrastructure, and teacher ICT competency. These policies highlight how Malaysian education policy aligns with the integration of hypermedia and digital tools in the classroom, reinforcing the importance of technology-enhanced pedagogies. By aligning hypermedia reading strategies with national policy-driven ICT initiatives, both parents and teachers can tap into supported frameworks, resources, and strategic goals—thereby enhancing the effectiveness of the embedded tools in STEM and environmental-awareness instruction.

This study, therefore, aims to explore the answer to the following research question: What are parents' and ESL teachers' perceptions of the workshops conducted by a public university in Malaysia on equipping the lower secondary school pupils with hypermedia reading strategies in improving reading comprehension on the area of environmental awareness?

Literature Review

ESL reading challenges in STEM

According to Othman (2024), reading comprehension in STEM subjects poses unique challenges for ESL learners in Malaysia. This is due to the complexity of complex language, specialised terminology and abstract concepts embedded within these reading materials. Likewise, Sibanda (2021) reports that ESL learners face considerable obstacles in developing strong STEM literacy, which in turn hinders their ability to understand and respond effectively to environmental issues. This is mainly because most STEM texts contain unfamiliar technical vocabulary, creating further complicates comprehension (Sibanda, 2021).

In addition to specialised terminology, Othman (2024) highlights that ESL learners struggle with both technical and non-technical vocabulary, as many words may take on meanings in scientific contexts that differ significantly from everyday usage. For example, common terms such as "model" or "reaction" take on distinct scientific interpretations which can confuse the learners (Pun & Cheung, 2024).

Hypermedia in Reading Instruction

Hypermedia integration transforms traditional learning into interactive and personalized experiences. According to Mayer's Cognitive Theory of Multimedia Learning (2020), learners process information more effectively when visual and verbal materials are presented together, which reduces cognitive load. Recent studies confirm that hypermedia tools such as mobile-based e-books and simulations significantly enhance engagement with complex environmental topics (Ojong & Addo, 2024).

Moreover, embedding sustainability concepts within STEM instruction helps learners connect abstract scientific ideas to real-world environmental issues, thereby fostering better reading comprehension on these issues (Mouboua et al., 2024). Integrating environmental sustainability principles into ESL instruction further nurtures learners' effective reading comprehension by strengthening their critical and creative thinking and preparing them to contribute to environmentally responsible solutions (Routray & Mohanty, 2024).

Local universities play an essential role in promoting effective and responsible hypermedia integration. Through workshops, training programmes and community outreach

initiatives, universities can raise public awareness of the pedagogical benefits of hypermedia tools and strengthen digital literacy among educators, students and parents (Jayadi et al., 2025; UNESCO IESALC, 2025). Such initiatives not only support teachers in enhancing their technological and instructional competencies but also empower communities especially parents to engage meaningfully with environmental and STEM-related content (Mardiana, 2024). Ultimately, university-led training helps bridge knowledge gaps, foster informed technology use, and contribute to cultivating a digitally competent society that can maximise the educational potential of hypermedia reading strategies (Kayyali, 2024).

Relevant Previous Studies

Many current studies indicate that digital reading comprehension requires sophisticated scaffolding to manage the cognitive load associated with non-linear navigation and multimodal integration (Lee & Kim, 2025; Gril et al., 2025). In this context, Hubbard (2021) mentioned that reading supports ESL learners in accessing and comprehending academic content, particularly within STEM (Science, Technology, Engineering and Mathematics) disciplines. Building on this, recent studies emphasize that hypermedia-based learning environments when integrated with inquiry-based and student-centered approaches could improve the pupils' comprehension on environmental issues and sustainability practices (Lee & Kim, 2025; Chen & Law 2025). By providing interactive and adaptive resources that tailor learning to individual needs, these hypermedia reading strategies help in transforming pupils' mindsets regarding environment and encourage positive behavioral changes in protecting their own environment (Kavaz & Aydin, 2025).

In addition, the rapid integration of Information and Communication Technology (ICT) in education has transformed traditional teaching approaches, creating opportunities for more interactive and personalised learning experiences. Hypermedia supports diverse learning styles, including visual, auditory and kinaesthetic preferences which allow students to learn at their own pace (Ojong & Addo, 2024). Lim and Ng (2026) stated that the use of smartphones to access e-books and educational applications not only enhances reading proficiency but also promotes engagement with complex environmental topics. By incorporating these digital tools into their instructional practices, teachers can cultivate effective learning environments that equips students with the necessary skills to succeed in reading and beyond.

Methodology

This study adopted a multiple case study in a qualitative research design. The research participants involved six secondary school teachers from six secondary schools in Putrajaya. Other research participants were ten parents of the pupils who attended the workshops. According to Creswell (2018), qualitative research aims to uncover in-depth insights and emerging patterns by employing semi-structured interview questions to investigate complex phenomena. This multiple case study embarked to answer the research question: What are parents' and ESL teachers' perceptions of the workshops conducted by a public university in Malaysia on equipping the lower secondary school pupils with hypermedia reading strategies in improving reading comprehension on the area of environmental awareness?

Setting

All 13 secondary schools in the Federal Territory of Putrajaya participated in this program, which consisted of a series of workshops and group activities. These included a one-day face-to-face workshop on hypermedia reading strategies, followed by three online workshops. The program was jointly organized by the local authority, Putrajaya Municipality, and the researchers.

During the one-day workshop, the researchers were assisted by 130 Year 3 students from the Teaching English as a Second Language (TESL) program. Subsequently, three online workshops were conducted over a two-month period to facilitate the pupils' application of the hypermedia reading strategies they had learned. The researchers organized all the workshops as well as the Public Speaking competition. The Public Speaking competition was conducted to prepare the secondary school students for a video competition involving all 13 schools. Each school sent a team of 10 lower-form pupils (aged 14), resulting in 13 competing groups. The pupils' English language proficiency levels generally range from B1 to C1. Each group produced a video on a topic related to environmental awareness.

In addition to the secondary school pupils who attended the workshops, each school sent two accompanying teachers, and parents of the participants were also invited to attend. In total, 26 teachers and 30 parents participated in the initial face-to-face workshop. During this session, the teachers were briefed by the researchers on how to instruct their pupils in the hypermedia reading strategies. Furthermore, both parents and teachers were invited by the researchers to attend the final public speaking competition. Regarding data collection, parents were interviewed in focus group for approximately 120 minutes by the researchers immediately following the one day workshop for 2 hours. The volunteered teachers were interviewed individually by the researchers either at their respective schools or via online platforms. Interviews were conducted by the researchers over a duration of 15 to 30 minutes per participant.

All six teachers are TESL graduates with more than five years of teaching experience. They teach Form One and Form Two students in Putrajaya. All ten parents live in Putrajaya or nearby areas and their ages range between 35 and 50 years old.

Research Instruments

The research instrument of this study is a semi-structured interview. Semi-structured interviews were selected because they provide a flexible yet structured format that enables researchers to explore participants' perspectives in depth while still maintaining consistency across interviews. According to Kallio et al. (2016), semi-structured interviews allow researchers to guide the conversation with predetermined questions but also permit probing and follow-up questions, enabling richer and more nuanced data to emerge. This is particularly important when investigating complex issues such as teachers' experiences with hypermedia reading strategies.

In addition, semi-structured interviews are well-suited for qualitative studies that seek to understand personal interpretations, beliefs, and practices, as they encourage participants to express their thoughts freely while remaining aligned with the study's objectives (Cohen, Manion, & Morrison, 2018). As Patton (2015) notes, this interview format enhances the depth and quality of responses, making it effective for exploring perceptions and challenges in authentic teaching contexts.

Given the exploratory nature of this study, semi-structured interviews were therefore chosen to obtain detailed insights into parents and ESL teachers' perceptions regarding the

workshop and the integration of hypermedia reading strategies in reading comprehension instruction.

The volunteered parents were interviewed immediately after the workshop in a focus group interview. The focus group interview was 2 hours. The teachers were interviewed individually at their respective schools two months after the workshop was held. Besides face-to-face interview sessions, WhatsApp video calls were also conducted. Each interview was between 15 to 30 minutes at the teachers' convenient time.

The interview questions were validated by four experts in the area. Three of these experts were PhD holders in TESL, and one expert was in STEM STEM-related area. They have more than 5 years of teaching experience in this area.

Research Ethics

The participants gave their consent to be interviewed. Participation in the study was strictly voluntary, and all participants were provided with clear information about the research objectives, procedures, and their rights before giving informed consent (Creswell & Creswell, 2018).

Confidentiality and anonymity were ensured throughout the research process. Participants' names, school identities, and any identifiable information were removed in order to adhere to the research ethics (Mohamad, 2024). Pseudonyms were given to each participant. For parents, the participants were labelled P1 to P10, and for teachers, they were labelled T1 to T6.

Interview questions were designed to be respectful and non-invasive, and the findings were reported in a fair, balanced, and accurate manner, reflecting the participants' genuine perspectives (Patton, 2015).

Data Analysis

As illustrated in Figure 1, the data obtained from the semi-structured interviews were analysed using Braun and Clarke's six-phase thematic analysis framework. Thematic analysis is an iterative process that requires constant movement back and forth between different analytical stages (Braun & Clarke, 2024). This framework is widely recognised for its flexibility across various research contexts, allowing researchers to adapt the analytical procedures to suit their specific research questions and the nature of their data (Majumdar, 2022).

During the analysis, participants' responses were organised into patterns or sub-themes using the Nodes tool. These sub-themes were then grouped and refined into overarching themes. In the final stage, the researchers produced a detailed report documenting the findings of the interviews.

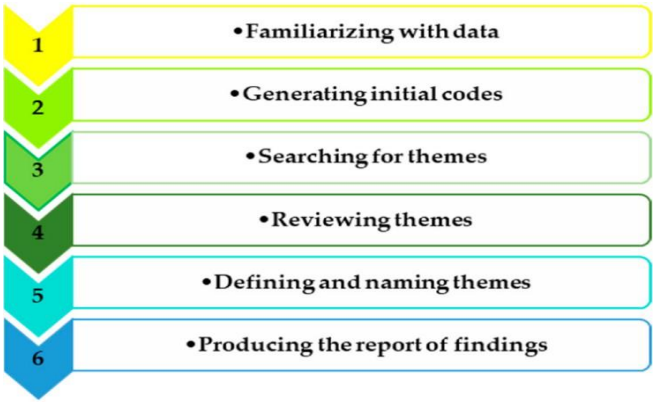


Figure 1. Braun and Clarke's Six Steps Thematic Analysis Framework (Source: Braun & Clarke, 2024)

Findings and Discussion

This section presents the findings on parents' and ESL teachers' perceptions of the workshop conducted by a public university in Malaysia on equipping the pupils with hypermedia reading strategies in improving reading comprehension of STEM-related content, particularly in the area of environmental awareness? The study involved six ESL teachers (five females and one male) with teaching experience ranging from five to twenty years. The teachers were labelled as T1-T6. Ten parents participated in this study, and they were labelled as P1 to P10.

Overall, the analysis generated six key themes:

A. community engagement
B. engagement through hypermedia,
C. improved comprehension and retention,
D. interactive learning and immediate feedback,
E. challenges with technology integration, and
F. professional development needs

Collectively, these themes demonstrate both the parents' and teachers' perceptions of the usefulness of hypermedia tools in enhancing reading comprehension, especially when dealing with environmental awareness materials.

A. Community Engagement

All parents and teachers were satisfied with the community engagement that made the workshop a success. The collaboration among three key groups namely teachers, parents, and community organization, effectively motivated the pupils to learn and apply hypermedia reading strategies to environmental awareness materials. Moreover, involving all relevant parties in training, has increased the targeted pupil engagement, ensuring consistent guidance across both at home and school environments. By developing a thorough understanding of this topic, both pupils and parents are better equipped to contribute to environmental conservation. The following episodes

reflect these outcomes:

> "*There were altogether 13 schools in Putrajaya. All of the schools were involved in this workshop. This demonstrates full support from the teachers as well as the pupils. The local authority has provided financial support for the meals and hall. The university lecturers and students were very cooperative by sharing their knowledge. Fantastic work*" (P1)
>
> "*This is a successful event with support from all stakeholders in Putrajaya. This event should be carried out more frequently"* (P5)
>
> "*Pupils' motivation to use the hypermedia reading strategies has increased significantly through the help of parents, teachers and university students*" (T3

B. Engagement through Hypermedia Comprehension

Hypermedia comprehension was found to significantly enhance student engagement when utilised during lessons. Teachers reported that hypermedia elements such as videos, animations, and interactive applications have captured pupils' attention and made complex STEM concepts, particularly those related to environmental awareness, more accessible and relevant. Teacher 5 and T6 noted that hypermedia reading strategies, especially animations, were highly effective in sustaining pupils' interest in abstract environmental concepts, as illustrated in the following excerpt:

> "*The animations and visuals are great for explaining tough STEM topics. For example, when teaching about climate change, the animations that show how the greenhouse effect works really help students understand it better*." (T5)
>
> "*The pupils are in the generation that enjoys technology. They demonstrate fun learning and increase their motivation. Their reading performance and speaking ability show great improvement*" (T6)

These responses demonstrate how visual features within hypermedia materials support the explanation of intricate environmental issues such as climate change. When the pupils demonstrate good engagement in learning this topic, they would feel more comfortable and confident to do public speaking. This aligns with Abdelgawad (2024), who emphasised that breaking down abstract concepts into clear visual formats enables students to engage more easily with the content, fostering both interest and deeper comprehension.

C. Improved Comprehension, Confidence and Retention

The study also revealed that hypermedia reading strategies enhanced students' comprehension and retention of STEM concepts, particularly those related to environmental awareness. Teacher 3 highlighted that hypermedia reading strategies supported a clearer understanding of environmental concepts while simultaneously strengthening students' grasp of the English vocabulary associated with these topics, as illustrated in the following excerpt. In addition, with ample practices, the pupils develop their self-confident to compete in public speaking competition on environment among schools:

> "*They're also more confident when presenting science ideas in English, which used to be difficult for them*." (T3)
>
> "*My child was practicing the public speaking for many times at home. She would constantly check the e-dictionary as taught by the teachers*" (P10)

"*My son was always looking forward for the online discussion with the university students. It is a new experience for them. He also employed the strategies to improve his vocabulary in both reading and speaking*" (P8)

The above responses demonstrate that the use of hypermedia strategies and tools not only enhanced the vocabulary repertoire, deepened pupils' interest and understanding of environmental themes but also improved their ability to articulate these ideas in English. This finding resonates with Mousa and Radif (2024), who reported that integrating hypermedia tools into classroom instruction enables students to connect linguistic and scientific knowledge, resulting in enhanced comprehension and long-term retention.

Similarly, Teacher 5 emphasised that interactive hypermedia reading strategies supported pupils' engagement with STEM-related topics in ways that conventional teaching strategies could not achieve. She stated:

"*The interactive tools in the apps have made complex concepts easier for students to understand. Even those who struggled with scientific terms now use them correctly and explain their ideas with more confidence."* (T5)

Participant 5's response further underscores that hypermedia tools positively influence the comprehension and retention of STEM content. The interactive nature of simulations and multimedia elements actively engages pupils, thereby improving their understanding of environmental science concepts. Additionally, the participant noted that these tools facilitated students' mastery of scientific vocabulary, an area that previously posed significant challenges.

D. Interactive Learning and Immediate Feedback

The study also found that interactive learning through hypermedia strategies and tools enables immediate feedback, allowing teachers to assess pupils' progress in real time. This student-centred approach allows teachers to address knowledge gaps as they emerge, creating a more dynamic and responsive learning environment (Bhardwaj et al., 2025). Teacher 4, Parent 4 and Parent 1 underscored the flexibility and instant feedback provided by mobile applications and interactive platforms, as shown in the following excerpt:

"*I can track their progress in real-time, which helps me see where they need more help*." (T4)

"*As a mother, I need to make sure that my daughter can speak well in English. Thus, by learning these strategies and immediate feedback and assistance from the trainee teachers and apps learnt, my daughter is able to speak in public confidently*." (P4)

"*I could see a lot of interactions took place, I am satisfied with the immediate feedback learnt from the apps and fellow trainee teachers in reading those hypermedia materials. I hope such program should be continued*" (P1)

Teacher 4, P4 and P1 explained that real-time progress tracking through hypermedia strategies greatly supports both teaching and learning. This aligns with the findings of Khanal and Pokhrel (2024), who reported that data generated from online platforms helps teachers identify learning patterns and predict potential challenges, thereby enabling more personalised instructional support.

Teacher 6 also acknowledged the flexibility afforded by mobile applications and websites, emphasizing that pupils are able to progress at their own pace, which contributes to a more personalized learning experience. T6 stated:

> "*The strategies have made my teaching more student-centered. They can engage with the content outside class, whether through apps or websites*." (T6)

Teacher 6's response highlights a clear shift towards a student-centred approach, where active participation is prioritized over passive learning. These findings further reinforce the value of interactive tools in promoting student autonomy and enabling independent access to learning resources.

E. Challenges with Technology Integration

Although there are numerous advantages, both parents and teachers reported challenges. Varied levels of technological competence among both teachers and pupils hindered the seamless use of these tools in the classroom (Pappa et al., 2024). Participants also acknowledged that differing levels of digital literacy among pupils created difficulties in utilising the applications appropriately, as reflected in the following excerpts:

> "*Some pupils also have trouble using the apps on their own, especially those with less experience with technology*." (T2)
> "*My daughter could not understand how to use some of the strategies. She needs other people to help her*" (P2)

This study indicates that although hypermedia strategies hold substantial potential, pupils' varying degrees of technological proficiency may limit their ability to fully engage with the learning content. This contradictory outcome may be attributed to the need for additional support and training for pupils who are less technologically adept (Cabasan, 2024).

Parents reported that their primary challenge concerns the pupils' lack of self-discipline and tendency toward distraction. Specifically, students frequently misuse their mobile phones for gaming rather than for academic purposes. P8 and P10 mentioned that,

> "*Even though these strategies and tools are useful but at times the pupils could use the phone not on academic purposes but to play games. I had to monitor my son to ensure that he used it for academic purposes*" (P8)
> "*Kids nowadays love to play games until morning. It is pretty disturbing for us to make sure they use the handphone wisely*" (P10)

F. Professional Development Needs

The study also identified a need for additional professional development to support teachers in effectively integrating hypermedia tools into their instruction. Although the E-STEM program provided valuable resources, teachers indicated that further specialised training was necessary to enhance their competence in utilising these strategies effectively. Teacher 2 suggested that while the tools were beneficial, more targeted training was required for effective classroom implementation:

> "*The training sessions from the E-STEM English Program were very helpful, but more teacher-focused training would be beneficial*." (T2)

Teacher 2's comment highlights the limited professional development available for teachers, particularly in relation to technology integration aimed at improving
. teaching and learning. This aligns with Berner et al. (2024), who emphasised that personalised and skill-specific workshops can strengthen teachers' ability to apply hypermedia tools and better support their students.

Similarly, Teacher 1 stressed the importance of training, particularly in managing technical issues that may arise during lessons, as demonstrated in the following excerpt:

> "*It would be great if the program included more localised content... and workshops on how to use the hypermedia strategies and tools effectively*." (T1)

Teacher 1's input underscores the need for practical, hands-on training that equips teachers to address technological challenges and ensures they are adequately prepared to manage issues that may occur when utilising hypermedia tools in the classroom.

Limitations of this study

This study involved a small sample size. Thus, the findings may not be representative of the general population. Therefore, the findings could not be generalized to other population.

In terms of the scope and time, this study was conducted in Putrajaya only within a period of three months. Therefore, the findings could not applied to other places or country of different cultural or socioeconomic contexts.

Conclusion

This study highlights the perceptions held by both parents and ESL teachers regarding the use of hypermedia reading strategies to support pupils' comprehension of STEM-related environmental content. The major findings are hypermedia tools such as videos, simulations, animations, and interactive applications in enhancing pupils' engagement, enhance their understanding of complex environmental concepts, and support vocabulary development essential for STEM literacy. The parents' observations further reinforce that pupils not only showed increased interest in environmental issues but also applied the strategies beyond classroom settings, particularly when preparing for public speaking activities. These results indicate that hypermedia reading strategies serve as an effective bridge between language learning and scientific literacy, enabling pupils to connect linguistic, digital, and conceptual skills in ways that traditional approaches may not achieve.

The use of a qualitative, multiple-case study approach was essential for documenting the varied and context-dependent perspectives of stakeholders in the Putrajaya education district. By involving a wide range of teachers and parents from 13 different schools, this study provided a thorough look at how hypermedia reading strategies can be successfully incorporated into ESL teaching.

This study advances ESL and hypermedia research by showing how digital tools can be customized for environmental subjects. The findings suggest that pedagogical success is

fundamentally social rather than merely technological. Notably, the evidences from the findings prove both relevant parties to the pupils, their parents and teachers, should receive training together. Hence, parents could become more active partners in the learning process. Their active participation could help bridge the home-based digital divide and promotes their children's engagement and motivation.

Based on the limitations and insights derived from this study, the following are proposed recommendations for future studies. Future studies should adopt a longitudinal approach to measure the persistence of gains in environmental knowledge and vocabulary beyond the conclusion of the program. Another recommendation is to better understand learner engagement from diverse levels namely primary, upper secondary and tertiary levels. Furthermore, other researchers should contrast the effectiveness of hypermedia content based on local environmental contexts versus broader, international standards.

Ultimately, by strengthening technological, pedagogical, and collaborative capacities across stakeholders, hypermedia can be harnessed more effectively to enhance STEM-related reading comprehension, nurture environmental awareness, and support Malaysia's broader ICT-driven educational aspirations.

Acknowledgement

Funding: Program STEM dan Minda Grant: GG-2024-013
Acknowledgments: We would like to extend my sincere gratitude to CRIM UKM and Faculty of Education, Universiti Kebangsaan Malaysia, and for their support in sponsoring the publication of this article.
Conflicts of Interest: The authors declare no conflict of interest.
Authenticity: Yes
Artificial Intelligence Statement: The AI was mainly used to edit the language and obtained the DOI for the references

About the Authors: This manuscript is an original work

Associate Professor Dr. Maslawati Mohamad is a Senior Lecturer in Teaching English as a Second Language (TESL) at the Faculty of Education, Universiti Kebangsaan Malaysia (UKM). Her areas of expertise include English for Specific Purposes (ESP), reading in ESL contexts, and teaching and learning innovation. ORCID ID: https://orcid.org/0000-0002-8979-5895

Vithieya Vermmah Samachalam is a Master of Teaching English as a Second Language (TESL) student at the Faculty of Education, Universiti Kebangsaan Malaysia (UKM). Her research interests include vocabulary learning strategies, game-based learning, and English language pedagogy.

Dr. Nur Yasmin Khairani Zakaria is a TESL lecturer at the Faculty of Education, Universiti Kebangsaan Malaysia (UKM). Her areas of expertise include English language teaching, academic writing, and educational technology. She is interested to conduct research on artificial intelligence in ESL education, mobile-assisted language learning, and game-based learning. She has contributed to studies on AI-powered writing assistants and innovative approaches to

improving English proficiency among ESL learners.
ORCID ID: https://orcid.org/**0000-0001-8129-3113**

Dr. Nur Ainil Sulaiman is a TESL lecturer at the Faculty of Education, Universiti Kebangsaan Malaysia (UKM). Currently, she is the Head of the Graduate Programme for the Centre for Learning and Teaching Innovation Studies.Her research areas include English language teaching, technology-enhanced learning, mobile-assisted language learning, and innovation in ESL education. ORCID ID: https://orcid.org/0000-0001-6212-7494

Dr. Nur Atiqah Jalaludin is a senior lecturer at the Faculty of Education, Universiti Kebangsaan Malaysia. Her research interests include STEM education, blended learning, and educational innovation. Her published articles include students' learning experiences and cognitive development in blended learning environments. ORCID ID: https://orcid.org/0000-0003-4114-5030

References

Abdelgawad, A. M. (2024). Transferring Comprehension Skills from Listening to Reading: Effects of Listening to Online Flash Fiction on Attitudes, Reading Comprehension and Vocabulary Size. *BSU-Journal of Pedagogy and Curriculum*, *3*(6), 1-37. https://doi.org/10.21608/bsuj.2024.364402

Anna, S., Havva Kurt-Taşpınar, & Milad, A. A. (2024). Book Clubs as a Pedagogical Tool for Developing Critical Thinking: Evidence from an English Education Program in Indonesia. *Indonesian Journal on Learning and Advanced Education, 6*(3), 350–364.https://doi.org/10.23917/ijolae.v6i3.23663

Aziz, A. et al. (2024). Student Insights: Challenges in Acquiring Critical Academic Reading Skills. *International Journal of Research and Innovation in Social Science*, *8*(9), 938-950. https://doi.org/10.51244/IJRISS.2024.809071

Berner, M., Berner, M., Ronan, D., & Brylow, D. (2024, March). Co-designing integrated cs curriculum artifacts with k-5 classroom teachers. In *Proceedings of the 55th ACM Technical Symposium on Computer Science Education V. 2* (pp. 1570-1571). https://doi.org/10.1145/3626252.3630913

Braun, V., & Clarke, V. (2024). Thematic analysis. In *Encyclopedia of quality of life and well-being research* (pp. 7187-7193). Cham: Springer International Publishing. https://doi.org/10.1007/978-3-319-69909-7_104505

Cabasan, R. A. A. (2024). Effective Technology Integration: Closing the Digital Gap among High School Students. *Journal of Interdisciplinary Perspectives*, *2*(8), 1-1. https://doi.org/10.5281/zenodo.13360408

Chen, C. H., & Law, V. (2025). Scaffolding inquiry-based learning with digital tools: A meta-analysis of STEM education outcomes. *Educational Technology Research and Development*, 73(1), 45–70. https://doi.org/10.1007/s11423-024-10356-9

Creswell, J. W., & Creswell, J. D. (2018). *Research design: Qualitative, quantitative, and mixed methods approaches*. 5th edition. Sage publications.

Fernandu, D. E., Abdurrahman, A., & Lengkana, D. (2022). Design and Validation of STEM Integrated e-Modules on Environmental Pollution to Improve Problem-

Solving Skills. *Jurnal Pendidikan MIPA*, *23*(2). https://doi.org/10.23960/jpmipa/v23i2.pp754-765

Gril, K., et al. (2025). Cognitive load management in multimodal digital reading environments. *Educational Psychology Review*, 37(1), 89–105.

Hassan, N., & Ibrahim, A. (2026). Cognitive load management in multimodal environmental learning environments: A study of secondary ESL learners. *Journal of Computer Assisted Learning*, 42(1), 88–104. https://doi.org/10.1111/jcal.13102

Hubbard, K. (2021). Disciplinary literacies in STEM: what do undergraduates read, how do they read it, and can we teach scientific reading more effectively?. *Higher Education Pedagogies*, *6*(1), 41-65. https://doi.org/10.1080/2574254X.2021.1963032

Jayadi, A., Ikawati, H., Abdurrahman, A., & Irawan, M.A. (2025). Digital Literacy Development Strategy in Higher Education Institutions. *Jurnal Teknologi Pendidikan: Jurnal Penelitian dan Pengembangan Pembelajaran*, *10*(1), 30-37. https://doi.org/10.23887/jtp.v10i1.13882

Kayyali, M. (2024). Digital Literacy in Higher Education: Preparing Students for the Workforce of the Future. *International Journal of Information Science and Computing*, *11*(01), 53–73. https://doi.org/10.48175/IJSC-1144

Kavaz, T., & Aydin, G. (2025). Digital transformation in environmental science education: Impact of gamified learning on student engagement and knowledge retention. *Journal of Science Education and Technology*, 34(2), 245–260. https://doi.org/10.1007/s10956-024-10118-2

Khanal, S., & Pokhrel, S. R. (2024). Analysis, Modeling and Design of Personalized Digital Learning Environment. *arXiv preprint arXiv:2405.10476*.

Lee, J. H., & Kim, M. S. (2025). Personalizing hypermedia environments for diverse learners: A framework for differentiated instruction in digital classrooms. *Computers & Education*, 225, 104689. https://doi.org/10.1016/j.compedu.2025.104689

Lim, S. Y., & Ng, K. W. (2025). Navigating the digital commons: Critical reading strategies for environmental sustainability in Malaysian secondary schools. *Asia Pacific Journal of Education*, 45(2), 212–230. https://doi.org/10.1080/02188791.2025.2450331

Majumdar, A. (2022). Thematic analysis in qualitative research. In *Research anthology on innovative research methodologies and utilization across multiple disciplines* (pp. 604-622). IGI Global Scientific Publishing. https://doi.org/10.4018/978-1-6684-5965-2.ch035

Mardiana, H. (2024). Perceived Impact of Lecturers' Digital Literacy Skills in Higher Education. *SAGE Open*, 14(2). https://doi.org/10.1177/21582440241234567

Mohamad, M. (2024). Qualitative data management and ethical considerations in educational research. *Arab World English Journal*, 15(1), 210–222. https://doi.org/10.24093/awej/vol15no1.14

Mohebbi, A. (2025). Enabling learner independence and self-regulation in language education using AI tools: a systematic review. *Cogent Education*, *12*(1), 2433814. https://doi.org/10.1080/2331186X.2025.2433814

Mouboua, P. D., Atobatele, F. A., & Akintayo, O. T. (2024). Bridging STEM and linguistic gaps: A review of multilingual teaching approaches in science education. *Open Access Research Journal of Multidisciplinary Studies*, *7*(2), 86-97. https://doi.org/10.30574/oarjms.2024.7.2.0084

Mousa, S., & Radif, M. (2024). Enhancing Technical Skills Through Hypermedia: An Exploration of Innovative Learning Approach. *Journal of Al-Qadisiyah for Computer Science and Mathematics*, *16*(3), 135-141. https://doi.org/10.61108/ijaems.v16i3.1492

Ojong, A. S., & Addo, E. H. (2024). Innovative Pedagogical Strategies: Fostering Inclusion and Motivation in the ESL Classroom. *International Journal of English Language Studies*, *6*(2), 10-32996. https://doi.org/10.32996/ijels.2024.6.2.26

Othman, J. (2024). Academic Vocabulary Learning in EMI Classrooms: Challenges and Strategies. *Arab World English Journal*, 15(3), 112-128. https://doi.org/10.24093/awej/vol15no3.7

Pappa, C. I., Georgiou, D., & Pittich, D. (2024). Technology education in primary schools: addressing teachers' perceptions, perceived barriers, and needs. *International Journal of Technology and Design Education*, *34*(2), 485-503. https://doi.org/10.1007/s10798-023-09804-w

Pun, J. K., Fu, X., & Cheung, K. K. C. (2024). Language challenges and coping strategies in English Medium Instruction (EMI) science classrooms: a critical review of literature. *Studies in Science Education*, *60*(1), 121-152. https://doi.org/10.1080/03057267.2023.2217688

Routray, S. K., & Mohanty, S. (2024). Integrating sustainability into STEM curricula. *IEEE Potentials*. https://doi.org/10.1109/MPOT.2024.3374895

Sibanda, J. (2021). Appreciating the layered and manifest linguistic complexity in mono-multi-lingual STEM Classrooms: Challenges and prospects. *Multilingual Education Yearbook 2021: Policy and Practice in STEM Multilingual Contexts*, 19-37. https://doi.org/10.1007/978-3-030-73897-6_2

Tan, P. L., Chong, M. S., & Razak, F. (2025). Multimodal literacy and environmental awareness: Bridging the gap in ESL science instruction. *System*, 128, 103567. https://doi.org/10.1016/j.system.2025.103567

UNESCO IESALC. (2025). *Digital literacy: Fostering possible futures through higher education*. Access via: https://unesdoc.unesco.org/