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The Design of an Interactive Science Literacy Model Using Design and Development Research (DDR) in Early Childhood Education

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ABSTRACT

This study aimed to develop an Interactive Model of Science Literacy based on Chinese children's folktales, using dialogic reading techniques with Chinese primary school preschool students. A Design and Development Research (DDR) methodology was employed, with data analysis using a combination of quantitative methods and the Fuzzy Delphi technique. A questionnaire, referencing Tyler's model, was administered to 12 experts to gather consensus on six key elements: teaching methods, science literacy, dialogic reading, folklore, theory, and student assessment. The Fuzzy Delphi method, using a 7-point Likert scale, determined the model's viability. Findings indicate that the Interactive Model of Science Literacy, grounded in Chinese folktales and dialogic reading, is effective and can be used to enhance science literacy among young learners.

KEYWORDS

Interactive Model, Science Literacy Element, DDR, Fuzzy Delphi

INTRODUCTION

The pedagogy of instruction and learning in kindergarten and in schools shapes children's development. Students are encouraged to develop important inquiry skills and knowledge when science is taught and learned using digital technology (Kamarudin et al., 2024). The foundation of children's education before entering school is preschool education, which is crucial to children's general growth and development. According to Sainain, (2020), children have the right to survival, protection, and development levels, in addition to the right to holistic development opportunities. This demonstrates that children should receive the best education possible in any preschool. Additionally, preschoolers start to develop the confidence they need to discover who they are by first engaging with people outside their families.

While traditional pedagogy reinforces fundamental skills like social interaction and critical thinking, digital pedagogy uses technology to increase engagement and encourage talents like

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creativity and problem-solving (Mohamad Ali et al., 2025). Research shows that combining the two strategies supports children's social, emotional, and cognitive development and prepares them for problem-solving in the future (Smith & Jones, 2023).

According to Zakaria et al. (2019), Chinese Malaysian tudents in particular, have yet to reach the language skill level that matches their Malay fluency. Children should be taught to discriminate, explore, document, ask questions, and engage in scientific dialogues, according to Sundberg et al. (2018). Therefore, preschool teachers should be creative in creating lessons that might enhance children's conversations about science and critical thinking. In order to improve their capacity to interact with and read about science, children actually need help from others around them at school, especially teachers. According to Hoisington and Diaz (2024), one can integrate science learning with language development by reading and discussing science-related books. This approach enhances vocabulary, comprehension, and the ability to communicate scientific ideas effectively.

Additionally, instructional techniques can be used more effectively to motivate children to read and study, such as collaborative learning and positive reinforcement (Omar et al., 2023). The main focus of the delivery methods for the aforementioned tactics can be adjusted to the children's capacity to attain the necessary degree of accomplishment and gain comprehension and proficiency in the language (Aisyah et al., 2020). One of the most important methods for evaluating a child's recall is to use instructional resources, such as fostering conceptual thinking, which can enhance a child's recall abilities. Research indicates that the development of conceptual thinking is related to improved performance in free recall tasks, as well as in responding to various types of questions (Terada & Merrill, 2024). To improve children's reading comprehension, especially in Chinese preschools in Malaysia, we developed an interactive science literacy model.

Science literacy is part of the Science and Technology Pillar of the National Preschool Standard Curriculum (National Standard Preschool Curriculum, 2017). Subject standards and learning standards that preschoolers can understand and master are the main focus of the preschool standard curriculum, as they will be the basis for their development in science literacy. Early reading proficiency, in preschool children especially, is essential.

Whitehurst et al. (1988) developed a dialogic reading method using the Vygotskian paradigm, that can support children's learning in a social context. Reading interactive picture books to students to help them improve their language and literacy skills is known as dialogic reading. During dialogic reading, children and adults will take turns telling stories until the former learns to be the storyteller with the help of adults, who participate as active listeners and questioners. As part of our research funding, we developed a folktale-based Interactive Science Literacy Model that uses dialogic reading techniques to help Chinese Malaysian Preschoolers become more proficient readers in science literacy.

PROBLEM STATEMENT

The use of an interactive model in teaching early science is essential compared to non-interactive models. This is because the new preschool curriculum, which will be implemented in 2026, emphasizes digital fluency rather than just digital literacy. Therefore, there is a critical need for an interactive model to support the new curriculum and align with the national digital education policy (Ministry of Digital Malaysia, 2024).

According to Ibrahim and Mohamed (2021), teachers must comprehend scientific principles when instructing children. Research based on an investigation conducted by the Malaysian Ministry of Education in 2012 and 2013 found that a significant portion of preschool teachers, particularly those who are required to teach, have difficulty understanding the curriculum's content. Smith al. (2022) study found that instructors' confidence in their competence to teach scientific topics is weakened by their either incomplete or erroneous comprehension of a subject. To increase their comprehension, preschool teachers should do extensive preparation before presenting science to their students. This is because inexperienced teachers are unable to adhere to the rules and procedures that need to be followed in the event of an exceptional situation (Duran et al., 2021).

From an alternative viewpoint, a lack of teaching and learning materials restricts scientific education (Barenthien & Dunekacke (2021). According to Yaakub et al. (2020), the choice of learning resources adds to the low level of science literacy, even though it is important for improving children's understanding of the subject. One aspect influencing children's low science literacy is the quality of the books used for education (Shohib et al., 2021). The cornerstones of science literacy include asking meaningful questions and being deeply interested in the world around us (Moore, 2017).

Using folktales in science literacy courses is a great way to increase children's interest in a topic (Bung, 2021). Shayzakov (2021) asserted that, because of its close relationship to literacy, folklore has been successfully integrated into teaching modern literature reading and has a major influence on children's learning and reading activities. Children's views and imaginations can be shaped by folktales, which can help children become better speakers, gain experience, imagine the outside world, and act on their ideas (Salimovna, 2023). This demonstrates how well children use folktales to express their opinions in class.

Dialogic reading techniques can help improve children's science literacy. According to Bezuidenhout (2021), effective dialogic reading techniques are a helpful way to gradually increase children's vocabulary and conceptual knowledge. Although this dialogic technique has been utilized for a long time in other countries, it is still not widely adopted in Malaysian education. Preschoolers' language development has been impacted and enhanced by dialogic reading, particularly in the area of reading abilities. Whitehurst et al. (1988) demonstrated how conversation reading techniques may improve the literacy development of children aged two to six (Kim & Riley, 2021). According to the issue description, there is not an interactive scientific teaching paradigm for children's science literacy.

The absence of an interactive scientific teaching paradigm significantly impedes the development of children's science literacy. Without engaging and structured approaches, children may struggle to grasp fundamental scientific concepts, leading to limited critical thinking and problem-solving skills. This deficiency can result in reduced interest in STEM fields, lower academic performance, and decreased preparedness for future scientific and technological advancements. Recent studies underscore the importance of interactive learning environments in fostering science literacy. For instance, research indicates that early exposure to scientific concepts through interactive workshops helps children develop foundational skills essential for their future academic and professional success (Muñoz-Losa & Corbacho-Cuello, 2025).

OBJECTIVE

This study was conducted to develop the interactive model of science literacy based on Chinese children's folktales using dialogic reading techniques in Malaysian Chinese preschools.

METHODOLOGY

The methodology is a design and development research (DDR) strategy with a combination of quantitative and qualitative approaches; the goal of this project was to create an interactive model of science literacy based on Chinese children's folktales employing dialogic reading techniques among Chinese primary school preschool students. Jamil and Noh (2021) asserted that a design, development, and systematic evaluation process serves as the empirical foundation for product creation. The study's data-gathering period ran from May 30, 2022, to May 30, 2023. Teachers and education specialists were included in the study sample. Research ethics were followed in the data analysis, which included getting the Ministry of Education's approval and consent via the Eras 2.0 portal. Furthermore, to safeguard the teachers' information and privacy, coding and anonymization were applied during data analysis.

The DDR design phase was divided into three parts:

Phase 1: Analyze the needs of the Interactive Science Literacy Model based on Chinese children's folktales using dialogic reading techniques among Malaysian Chinese preschools.
Phase 2: Develop an Interactive Science Literacy Model based on Chinese children's folktales using dialogic reading techniques among Malaysian Chinese preschools.
Phase 3: Explore the applicability of an Interactive Science Literacy Model based on Chinese children's folktales using dialogic reading techniques among Malaysian Chinese preschools.

We only focused on Phase 2 in this article. To identify the components required for the model, we used the Tyler Model in this phase. The motivation for education, acquiring skills to attain objectives, organizing the learned skills, and assessment/evaluation are the four fundamental elements of curriculum building that must be followed in the correct order, according to Tyler, (1969), Expert consensus on model elements was obtained through the use of the Fuzzy Delphi Method in this quantitative investigation. Consensus or strong expert agreement was used to select and incorporate elements into the model. Eleven experts were chosen to complete the "Content Validation Form" during the model design phase.

VALIDITY

The questionnaire was content-validated and analyzed using the Cohen's Kappa index. Three specialists carried out the content validation. This panel of experts reviewed the steps and substance of the model activity. This data was processed using the Cohen's Kappa calculation method. The Cohen's Kappa indexing analytical approach was first presented by Cohen, (1960). According to Cohen, two or more independent judges should decide on a sample's degree, relevance, and stability based on their consensus. The degree of expert reliability agreement on the researcher's model was assessed in this study using the Cohen's Kappa data analysis approach. The data agreement value is determined using the formula in Equation 1.

$$K = \frac{fa - fc}{N - fc} \quad (1)$$

where K = Cohen's Kappa coefficient value, fa = frequency of agreement, fc = frequency of 50% expected agreement, and N = number of units tested agreement value.

Table 1 shows Cohen's Kappa value table and interpretations (levels).

Table 1. Cohen's Kappa Value Table and Interpretations (Levels)

Cohen's Kappa Value	Interpretation
Less than 0	Very weak
0.00–0.20	Weak
0.21–0.40	Moderately weak
0.41–0.60	Medium
0.61–0.80	Good
0.81–1.00	Very good

Note. Source: (Cohen, 1960)

Table 2 shows the Cohen's Kappa value subsequent to experts' assessments. Two out of three experts showed a Cohen's Kappa value of 1.0, which demonstrates a very good interpretation. One expert has given a Cohen's Kappa value of 0.96, where the interpretation is also deemed very good.

Table 2. Expert Cohen's Kappa Values for Questionnaire Instruments

Expert	Cohen's Kappa Value
Expert 1	1
Expert 2	0.96
Expert 3	1

RESULT

The research questionnaire contained 65 items involving six main constructs.

Construct 1—Objective: Learning

According to the findings of the study, nine components have received expert approval. The element with the highest score, which came in first place with a percentage of 92%, is related to the National Curriculum, according to the researcher's fuzzy score analysis. The ability to use multidirectional communication patterns when teaching, creating a flexible and democratic classroom environment, and being suitable for usage both inside and outside the classroom were the next three components that share the same score in the second position. The expert group agreed with these three aspects 92% of the time. Based on expert group consensus, the study's results involving the nine elements.

Table 3. Objective Learning Elements

Elements	Terms of Triangular Fuzzy Numbers		Terms of Defuzzification Process				Expert Agreement	Element ACCEPTED	Ranking
	Threshold value, d	Percentage of Expert Group Agreement	m1	m2	m3	Fuzzy Score (A)			
Refer to the National Curriculum.	0.095	92%	0.817	0.950	0.992	0.919	ACCEPTED	0.919	1
Attract the reader's attention with pictures, images, or visuals to spread an idea or message.	0.122	83%	0.783	0.925	0.983	0.897	ACCEPTED	0.897	5
Have a moving image.	0.125	75%	0.717	0.883	0.975	0.858	ACCEPTED	0.858	9
Involve user interaction by using inputs, such as a keyboard, mouse, or touchscreen.	0.134	75%	0.733	0.892	0.975	0.867	ACCEPTED	0.867	8
Include multimedia elements, such as text, audio, video, and animation.	0.122	83%	0.783	0.925	0.983	0.897	ACCEPTED	0.897	6
Teachers play more of a role as facilitators, resource persons, and democratic class managers.	0.102	83%	0.733	0.900	0.983	0.872	ACCEPTED	0.872	7
Apply multi-directional communication patterns.	0.097	92%	0.783	0.933	0.992	0.903	ACCEPTED	0.903	2
Create a flexible and democratic classroom atmosphere.	0.097	92%	0.783	0.933	0.992	0.903	ACCEPTED	0.903	2
Use inside or outside the classroom.	0.097	92%	0.783	0.933	0.992	0.903	ACCEPTED	0.903	2

Construct 2—Content: Science Literacy

Experts have determined that science literacy consists of 15 components. According to the fuzzy score analysis, the aspects that rank first are (1) speaking, (2) writing, (3) listening, and (4) reading, all of which form the foundation for gaining science literacy. Four elements are then in the same location. Literacy science, which includes inquiry learning that combines hands-on activities with experiments and explores a scientific phenomenon, allows students to (5) develop competence in explaining phenomena scientifically, (6) evaluate, (7) design scientific inquiries, and (8) interpret data and evidence scientifically. These are the four components that make up the third position. The other three components are (9) students learning new information, (10) becoming involved in science literacy, and (11) wanting to learn more about science.

An 83% expert agreement rate was given to each of these components. A child's desire to participate in knowledge application, which is the goal of gaining science literacy, is the 10th element, where two elements share the same position. This aspect obtained a percentage of 75%. Additionally, two components that share the 12th position with science literacy, which represented and retain the ability to explain a phenomenon scientifically, evaluate and design scientific inquiry, interpret data and evidence scientifically, and retain knowledge of methods, received a percentage of 75%.

The 14th position, which received a similar percentage with 75% expert agreement, has two components. First, children who are proficient in science literacy will have a sufficient understanding of basic scientific material to appreciate its beauty and ingenuity. Second, the element of content knowledge is the reason for learning science literacy. The science literacy elements are displayed in Table 4.

Table 4. Science Literacy Elements

Elements	Terms of Triangular Fuzzy Numbers		Terms of Defuzzification Process				Expert Agreement	Element ACCEPTED	Ranking
	Threshold value, d	Percentage of Expert Group Agreement	m1	m2	m3	Fuzzy Score (A)			
Scientific knowledge skills enable children to identify questions.	0.102	83%	0.733	0.900	0.983	0.872	ACCEPTED	0.872	7
Children acquire new knowledge.	0.119	83%	0.767	0.917	0.983	0.889	ACCEPTED	0.889	3
Children gain an awareness of how science and technology shape natural, intellectual, and cultural environments.	0.134	75%	0.733	0.892	0.975	0.867	ACCEPTED	0.867	9
Children a desire to get involved with science-related issues, and they care about them.	0.125	75%	0.717	0.883	0.975	0.858	ACCEPTED	0.858	10
Children who are proficient in science literacy will have a sufficient understanding of basic scientific material to appreciate its beauty and ingenuity.	0.160	75%	0.700	0.867	0.958	0.842	ACCEPTED	0.842	14

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Table 4. Continued

Elements	Terms of Triangular Fuzzy Numbers		Terms of Defuzzification Process				Expert Agreement	Element ACCEPTED	Ranking
	Threshold value, d	Percentage of Expert Group Agreement	m1	m2	m3	Fuzzy Score (A)			
Science literacy involves the ability to explain phenomena scientifically, evaluate and design scientific inquiry, and interpret data and evidence scientifically.	0.167	75%	0.717	0.875	0.958	0.850	ACCEPTED	0.850	12
Content knowledge is the purpose of science literacy learning.	0.160	75%	0.700	0.867	0.958	0.842	ACCEPTED	0.842	14
Knowledge of methods is the purpose of learning science literacy.	0.116	75%	0.700	0.875	0.975	0.850	ACCEPTED	0.850	12
Understanding scientific knowledge is the purpose of learning science literacy.	0.102	83%	0.733	0.900	0.983	0.872	ACCEPTED	0.872	7
Applying knowledge is the purpose of learning science literacy.	0.125	75%	0.717	0.883	0.975	0.858	ACCEPTED	0.858	10
Science literacy is an engagement and desire to understand more about science.	0.119	83%	0.767	0.917	0.983	0.889	ACCEPTED	0.889	3
Students' science literacy includes decision-making skills.	0.097	92%	0.783	0.933	0.992	0.903	ACCEPTED	0.903	2

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Table 4. Continued

Elements	Terms of Triangular Fuzzy Numbers		Terms of Defuzzification Process				Expert Agreement	Element ACCEPTED	Ranking
	Threshold value, d	Percentage of Expert Group Agreement	m1	m2	m3	Fuzzy Score (A)			
Students will gain competence in explaining phenomena scientifically, evaluating and designing scientific inquiries, and interpreting data and evidence scientifically.	0.119	83%	0.767	0.917	0.983	0.889	ACCEPTED	0.889	3
Reading, writing, listening, and speaking are fundamental in learning science literacy.	0.074	100%	0.783	0.942	1.000	0.908	ACCEPTED	0.908	1

Construct 3—Method: Children's Folk Stories

Five aspects of folklore were identified by the chosen panel of specialists based on the study's findings. The feature of voice intonation that is necessary for folklore had the highest expert agreement with 92%, according to the fuzzy score analysis. The portion of folklore that involves knowledge and imagination through telling or listening to stories obtained the lowest percentage of fuzzy score, 75%. Based on the expert group's conclusion, the study's findings included five elements, which are shown in Table 5.

Table 5. Method Elements

Elements	Terms of Triangular Fuzzy Numbers		Terms of Defuzzification Process				Expert Agreement	Element ACCEPTED	Ranking
	Threshold value, d	Percentage of Expert Group Agreement	m1	m2	m3	Fuzzy Score (A)			
Folktales are stories passed down from generation to generation.	0.122	83%	0.783	0.925	0.983	0.897	ACCEPTED	0.897	3
Folktales involve knowledge and imagination through the telling and listening to stories.	0.116	75%	0.700	0.875	0.975	0.850	ACCEPTED	0.850	5
Facial expression skills are important in folklore.	0.098	92%	0.800	0.942	0.992	0.911	ACCEPTED	0.911	2
Body language expression is important in folklore.	0.112	83%	0.750	0.908	0.983	0.881	ACCEPTED	0.881	4
Voice intonation is important in folklore.	0.095	92%	0.817	0.950	0.992	0.919	ACCEPTED	0.919	1

Construct 4—Method: Dialogic Reading Technique

Based on the fuzzy score analysis, 10 components of the dialogic reading technique have received expert agreement. According to the fuzzy score analysis, the researcher found that, with a 92% expert agreement rate, the element in the first position with the highest fuzzy score value is responsible for generating children's interest in the dialogic reading technique. Next, the children's role as storytellers employing the dialogic style got an 83% expert agreement rate in the second position. The component in the last position commends and motivates children to focus on the narrative—this one has a 75% expert agreement rate. Table 6 shows the research findings for elements of dialogic reading techniques.

Table 6. Dialogic Reading Technique Elements

Elements	Terms of Triangular Fuzzy Numbers		Terms of Defuzzification Process				Expert Agreement	Element ACCEPTED	Ranking
	Threshold value, d	Percentage of Expert Group Agreement	m1	m2	m3	Fuzzy Score (A)			
Picture description is a strategy that can be used in dialogic-reading techniques.	0.112	83%	0.750	0.908	0.983	0.881	ACCEPTED	0.881	4
Talk a mile a minute is a strategy that can be used in dialogic-reading techniques.	0.162	75%	0.650	0.833	0.950	0.811	ACCEPTED	0.811	9
PEER (Prompt, Evaluate, Expand, and Repeat) is a technique used in dialogic reading.	0.134	75%	0.733	0.892	0.975	0.867	ACCEPTED	0.867	6
CROWD (Completion, Recall, Open-ended questions, Wh-questions, and Distancing) is a technique used in dialogic reading.	0.179	75%	0.750	0.892	0.958	0.867	ACCEPTED	0.867	6
Give praise and encouragement to children to encourage interest in the story.	0.125	75%	0.717	0.883	0.975	0.858	ACCEPTED	0.858	8
Develop children's interest when dialogic reading techniques are used.	0.095	92%	0.817	0.950	0.992	0.919	ACCEPTED	0.919	1

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Table 6. Continued

Elements	Terms of Triangular Fuzzy Numbers		Terms of Defuzzification Process				Expert Agreement	Element ACCEPTED	Ranking
	Threshold value, d	Percentage of Expert Group Agreement	m1	m2	m3	Fuzzy Score (A)			
The children's role becomes that of the narrator while using dialogic techniques.	0.119	83%	0.767	0.917	0.983	0.889	ACCEPTED	0.889	2
Adults function as active listeners and questioners.	0.141	75%	0.750	0.900	0.975	0.875	ACCEPTED	0.875	5
Developing the student's answer by repeating it, clarifying the question, or asking further questions is the teacher's role in the dialogic technique.	0.147	75%	0.767	0.908	0.975	0.883	ACCEPTED	0.883	3

Construct 5—Method: Theory

Experts have agreed upon six elements based on the results of the Fuzzy Delphi Method score analysis. The three levels of the developmentally appropriate practices (DAP) that were given the top spot (83%) according to the fuzzy score analysis were concept appropriateness with age development, appropriateness with individual growth patterns, and appropriateness with the child's culture. These levels are necessary for learning literacy science.

The three stages of a child's cognitive development—enactive, iconic, and symbolic—involve learning through representations that symbolize concepts, which are essential for developing scientific literacy. In the symbolic stage, children are better able to understand and acquire concepts through the use of language and symbolic representations. The final component of theory accounting for 75% of the total, is Piaget's theory of cognitive development, which holds that children are "little scientists" who should be allowed to play freely, investigate unreservedly, and develop their knowledge liberally to acquire science literacy. One component of the theory is shown in Table 7.

Table 7. Theory Elements

Elements	Terms of Triangular Fuzzy Numbers		Terms of Defuzzification Process				Expert Agreement	Element ACCEPTED	Ranking
	Threshold value, d	Percentage of Expert Group Agreement	m1	m2	m3	Fuzzy Score (A)			
Piaget's theory of cognitive development assumes children are "little scientists" that should be given the opportunity to play freely, explore, and build their own understanding of learning science literacy.	0.134	75%	0.733	0.892	0.975	0.867	ACCEPTED	0.867	6
Vygotsky's theory introduced the concept of the zone of proximal development (i.e., students need teachers' help during science literacy learning).	0.141	75%	0.750	0.900	0.975	0.875	ACCEPTED	0.875	5
In science literacy, children's cognitive development goes through three stages, namely the enactive stage, the iconic stage, and the symbolic stage.	0.119	83%	0.767	0.917	0.983	0.889	ACCEPTED	0.889	3
The symbolic level is the use of an image to symbolize a concept; students can understand and learn through symbols and concepts more than through language in science literacy.	0.119	83%	0.767	0.917	0.983	0.889	ACCEPTED	0.889	3

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Table 7. Continued

Elements	Terms of Triangular Fuzzy Numbers		Terms of Defuzzification Process				Expert Agreement	Element ACCEPTED	Ranking
	Threshold value, d	Percentage of Expert Group Agreement	m1	m2	m3	Fuzzy Score (A)			
Developmentally appropriate practices (DAP) are learning methods used in interactive learning in science literacy.	0.122	83%	0.783	0.925	0.983	0.897	ACCEPTED	0.897	2
The three levels of the DAP concept are appropriateness with age development, appropriateness with individual development (individual growth patterns), and appropriateness with children's culture, which are required in learning science literacy.	0.122	83%	0.800	0.933	0.983	0.906	ACCEPTED	0.906	1

Construct 6—Student Assessment

Experts have agreed upon six elements based on the results of the Delphi fuzzy score analysis. The aspect that ranked highest, according to fuzzy score analysis, was the children's capacity to apply science and knowledge in a creative way to address issues in daily life, which achieved a 92% expert agreement rate. The third position was thus shared by three components: a child's ability to explain scientific phenomena, their ability to make fact-based conclusions, and their ability to pose open-ended questions about the narrative when dialogic approaches were applied. One component of student assessment is shown in Table 8.

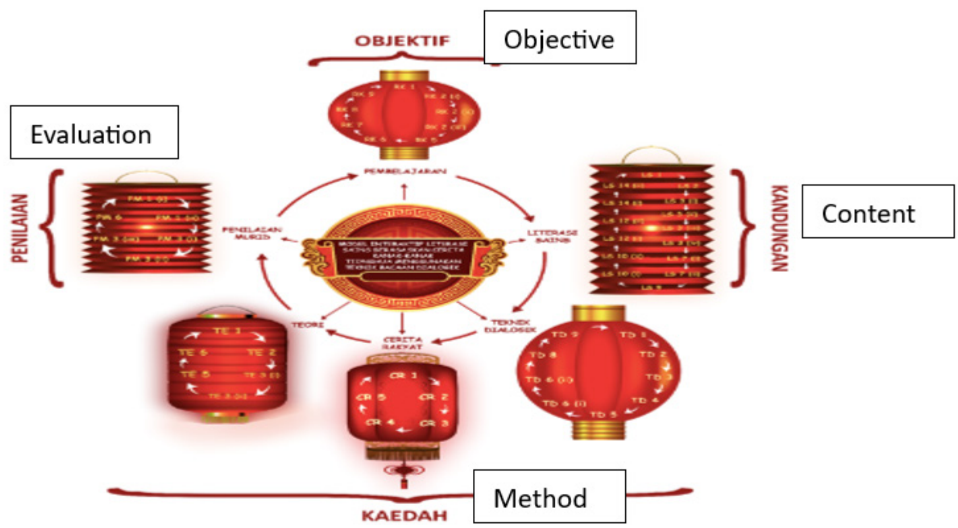
Table 8. Student Assessment Elements

Elements	Terms of Triangular Fuzzy Numbers		Terms of Defuzzification Process				Expert Agreement	Expert Agreement	Ranking
	Threshold value, d	Percentage of Expert Group Agreement	m1	m2	m3	Fuzzy score (A)			
Children can explain scientific phenomena.	0.070	83%	0.667	0.867	0.983	0.839	ACCEPTED	0.839	3
Teachers use authentic assessment to assess students.	0.111	92%	0.650	0.850	0.967	0.822	ACCEPTED	0.822	6
Children can creatively use science and knowledge in everyday life to solve problems.	0.038	92%	0.683	0.883	0.992	0.853	ACCEPTED	0.853	1
Children can draw conclusions based on facts.	0.070	83%	0.667	0.867	0.983	0.839	ACCEPTED	0.839	3
Children can make rational decisions based on evidence.	0.038	92%	0.683	0.883	0.992	0.853	ACCEPTED	0.853	1
Children can ask open questions about the story when dialogic techniques are used.	0.070	83%	0.667	0.867	0.983	0.839	ACCEPTED	0.839	3

DISCUSSION

The findings of the study have led to the development of a model that can serve as a guideline for early childhood educators in teaching early science using dialogic techniques. The developed model is an interactive model that aligns with the new curriculum and the national digital policy. Six constructs were developed to produce this interactive model. The items within these constructs were validated and agreed upon based on the data obtained from the research findings. All six constructs were grounded in the Tyler Model (1969), which consists of four key indicators: objectives, content, methods, and assessment.

Figure 1. Interactive Science Literacy Model in Chinese Preschools in Malaysia



Reference is one of the key components used in the creation of this model. In order to construct the model, the National Curriculum was studied. Based on the National Education Philosophy, the preschool curriculum was thoughtfully created to accommodate children's needs and skill levels. The National Preschool Standard Curriculum is the current curriculum in use. The focus of this preschool standard curriculum is on learning and content requirements that children can comprehend and master. Early reading proficiency is essential for children, particularly in preschool settings, since it will serve as the foundation for their gradual mastery of science literacy.

Additionally, in general, the teaching strategies employed in the classroom are crucial. The teaching methods that are employed to help gauge whether students grasp a skill (Jamian & Baharom, 2018). Thus, teachers are crucial in employing suitable and efficient teaching methods, and their ability to keep students' focus on studying Malay might indirectly enhance their science literacy. According to Abdul et al. (2019), a teacher's teaching style is crucial for having a significant impact on children's emotional development and helping them to form a self-image.

Teachers can employ a variety of strategies and tactics to help Chinese preschoolers develop and master their reading skills, and researchers create models of dialogic reading strategies using stories to pique students' interest and encourage them to improve.

Teachers reported an increase in children's capacity to formulate questions using prompt, evaluate, expand, and repeat (PEER) and completion, recall, open-ended questions, wh-questions, and distancing (CROWD) approaches, according to Ratminingsih et al. (2021). In order to address the science literacy reading issue that Chinese preschoolers encounter, we employed the dialogic reading technique. This model's development places a strong emphasis on the use of theory in the classroom, folktales, and dialogic reading strategies to teach science literacy.

Fostering young children's interest and fundamental comprehension of scientific topics requires the use of an interactive science literacy approach in early childhood education. This model was developed using the DDR approach, which guarantees a methodical process that integrates theoretical and practical discoveries, improving the effectiveness and engagement of the learning process.

Design, development, and assessment cycles are iterative, according to the DDR research approach. Because it enables ongoing improvement based on input from stakeholders, such as educators, students, and specialists, this method is ideal for developing interactive educational tools. Researchers can ensure that the science literacy model is both developmentally appropriate and pedagogically sound by addressing the special demands of early learners through DDR (Wang et al. 2024; Wang & Hannafin, 2005).

Interactive models are very helpful in the early childhood education setting because they promote active learning, which is superior to passive teaching methods. Young children can experiment, investigate, and interact with scientific topics in a hands-on way with interactive science literacy tools, which can greatly improve their comprehension and memory of the material (Brown, 2024). This is consistent with Vygotsky's constructivist theory, which holds that social interaction and active participation are the best ways for kids to learn.

Additionally, digital technologies, which have been demonstrated to effectively captivate and engage young learners, can be used in the creation of interactive science literacy models. Science literacy learning, content, dialogic procedures, folktales, theory, and assessment are the six main components of this model. The interactive pedagogy that can be implemented in Chinese preschools in Malaysia is supported by indicators for each component. These components include curriculum and storytelling pedagogy, according to the study's findings. The study's conclusions, which have been coded into the model, serve as the foundation for the recognized indications.

Mohamad Ali et.al, (2025) asserts that digital technologies in education can deliver immersive experiences, adjust to the learner's pace, and give real-time feedback, all of which are challenging to accomplish with conventional techniques. This is in line with current educational trends, which show that early childhood classes are increasingly integrating technology.

However, the iterative nature of DDR is crucial to the development of such models. To make sure the model stays in line with educational objectives and fulfills the requirements of both teachers and children, ongoing evaluation and feedback are crucial. The model's inclusivity and accessibility must also be considered in order to make sure that kids from a variety of backgrounds and learning styles may use it (Garcia, 2023).

CONCLUSION

Overall, we effectively created the preliminary framework of the "Interactive Model of Science Literacy Based on Folktales for Chinese Children Using Dialogic Reading Techniques" Among Chinese Malaysian Preschool as a consequence of the analysis conducted using the Fuzzy Delphi Method. The analysis's findings demonstrate that the experts accepted the researcher's recommended items. The development of an interactive model of science literacy based on Chinese children's folktales using dialogic reading techniques among Chinese Malaysian Preschool is the research question, and the expert consensus indicates that all the agreed values are high, thereby demonstrating the success of the results analysis.

In conclusion, the "Interactive Model of Science Literacy Based on Folktales for Chinese Children Using Dialogic Reading Techniques" offers a culturally responsive and pedagogically sound approach to enhancing early science education in Chinese preschools. By integrating traditional folktales with dialogic reading strategies, the model not only promotes scientific thinking and inquiry skills but also nurtures language development and cultural identity. The interactive nature of the model supports the goals of the upcoming preschool curriculum and aligns with the National Digital Education Policy, emphasizing digital fluency and active engagement. Grounded in the Tyler Model framework (Tyler, 1969)—comprising objectives, content, methods, and assessment—this model provides educators with a comprehensive guide to implementing effective, meaningful, and engaging science instruction tailored to the developmental and cultural needs of Chinese preschoolers.

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COMPETING INTERESTS

The authors of this publication declare there are no competing interests.

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