Exploring the Role of Resource Based Learning (RBL) and Higher-order Thinking Skills (HOTS) in Enhancing Student Engagement in Primary Science Education: A Case Study from Gombak District

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ABSTRACT

This qualitative case study explores how six primary science teachers in the Gombak district utilize resource-based learning (RBL) to implement higher-order thinking skills (HOTS) activities and enhance student engagement in primary science education. Teachers with a minimum of five years of teaching experience from the three different types of primary schools were selected as participants. This research investigates how these RBLs are integrated into instructional practices, teaching methods, and assessment strategies to foster HOTS thereby sustaining student engagement in primary science education. The strategies that teachers employ to create resource-rich, inquiry-driven learning environments are examined where students can actively locate, evaluate, and utilize various RBLs. These include textbooks, digital content, multimedia, and other physical materials. Data were collected through classroom observations, semi-structured interviews, and document analysis from six experienced science teachers selected via purposive sampling. All interviews were recorded, translated, and transcribed verbatim. Next, thematic analysis was applied to the transcripts for a comprehensive assessment of the gathered data. Three themes were revealed from the analysis. The findings highlight that the effective integration of RBL significantly enhances student engagement and the development of HOTS. Incorporating these into teaching practices and assessments positively impacts students' cognitive skills, fostering a more student-centered, interactive, and cognitively enriching learning environment. These findings emphasize the transformative role of RBL in reshaping classroom dynamics and improving HOTS in primary science education.

Keywords*:* Higher-order Thinking Skills (HOTS), Resource-Based Learning (RBL), Students' Engagement, Primary Science Education.

INTRODUCTION

Resource-based learning (RBL) is an educational approach that allows students to take an active responsibility for what they learn by exploring various resources such as books, articles, videos, websites, and others. RBL strives to equip students with higher-order thinking skills (HOTS) like critical thinking and problem-solving, as well as, self-directed learning skills by supplying them the resources and tools to do so. In addition, other advanced cognitive processes such as analysis, evaluation, and creation (Bloom, 1956), are essential to be cultivated amongst students to enable a deeper and more meaningful learning. According to Beswick (1977), RBL is unique because the resources can be used multiple times and in multiple ways to support a variety of learning needs. Research has shown that the use of RBL is vital to nurture HOTS effectively where traditional and digital materials are used to enhance student engagement and interest in learning activities (Hattie, 2009; McTighe & Wiggins, 2013). Other researchers have also emphasized the importance of RBL in implementing HOTS and enhancing student engagement in science education (Patton, 2015; Yin, 2018).

Additionally, integrating interactive, student-centered teaching strategies, aligned with curricular objectives, supports HOTS, and overall academic achievement, reflecting broader educational principles (Marzano, 2007;

Wiggins & McTighe, 2005). Although these studies have highlighted the importance of RBL to enhance HOTS, studies that specifically explore the impact of RBL on student engagement in HOTS remain limited. This research seeks to fill this gap by exploring how primary science teachers in Gombak, an urban district in the state of Selangor, utilize RBL to engage students in HOTS and optimize learning outcomes. Gombak district is located in the eastern part of Selangor and is made up mainly of urban Malays and a mix of Chinese and Indian population. This district is chosen to facilitate data collection.

In this study, Bloom's Taxonomy and Constructivism Theory has been chosen as the theoretical framework since Bloom's (1956) emphasis on students analysing, understanding, and identifying appropriate connections between prior experiences and new situations, aligns well with the basic principles of HOTS and RBL. Both emphasized using methods and knowledge that can be easily applied, as well as placing importance on the value of interactive and RBL in fostering cognitive skills and student engagement.

Objectives of Study

Thus, the objectives of this study are to explore how primary science teachers in the Gombak district leverage RBL to implement HOTS and investigate how teachers improve student engagement using RBL. The study hopes to answer the following research questions:

1. How do primary science teachers in the Gombak district use RBL to implement HOTS?
2. How do teachers improve student engagement using RBL?

METHODOLOGY

A. Research Design

This qualitative case study explores how primary science teachers in the Gombak district utilize RBL to implement HOTS activities and enhance student engagement. By focusing on the use of RBL such as textbooks, multimedia, and digital materials, the study assesses how teachers foster critical thinking, problem-solving, and creativity. Adopting a case study design allows the research to investigate these phenomena within their authentic, real-life context, providing a detailed exploration of how RBL is applied to promote deeper learning. Case study research offers the advantage of examining events or phenomena in a specific time and place (Denzin & Lincoln, 1994), facilitating an in-depth understanding of naturally occurring educational practices, and enabling an in-depth examination of naturally occurring phenomena, thereby contributing to a nuanced and contextually informed understanding (Creswell, 2002). The justification for utilizing a case study approach resides in its capacity to elucidate educational practices that promote student engagement and facilitate the cultivation of critical thinking skills.

B. Participants

The participants in this study were six experienced primary science teachers from the three types of Malaysian primary schools in the Gombak district offering diverse educational contexts; four from the National Type public schools (or SK), one from the National Type Chinese vernacular school (SJKC) and one from the National Type Tamil vernacular schools (SJKT) (see Table 1). This variety provided valuable perspectives on how HOTS are implemented in different instructional and cultural settings. By including teachers from multiple national school systems and experience levels, this study explores how teachers adjust strategies to meet diverse student needs. For instance, National Schools (SK), primarily serving Malay students, may incorporate specific cultural or linguistic elements, while Chinese National Schools (SJKC) and Tamil National Schools (SJKT) add further cultural and linguistic considerations that shape HOTS instruction.

Table 1: Demography of Participants

No	Participants Pseudonym	Workplace	Teaching experience (years)
1	Sarah	SK 1	12
2	Gayatrie	SJK(T)	9

3	Azie	SK 2	7
4	Linda	SK 3	15
5	Huda	SK 4	9
6	Nisa	SJK(C)	11

Out of the 68 primary schools in the Gombak district, schools with a student population of more than two thousand and having at least ten science teachers were the inclusion criteria. Additionally, schools with up-to-date facilities, such as internet access and computer supplies provided by the Ministry of Education, were included to explore how technological advancements support HOTS practices. The six teachers were selected using purposive sampling. They were recommended by the heads of the primary schools. Only those with more than five years of experience teaching science subjects were included to ensure insights from experienced practitioners. In this study, teachers' teaching experience ranged from 7 to 15 years, with an average of 10.5 years.

Ethical considerations were carefully addressed, including protecting participants' identities through the use of pseudonyms, obtaining informed consent prior to data collection, and securing ethical approval from the relevant institutional review board. This sampling strategy was designed to achieve data saturation and provide comprehensive insights into the implementation of HOTS in science classrooms in primary schools.

C. Data Collection

Three data collection methods were employed to capture diverse perspectives: classroom observations, semi-structured interviews, and document analysis. Classroom observations offered insights into the practical application of HOTS within teaching practices and student-teacher interactions. These observations emphasized how teachers used RBL in lessons and employed interactive approaches to engage students and promote HOTS. The researcher personally observed the respondents' teaching sessions to gather firsthand insights. A structured observation guide was used to ensure consistency across the classroom (see Appendix 1: Observation Rubric). Next, semi-structured interviews were conducted with the six science teachers between November 2022 and May 2023. The one-to-one semi-structured interview allowed for an in-depth exploration of the objectives of this study. Each interview session, which was conducted in the Malay Language in the staff room after their teaching hours, lasted approximately 30 to 40 minutes and was audio-recorded with the participant's consent.

The interview questions were designed and reviewed by experts such as senior educators in the district of Gombak, and academic researchers at a local university to ensure clarity and precision, covering topics such as teaching experience, knowledge of HOTS, and implementation practices.

The following interview questions were asked to answer the first research question, which was to explore how primary science teachers in the Gombak district leverage RBL to implement HOTS: (1) How do you integrate HOTS into your daily teaching practices? (2) What challenges do you face in implementing HOTS in the classroom? (3) Can you share examples of specific activities or strategies you use to promote HOTS among your students? Follow-up questions, such as "Can you elaborate further?", "What or why do you think…?", or "Can you give me an example of…?", were also used to encourage more detailed responses and explore teachers' views on RBL and HOTS.

The second research question explored how teachers enhance student engagement during science learning using RBL. The participating teachers were asked questions such as: "In your experience, how is student involvement in the learning session?", "How do you emphasize HOTS as a key element in the daily Lesson Plan?", "How do you prepare HOTS questions in your lesson?", "Can you share how you apply higher-order thinking skills (HOTS), such as analysing, evaluating, and creating, to the topics taught in class?", and "Do you have any problems administering HOTS items during the lesson?". To further probe their responses, follow-up questions like "Why?", "How?", or "Please explain…" were also used to encourage more detailed answers.

Document analysis included reviewing lesson plans, teaching materials, and student work samples. This allowed for a deeper understanding of how HOTS were integrated into the curriculum and assessments. This

analysis provided a comprehensive understanding of instructional practices and the role of diverse educational resources in promoting student engagement.

D. Ethical Approval

This study adhered to strict ethical standards, securing approval from the Institutional Review Board and the Ministry of Education, as emphasized by Siti Roshaida Mohd Arifin (2018), who highlighted the importance of aligning research with initiatives to improve the education system. Participants were fully informed about the study's objectives, methodology, and their rights, including the option to withdraw, ensuring informed consent, and the safeguarding of confidentiality through pseudonyms and secure data storage. Approval involved thorough reviews by the Faculty of Education and the Ministry of Education, with introductory letters sent to school administrators to facilitate the process. Consent forms detailed data use and confidentiality, upholding ethical and legal standards. Research integrity was maintained throughout, with transparency ensured via opportunities for participants to ask questions and raise concerns.

E. Data Analysis

The data collected in this study was thematically analyzed. The six steps suggested by Braun and Clarke (2012) were adhered to. An iterative method was used to read and listen to each interview transcript, taking notes and making memos in the left-hand margins to document anything noteworthy or intriguing. In addition to remarks on similarities, differences, contradictions, and initial interpretations, the notes and memoranda summarized the information. After that, the transcripts were reviewed again, and any new topics were noted in the right-hand margins. Furthermore, several listening sessions were also taken for the audio records to match the verbatim transcriptions. In order to familiarize with the transcripts, the researcher also meticulously translated the transcripts into English and carefully reviewed the translations several times. This iterative process allowed the information to be closely examined, and the first reflective notes taken.

Subsequently, the second phase of the analysis, coding, was carried out. Transcripts relevant to the research topics were carefully and repeatedly read. The following of three stages, such as theme creation, refinement, and naming, were successfully carried out. In these three processes, the data and potential themes were coded, reviewed, and then modified. Thus, a thorough study of the data was enabled, which served as the basis for the finalized themes. The following section presents the finalized themes.

F. Triangulation for Validity and Reliability

Triangulation is a crucial method in qualitative research that enhances both the validity and reliability of findings by cross-verifying multiple data sources. This approach enables researchers to confirm findings from various perspectives, ensuring that the results are credible and well-supported (Cho & Trent, 2006; Patton, 2002). In this study, triangulation was achieved through classroom observations, semi-structured interviews, and document analysis. By corroborating evidence across these different methods, the study minimized potential biases and increased the accuracy of the conclusions (Patton, 2015; Yin, 2018). This cross-verification process strengthens the overall integrity of the research and provides a more comprehensive understanding of how HOTS is implemented. To further ensure the validity of the study, member checking was employed, allowing participants to review and confirm the accuracy of their interview transcripts and the preliminary findings. This process ensures that the interpretations reflect the participants' authentic experiences, thereby enhancing the study's credibility.

Reliability was maintained by ensuring consistent methodologies and standardized protocols throughout data collection and analysis (Camp, 2000). These measures minimized errors and discrepancies in the process. Additionally, peer debriefing sessions with colleagues and subject-matter experts offered critical feedback, refining the research design, and interpretation of findings, further strengthening the rigor of the study. Together, triangulation, member checking, and peer debriefing form a robust framework for ensuring the trustworthiness of the research. These strategies not only enhance the credibility and reliability of the study but also ensure the findings provide a well-rounded and rigorous understanding of the educational practices examined.

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RESULTS AND FINDINGS

The data in this study were collected via classroom observations, semi- structured interviews, and document

analysis. The classroom observations and document analysis provided the triangulation of the data collected from the semi-structured interviews. The interviews from the six teachers were initially transcribed verbatim. These were then translated from the Malay Language into English and later verified by two linguist experts from a local university. The interview transcriptions were then analysed thematically. The three emerging themes that were obtained after the data analysis process are as follows: (1) RBL 21st-Century Pedagogy, (2) Educational Assessment Strategies, and (3) 21st-Century Skills. The following discussion elaborates on these three themes.

A. Theme 1: RBL 21st-Century Pedagogy

Pedagogy in the 21st century refers to the systematic approach of instructing concepts and ideas by utilizing various advanced technological tools to achieve specific educational goals. This diverse range of tools includes digital technologies, multimedia, and physical materials, all of which are used to foster Higher-Order Thinking Skills (HOTS) through the use of Resource-based learning (RBL). In this study, participating teachers like Sarah, Gayatri, and Huda demonstrated innovative methods for integrating RBL strategies that move beyond traditional textbooks to include digital tools and reference materials. Their efforts were clearly shown to encourage critical thinking, creativity, and deeper engagement among students. For example, Sarah integrated books and online resources to give students a broader range of information and perspectives. She explained,

"Apart from the school textbooks, I also go online to search for supporting materials, such as additional information, images, videos, and animations, to help students understand the science concepts better. Students are encouraged to ask questions based on the various resources used" (222/140/Sarah/3).

By blending traditional and digital resources, Sarah ensured her teaching materials were diverse, current, and aligned with fostering HOTS to enhance students' engagement and critical thinking. On the other hand, Gayatri leveraged reference books with varying levels of difficulty to cater to differentiated instruction. She explained,

"I like to use different reference books that have multiple levels of presentation and difficulty to cater to the different academic abilities of my students" (266/155/Gayatri/3).

This approach supports students in building foundational knowledge while challenging them to think critically and analytically related to key elements of HOTS. A balanced use of RBL, a focus on the curriculum, and continuous school-based assessment can create an environment where HOTS and active student involvement thrive.

The pie (bar) chart in Figure 1 illustrates the different types of resources the teachers in this study utilized.

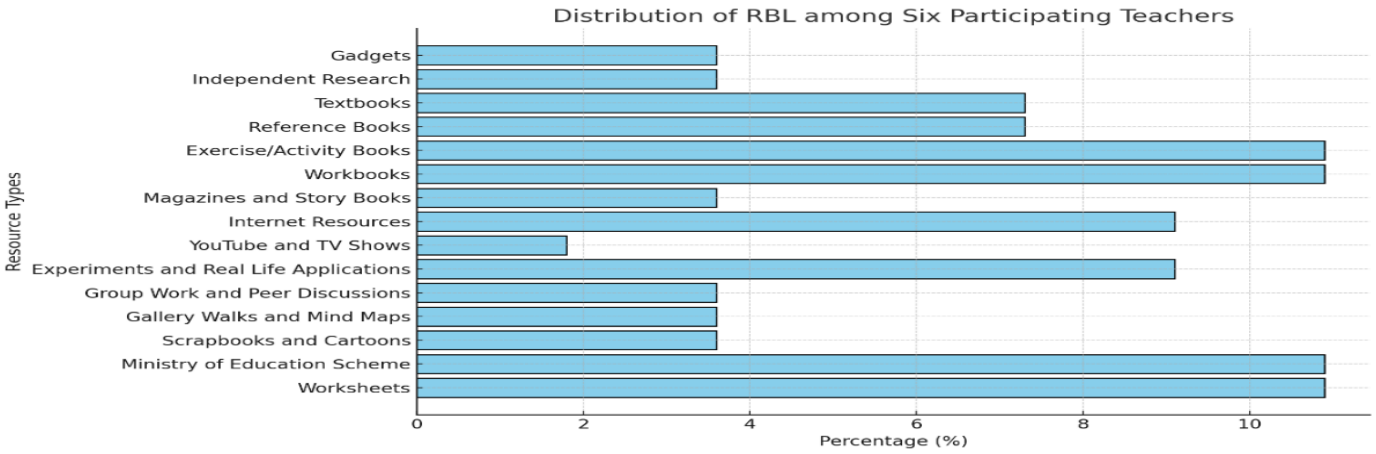

Figure 1: Distribution of RBL among the Six Participating Teachers.

The bar chart delineates the allocation of RBL utilized by participants, categorized into five principal segments: traditional print resources, digital tools, hands-on methods, and independent learning resources. A significant portion of RBL is associated with workbooks, exercise or activity books, worksheets, and initiatives from the Ministry of Education, each involving six participants, representing 20% of total usage. These resources are primarily utilized to facilitate structured problem-solving and adherence to curriculum standards.

In this study, five (5) teachers, representing 16.7% of the study sample, used digital tools, including internet resources, to enhance classroom learning through research-based activities. They also integrated experiments and real-life applications, effectively bridging theoretical concepts with practical implementation. In contrast, the use of collaborative methods such as group work, along with the use of magazines, creative methods, and independent research, is less frequent, with each category being represented by only two (2) participants or 6.7% of the study sample. This observation highlights the more specialized function of these resources in promoting collaboration and personalized learning experiences. Lastly, digital multimedia tools, including platforms such as YouTube and television shows, are the least frequently used, as evidenced by the involvement of only one (1) participant (3.3%). This finding suggests that the contribution of these resources remains limited within this educational context.

The distribution of RBL emphasizes the importance of a multifaceted approach that integrates traditional, digital, and interactive tools to facilitate various aspects of learning, including problem-solving, critical thinking, and independent exploration toward HOTS. Furthermore, some RBLs can be considered evaluative instruments in the classroom context. Specifically, materials such as workbooks, exercise/activity books, and worksheets are frequently used for structured tasks and problem-solving exercises, serving as mechanisms to assess students' understanding and application of scientific concepts. Through the integration of these materials, teachers can evaluate the extent to which students comprehend the content, complete assigned tasks, and demonstrate higher-order cognitive skills.

B. Theme 2: Educational Assessment Strategies.

A meaningful and equitable learning experience can only be achieved by advancing and fortifying 21st-century pedagogy through the alignment of assessments with the curriculum, RBL, and HOTS. This will guarantee fairness, accuracy, and relevance. The second theme supports valid assessments by directly linking them to the intended learning outcomes, namely fostering a culture of HOTS among students. The implementation of RBL is evident in teachers' practices in the Gombak district. As Sarah pointed out;

"Actually, apart from the school textbooks, I also look at other books but search more on Google. I refer to questions from other books and the internet and compare them with the scheme from the Ministry of Education" (222/140/Sarah/3).

By referring to the curriculum guidelines, Sarah ensures alignment between assessment items and learning objectives. This practice highlights how integrating RBL into education can be used to create assessments that accurately reflect curriculum objectives while promoting HOTS among students.

Huda, on the other hand, used a variety of resources to construct questions for her students. She elaborated as follows;

"To construct questions, I rely on textbooks, reference books, and the internet. For student assessment, 70 percent is guided by the questions, and 30 percent is based on the student's development while the student is doing the activities" (286/164/Huda/3).

Meanwhile, Gayatri used questions of different levels from reference books to her students to elicit better engagement. She stressed on aligning question difficulty with student abilities to ensure appropriate challenges that support the development of critical thinking skills. The following excerpt illustrates this;

"First of all, I will use the book, specifically the reference book related to the topics and containing questions of different levels. Well, of course, I will apply those questions. The students at the advanced level can help the

students at the moderate and low levels by discussing the answers with them" (266/155/Gayatri/3).

Inclusive and accessible assessments are essential to ensure educational equity in primary science education. By designing assessments that cater to diverse learning needs, teachers create opportunities for all students to demonstrate their understanding and apply HOTS, regardless of their backgrounds. This inclusive approach fosters a supportive and engaging learning environment, promoting fairness and active participation. Linda, however, preferred questions that are focused on problem-solving. As shown in the following excerpt;

"Time is limited, so I just use whatever is provided. There aren't many problems, only the students' behaviors that need to be controlled. Normally, I give my students problem-solving questions. The workbook is the easiest way because it already provides them. The textbook also includes questions at the end of the chapter, which also cover HOTS questions" (333/191/Linda/3).

Linda preferred to encourage her students to apply their knowledge to practical challenges to promote deeper cognitive processing. She adapted her questioning techniques to align with topics and contexts, drawing on a mix of textbooks, reference books, and exercise books, and adapted these to real-world contexts illustrating the flexibility of RBL usage. This ultimately promotes lifelong learning and adaptability in an ever-evolving educational landscape. Meanwhile, Huda employed a combination of textbooks, reference books, and online materials to design questions and student assessments. She mentioned,

"To construct questions, I rely on textbooks, reference books, and the internet. For student assessment, 70 percent is guided by the questions, and 30 percent is based on the student's development while they are doing the activities" (286/164/Huda/3).

Lastly, Nisa uses easily accessible RBL that at the same time aligns with the need to develop HOTS. She also ensures her assessments using activity books are aligned with the Ministry of Education's scheme. She practices the use of structured materials to challenge her students. She stated,

"Eazy… Many books provide it. If it's an individual, I divide it based on the activity book. It is ready to use anytime because all of my students have it." (333/190/Nisa/3)

Nisa provided valuable insights into how students approach solving HOTS problems, noting that some students solve problems creatively, systematically, and carefully plan when using RBLwhile others rely on more routine or conventional answers. Nisa emphasized the need for creative teaching strategies, well-structured lessons, and activities to promote HOTS in science primary school as this approach enables students to develop the skills needed to tackle complex real-world challenges. She observed,

"Yes, in the classroom and in their house. From there, you can see how your students are solving the problems. Are they doing it creatively, systematically, and well-planned? Or do they just give normal answers? You will realize this when you see their patterns of answering the questions." (366/193/Nisa/3)

She further explained,

"You can see how students solve problems creatively, systematically, and in a well-planned manner, or if they just give normal answers. It becomes obvious through their patterns of answering the questions." (366/193/Nisa/3)

The differences in response patterns highlight the importance of teaching students not only produce solutions but also to critically analyze the methods and RBL materials they used. Nisa's observations align with the principles of student-centered teaching strategies integrated with RBL and HOTS, where students actively interact with their environment to hypothesize, observe, and critically analyze their experiences using real-time feedback to enhance their learning process.

Thus, balancing formative (ongoing) and summative (final) assessments is another key strategy to enhance student engagement and HOTS. Formative assessments and timely feedback enable teachers to adjust their

instruction to meet students' needs, facilitating continuous improvement in learning outcomes. On the other hand, summative assessments provide a broader picture of student achievement, offering insights into their progress toward curriculum objectives and mastery of HOTS.

The use of RBL plays a critical role in facilitating formative assessment, enabling educators to monitor students' progress through various exercises and practical problems. Additionally, digital resources, combined with hands-on approaches such as experiments, provide further opportunities to evaluate students' practical application of scientific theories. Thus, while the chart illustrates the distribution of resources, it also highlights the essential role these materials play in the assessment process within the context of primary school science education.

Enhancing students' hands-on activities can stimulate the student's engagement in the classroom. It is essential to achieving the goal of instilling HOTS as a thinking culture. Indirectly, this effort needs to be aligned with the development of RBL, especially in primary school science education. .

C. Theme 3. 21st-Century Skills

To enhance student engagement and learning outcomes in primary science education, the teachers in this study practiced collaborative group work, independent research, spontaneous questioning, and practical experiments to foster HOTS. As Nisa shared,

"I do a gallery walk." (323/189/Nisa/3)

"If it's grouping, I do a gallery walk. If it's an individual, I divide it based on the activity book." (330/190/Nisa/3)

During a gallery walk, students need to actively move from one group to another to discuss and get involved in synthesizing important science concepts, writing, and public speaking. The technique not only cultivates good listening habits but also improves team-building skills.

In contrast, Sarah implemented activities like Spontaneous Questioning and Mind Mapping in her teaching sessions. She stated,

"Yes… emmm… some of the questions are given individually, and some are given spontaneously in groups. The students discuss with their group and present their ideas. The teacher will identify if there are any errors or areas for improvement." (310/182/Sarah/3)

For Sarah, this approach encourages students to think critically in real-time, collaborate on problem-solving, and articulate their ideas. This, in turn, strengthens student-centered teaching strategies and HOTS in primary science education. Furthermore, Sarah also demonstrated that the integration of RBL is crucial for improving student achievement and engagement, especially in developing HOTS. Sarah has integrated Internet sources and traditional books in addition to using mind maps as visual aids to support her students' understanding. By requiring students to create mind maps, she not only supports content retention but also nurtures HOTS development. This illustrates how visual aids successfully foster deeper learning. She emphasized that;

"A mind map is mandatory. Facts are easier to remember using mind maps for science subjects." (315/184/Sarah/3)

Gayatri, on the other hand, focuses on teaching methods that utilize Mixed-Ability Group Work and Reference Books. She explains that the use of Mixed-Ability Group Work and Reference Books is essential for fostering peer mentoring and student-centered teaching strategies within groups. She stated:

"Of course… when it comes to group work, it must blend with students of different levels." (345/120/Gayatri/3)

She further added:

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"The students at the advanced level can help those at the moderate and low levels by discussing the answers with them." (348/120/Gayatri/3)

This strategy enables students to engage in reflective thinking as they support their peers while also creating peer learning as a student-centered teaching strategies environment aligned with the principles of HOTS. Gayatri also uses reference books with questions at varying levels of difficulty to support different learning levels. She encouraged peer learning by stating:

"The students at the advanced level can help those at the moderate and low levels by discussing the answers with them. This method helps students remember, understand, and repeat the concepts to explain them to their friends." (352/121/Gayatri/3)

Meanwhile, Azie utilizes Group-Based Experimental Activities based on the student-centered teaching strategies integrated with RBL. In her opinion, adopting group-based experimental activities allows students to apply theoretical knowledge to practical scenarios. She explained,

"They conduct experiments and answer the given questions. I implement experimental activities for group work." (308/177/Azie/3)

Azie further elaborated,

"They are in groups, they do experiments and answer given questions" (310/177/Azie/3).

This practical approach supports HOTS by encouraging students to synthesize theoretical concepts with practical applications, thereby enhancing their problem-solving and critical-thinking skills. Azie adopts a more structured approach by providing exercises and worksheets that guide students through problem-solving tasks.

This is explained in the following comment:

"I love to give them the exercise…. emmm…For individuals, the teacher will give a worksheet and the teacher will guide the student to answer the question. Normally we will discuss the answer in the classroom. The students are free to ask if they do not understand" (312/178/Azie/3).

Next, Huda, who conducts Independent Research and Group Activities in her teaching combined independent research with group-based activities to create a comprehensive learning experience. For independent research, Huda shared,

"I suggest individual reports. My students are free to search the info and do their idea" (248/145/Huda/3),

"Individually, students will make a report. They will get much info from many resources such as magazines, textbook, and internet. They love to do scrapbook" (256/ 137 / Huda / 3),

However, for group-based activities, Huda commented;

"In groups, students will do hands-on activities in experiments. They enjoy doing the work with their friends" (252/146/Huda/3).

The Real-life application is the preferred method for the next respondent, Linda. She integrates instructional practices and incorporates a variety of strategies such as group projects, workbook-based HOTS questions, and real-life applications into her teaching. She noted,

"*I assign group projects to be completed together. They can explore more" (322/190/Linda/3),*

By engaging students in problem-solving through practical real-life applications, Linda's approach ensures that the students can contextualize their learning and develop the skills necessary to address complex, real-world challenges. She also adapts HOTS questions from the RBL such as references from the internet and textbooks, focusing on fostering HOTS. Linda further added,

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"Students often do experimental activities through hands-on practical activities with real-life applications. They try to relate what they learn with real- life" (330/191/Linda/3).

On the other hand, Gayatri stressed the importance of integrating various resources into the curriculum. She stated:

"The diversity of RBL, including the internet, cartoons, TV shows, and storybooks, provides knowledge about the outside world" (390/125/Gayatri/3).

Gayatri also highlighted the supplementary role of these RBLs in traditional learning environments, stating:

"My students get the information from the show. A lot of it is provided via YouTube" (392/126/Gayatri/3).

Additionally, Gayatri also emphasized the importance of promoting independent learning:

"Students should not just stay in their shells. They must explore many resources. Most of my students have gadgets" (398/127/Gayatri/3).

Gayatri encourages students to use RBL to help them develop independence, resilience, and responsibility for their education. These traits are crucial for lifelong learning, equipping students to adapt to evolving challenges in academic and professional contexts. She added:

"They should be given the platform to voice their opinion through the assignments they work on. As a result, teachers can see a variety of outcomes when students submit their work" (400/127/Gayatri/3).

DISCUSSION

In this study, the two research questions are to explore how primary science teachers in the Gombak district use RBL to implement HOTS, and how teachers enhance student engagement during science learning using RBL. Three (3) themes were identified from the data analysis: 21st-century pedagogy, assessment strategies, and 21st-century skills. The first and second themes answer the first research question, while the third theme answers the second research question.

The teachers' experiences have demonstrated how RBL and HOTS can be implemented in student-centered teaching strategies. These approaches transform students into active participants in their learning while preparing them to apply their knowledge in real-world contexts. The student-centered teaching strategies integrated with RBL and HOTS are crucial in fostering deep understanding and driving academic performance by encouraging students to move beyond rote memorization. It emphasizes HOTS, information evaluation, and the generation of innovative solutions, aligning with the goals of the national curriculum to create an engaging student-centered learning environment. Various RBLs were employed by teachers in this study including textbooks, workbooks, video clips, cartoon shows, questions/ activities from the Internet, TV shows, storybooks, as well as magazines. The visual representation in Figure 1 encapsulates the diversity of materials employed, encompassing traditional print resources, digital tools, hands-on methodologies, and structured guidelines. Furthermore, it illustrates the incorporation of these various resources into pedagogical and learning practices.

The integration of the various RBL appears to have enhanced student engagement by encouraging peer interaction in student-centered teaching strategies. It requires students to critically evaluate their peers' work, which fosters HOTS processes and allows students to complete tasks independently. This approach ensures not only a balanced development between collaborative and individual skills but also strengthens student-centered teaching strategies and fosters HOTS through group discussions using RBL. It promotes inclusivity and ensures that students of varying abilities can accept the benefit from the exchange of ideas and knowledge among their peers.

Apart from utilizing the various RBLs, the assessment strategies practiced by the participating teachers have enhanced student engagement during their science class. For example, the step-by-step method in these Group-Based Experimental Activities has helped students to systematically engage with complex materials and apparatus, thereby developing problem-solving skills and independent learning habits grounded in RBL. This ensures that the focus remains on essential concepts while gradually increasing difficulty in matching students' developing abilities in applying HOTS. Other activities like collaborative group work, independent research, and hands-on experimentation have provide students with opportunities to enhance HOTS and apply their learning in meaningful ways. These approaches align with the goals of 21st-century education, to equip students with the skills needed for lifelong learning and real-world adaptability.

The use of digital platforms as one of the RBLs has emerged as a key element in the teaching methods of respondents in the Gombak district. Participants such as Gayatri and Nisa emphasized the integration of RBL such as the digital platforms to foster HOTS in primary science education. The perspectives of these participants align with existing literature that highlights the importance of using RBL digital platforms for academic success and career readiness. These skills equip students to navigate complexities in the workforce and society.

By incorporating RBL such as media and non-traditional resources, teachers expose students to real-world contexts, broadening their awareness beyond their own experiences. This approach fosters HOTS as students analyze information from multiple sources of RBL and develop unique solutions. Furthermore, the use of RBL stimulates creativity by encouraging students to interact with varied content, triggering divergent thinking and opening new opportunities. Students' engagement in learning HOTS through RBL can be conducted flexibly via several approaches. These include embracing diverse ideas, fostering autonomy, focusing on relevance and participation, and creating students who know how to organize their world based on discernible patterns using problem-solving skills.

This statement underscores the importance of students' engagement in the conducive environment of RBL where students can freely express their ideas. Such an environment fosters independent, open dialogue, and a classroom culture that HOTS. By integrating RBL and promoting HOTS, teachers in the Gombak district equip students with the skills to navigate the complexities of today's digital and interdisciplinary landscape. This approach not only enhances academic performance but also prepares students for lifelong learning and adaptability in an ever-changing world.

The findings presented emphasize the importance of enhancing students' engagement through RBL to achieve HOTS. This approach provides students with the opportunity to express their thoughts and ideas, thereby fostering independent reasoning and critical analysis. By encouraging students to formulate their own concepts and critically evaluate information, they transform into autonomous learner's adept at navigating the vast information landscape of the contemporary digital age. This educational approach not only improves HOTS but also equips students for lifelong learning, ensuring their adaptability and innovation as thinkers.

Additionally, the application of HOTS through the use of RBL during students' engagement creates opportunities for experiential learning, independent reasoning, and the construction of a comprehensive framework conducive to HOTS development. The use of RBL aims to enhance students' access to unique perspectives and connect them to real-world situations requiring filtration through multiple lenses. This form of analysis is fundamental to fostering HOTS as it requires students to thoroughly evaluate and integrate information from various sources. Furthermore, the use of RBL during students' engagement promotes creativity, ultimately leading to cross-content experimentation in diverse formats and exploring new ways to generate original ideas.

The insights of the participants collectively indicate that pedagogical strategies applied at school to encourage critical thinking, creativity, and problem-solving range across a broad spectrum. The participating teachers in this study have shown that there are many ways in which they use different tools and methods to empower students with those skills that enable them to navigate through a plethora of changes happening around us. Educators can prepare students for critical thinking and flexibility in several ways: embracing variety,

promoting agency, focusing on relevance and engagement, and creating questioners who know how to order their world around noticeable patterns using problem-solving skills.

The findings presented highlight the importance of providing students with opportunities to articulate their thoughts and ideas, which, in turn, cultivates independent reasoning and critical analysis. By encouraging students to formulate their concepts and to critically evaluate information, they are transformed into autonomous learners who are adept at navigating the extensive array of information characterizing the contemporary digital landscape. This educational approach not only enhances academic performance but also equips students for lifelong learning, ensuring their adaptability and innovation as thinkers.

Moreover, the incorporation of diverse educational resources, experiential learning, and independent reasoning constructs a comprehensive framework conducive to the development of HOTS, which is essential for success across both academic and professional domains. The use of a variety of media and resources seeks to increase student access to unique perspectives, grounding them in real-world situations that require filtering through several lenses. This form of A-Line analysis is fundamental for the cultivation and honing of critical thinking skills as it requires students to fully evaluate and incorporate information from multiple entities. In addition, the use of this wide variety of resources encourages creativity ultimately leading to experimenting with crossing content in various formats and deliberating new ways for creating original ideas.

The use of RBL encourages student engagement and, in turn, flexibly optimizes HOTS through the openness of teachers to accept various forms of student work. Using RBL in student engagement highlights the importance of providing students with opportunities to articulate their thoughts and ideas, which fosters independent reasoning and critical analysis. By encouraging students to formulate their own concepts and critically evaluate information, they become autonomous learners capable of navigating the vast amount of information that characterizes the contemporary digital landscape. This educational approach not only enhances academic performance but also equips students for lifelong learning, ensuring their ability to adapt and innovate as HOTS thinkers.

A new framework in the field of education related to the conducive integration of RBL to trigger HOTS is needed in Malaysia. The goal is to enhance students' access to RBL within a unique perspective based on real-world situations that require screening through various viewpoints. Such analysis is also necessary because students need to fully evaluate and synthesize information from various entities. The use of RBL promotes creativity, which ultimately leads to cross-content experimentation in various formats and the development of new ways to generate original ideas.

The findings also indicate that the assessment of science learning should be guided by levels of engagement, interaction satisfaction, and performance in HOTS tasks by students. This multidimensional approach supports formative assessment and provides insights into students' critical thinking and their engagement with scientific concepts. Emphasis on teacher satisfaction with students' responses to HOTS tasks further highlights the effectiveness of RBL in fostering HOTS.

CONCLUSION

In conclusion, this study highlights the importance of the role of RBL in enhancing student engagement and triggering HOTS in primary school science education. Insights from teachers in the Gombak district reveal that integrating RBL such as textbooks, digital tools, and practical activities supports student engagement by catering to diverse learning styles and promoting inclusivity.

These findings highlight how teachers in the Gombak district effectively implement RBL to enhance students' engagement and promote HOTS in primary science education. These create a dynamic, student-centered learning environment by leveraging a blend of traditional and modern resources. Their innovative use of RBL demonstrates its potential in students' engagement to broaden learning opportunities, deepen students' understanding, and align with 21st-century educational priorities. This alignment of RBL principles reflects the potential of RBL to promote comprehensive, student-centered learning outcomes (Brunner & Tally, 2021).

Research demonstrates that utilizing varied resources, such as online platforms, significantly improves learning outcomes and promotes active participation (Means, Bakia, & Murphy, 2014). Teachers play a critical role in guiding students to develop skills such as critical thinking, problem-solving, and information literacy, which are essential components of HOTS (American Library Association, 2000).

The study found that interactive and student-centered teaching strategies, such as hands-on activities and digital platforms, were particularly effective in aligning with curricular objectives. These methods not only improved student engagement but also fostered the development of HOTS by offering dynamic, immersive learning experiences. Customizable learning paths also played a role, allowing students to explore topics of personal interest, and fostering both autonomy and motivation.

In addressing the research question concerning how teachers in the Gombak district utilize RBL to implement HOTS activities and enhance students' engagement in primary science education, the study found that a variety of educational materials, such as books, digital resources, and multimedia, effectively accommodate different learning preferences. This RBL helps sustain student engagement by providing multiple avenues for interaction with the content, thereby facilitating the development of HOTS. These findings emphasize the need for RBL teaching approaches to facilitate deeper learning, which aligns with larger educational ideas (Marzano, 2007; Wiggins & McTighe, 2005). Moreover, incorporating real-world applications into these resources further enhanced the relevance and engagement of the learning experience.

Interviews with teachers revealed that the strategic use of varied materials and interactive methods is essential for fostering student engagement and supporting the development of HOTS. By offering flexible and engaging learning opportunities, teachers were better equipped to meet the diverse needs of students, ultimately improving both academic achievement and critical thinking in science education.

The RBL involves teachers utilizing a diverse array of resources, from traditional textbooks to modern digital tools, fostering a more interactive and self-directed learning environment that accommodates different learning styles and links classroom concepts to real-world applications. In 21st-century pedagogy, instructional strategies align closely with curriculum-based assessments, ensuring fairness and coherence in evaluating student progress. Teachers emphasize HOTS, encouraging critical thinking, problem-solving, and collaboration through methods like group work and open-ended questioning, promoting deeper cognitive engagement. Additionally, teachers diversify assessment strategies by combining traditional and modern tools, allowing students to demonstrate knowledge in ways that suit their strengths. Central to science education is the development of 21st-century skills, including creativity and critical thinking, which prepare students for future academic, personal, and professional success. Below is the discussion summary of findings based on the themes.

LIMITATION OF STUDY AND RECOMMENDATIONS

Since this study utilizes a case study method, it is important to acknowledge its limitations. First, the study focused on a specific community, which is the six participating teachers in a suburban part of the city, which potentially limits the generalizability of the findings. Future studies could broaden this scope by considering diverse educational settings as well as different locations and include more science teachers in the country to provide a more comprehensive understanding of RBL and HOTS across different contexts.

Second, the study relied primarily on the self-reported experiences and perceptions of the participants. While valuable, these subjective data may introduce biases and limitations. Future research could complement these insights using videotaped observational data and other objective measures to offer a more holistic view of educators' challenges and problems in implementing RBL and HOTS.

To strengthen these findings, future researchers could expand sample diversity across various regions and school types to enhance generalizability. Comparative studies across educational levels could clarify how RBL and HOTS strategies evolve as students' progress. Longitudinal research tracking the development of HOTS over time could provide valuable insights into the long-term effects of RBL. With these future research directions, it is possible to refine educational strategies that improve student outcomes across diverse contexts.

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IMPLICATION OF STUDY

The implications drawn from this study offer valuable insights for the Ministry of Education and other administrative education authorities to support science teachers in primary schools. First, it is imperative to prioritize the enhancement of teacher development opportunities and programs. The findings highlight that there is great potential for enhancing RBL in science classrooms as the benefit for students' learning outcomes is immense. Therefore, the Education Ministry should consider incorporating targeted RBL programs into their professional development programs. These initiatives can encompass training sessions, workshops, or readily accessible resources designed to equip science teachers with the tools and strategies necessary to navigate challenges effectively. Second, this study underscores the importance of providing comprehensive support to science teachers by lessening another non-teaching-related workload.

The study also makes a significant contribution to the field of education by identifying the most effective RBL approaches for sustaining student interest in RBL-based learning environments. By balancing traditional texts with digital tools and interactive activities, educators can make informed choices to foster greater student motivation and engagement. Additionally, the study emphasizes that addressing diverse learning styles through a mix of RBL can create more inclusive educational experiences, reinforcing the importance of combining foundational knowledge with RBL. According to Prince and Felder (2006), the effectiveness of RBL varies, with each method having its advantages and disadvantages, and it has been proven to be more effective overall.

This approach is supported by Jing et al. (2023), who argue that understanding current research trends is essential for advancing educational practices. Furthermore, the study provides qualitative data to help teachers assess the impact of their RBL choices on student interest and achievement. This aligns with the findings of Gligorea et al. (2023), who state that personalized learning strategies enhance student motivation and sustain interest. This can be achieved by tailoring lesson content to meet individual student needs. The findings also contribute to the literature on RBL usage, showing how RBL impacts student success and suggesting ways to sustain student interest through targeted resource selection. For educators and curriculum developers, the study underscores the need for inclusive curricula aligned with the objectives of HOTS, global citizenship, and technological adaptation.

Additionally, the Education Ministry should actively encourage and facilitate other innovative teaching methods and provide necessary resources for science teachers to experiment with new approaches. This adaptability not only enhances the learning experience for students but also equips educators with the skills to overcome challenges effectively. Furthermore, the latest RBL teaching strategies are a relevant and enduring aspect of a teacher's daily professional life. The ministry must recognize that challenges can emerge from various sources, thus, they should proactively prepare science teachers to navigate a dynamic academic landscape through ongoing training and support.

Finally, this study underscores the importance of continued research on RBL and HOTS within the science teacher community. It is essential to explore other dimensions of the skills needed by teachers to be more effective as science educators to help mould the next generation of Malaysian citizens with the latest 21st-century skills to drive the county to better heights.

Author Contribution

NN conceptualized and designed the study, conducted the data collection and draft manuscript preparation. All authors were involved in the analysis and interpretation of results.

Declaration Statement

The authors confirm that this study provides an honest, accurate, and transparent account of the reported study. No crucial aspects of the study have been omitted, and nor are there any discrepancies from the original plan.

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CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest in this study.

Appendix 1:**Observation Rubric** (**Observation Form for Teachers)**

Items	**Unsatisfactory**	**Satisfactory**	**Very Satisfactory**	**Outstanding**	**Rating**
Lesson Plan	Some parts or HOTS activities are not congruent and clearly stated	Objectives, contents, activities and assessment are written	All parts are appropriate,congruent and clearly stated.	Valuing objectives and activitiesenable students to enjoy learningbased on assessment	
Instructional Hots Materials And Resources	Uses easily available and common material	Presents various materials with clear purpose	Develops and utililes creative and manipulative materials	Applies appropriate use of mix materials and technology	
Prosedure Instructional Hots Activities	Gives only one learning activity to all learners	Uses different learning activities to different kinds of learners	Applies creative and logical learning activities guided by demonstration of learning	Engages students on interactive,advanced and logical activities attheir own pace and learning style	
Classroom Management	Needs to improve classroom restructuring and maintenanc	Ensured classroom is safe and conducive to teaching andlearning process	Practices classroom routinesand positive discipline with gender sensitivity	manages student behavior proactively and redirects healthy noise participation	
Interaction Or Discussion	Ask HOTS questions and listen to student's answers	Responds appropriately to students'mistakes\ requeries. Praises correct responses	Follow up the questions to manitor learners	Encourage/ practices students to answer difficult, open ended, HOTS questions	

Students /Class Engagement	Limited number of students participating to HOTS class activities	Students/class behaviour indicates strong and sustained interest in the HOTS class activities	Student engagement is high throughout the class time with varied HOTS learning styles	Students discuss relevant ideas and draws conclusions and generalizaations	
Students Responses In Hots	Only few students can answer HOTS properly	Students are free to express what they know and able to do and ask questions	Some students formulate well developed answers in complete sentence or in their own words	Students demonstrate high knowledge, skills and own level of understanding	

Adopted and adapted from HOTS Elements In Pedagogy (Malaysia Ministry of Education, 2014) and STAR observation Rubric, Department of Education, Phillipnes, 2012).

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