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Evaluating Student Performance and Cognitive Skills Development Using the BRITE Model in Inquiry-Based Learning: A Quantitative Study

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Abstract

Inquiry-based learning promotes active exploration and critical thinking by encouraging students to investigate, analyze, and discover information on their own. This study utilized four inquiry-based learning approaches (structured, open, confirmation, and guided) and was employed using a time series design to assess how well the BRITE model improved the academic performance of Grade 8 students in Earth and Space Science, particularly earthquakes, typhoons, comets, meteors, and asteroids. A total of one hundred ninety-two (192) students from Abra High School participated in the study, grouped into four sections. Every week, each inquiry approach was matched to different teaching resources. Quantitative data was gathered using validated pretests and posttests aligned with Bloom's Taxonomy to assess cognitive development, and the qualitative data on the students' challenges was obtained through an interview questionnaire. This data was then subjected to a thematic evaluation.

Results demonstrated that the utilization of all inquiry approaches, and instructional materials significantly obtained higher posttest scores when the BRITE model was used. The structured inquiry approach had the highest mean score, which was described as "very satisfactory," especially for the typhoon and earthquake topics. In the celestial bodies' topic, Open Inquiry outperformed Structured Inquiry, proving its ability to encourage innovation and exploration. Furthermore, CAI and multimedia demonstrated extraordinary efficacy, especially when combined with structured and confirmation approaches. Structured inquiry produced the biggest mean gain, suggesting its effectiveness in establishing basic scientific knowledge. All approaches showed a statistically substantial increase ($p < 0.001$) from pretest to posttest.

Moreover, the qualitative data indicates positive student feedback for the BRITE Model, but challenges vary depending on inquiry type. The BRITE Model, when combined with technology-enhanced materials, enhances students' comprehension and interest in science, promoting foundational knowledge and higher order thinking skills despite challenges.

Keywords: *Structured, Confirmation, Open, Guided, Inquiry-based learning , the BRITE Model, quantitative data, Bloom's Taxonomy*

I. INTRODUCTION

Science education is an exciting and transformative field of study. It provides opportunities for students' engagement and exploration as they observe, classify, infer, predict, and experiment. Exposing students to this dynamic engagement helps them foster the life skills they need not only scientific literacy but also a deeper understanding of the world. By improving their cognitive abilities through methodical, evidence-based approaches, it motivates students to explore and find solutions to problems. Traditional approaches like textbooks and worksheets are now complemented by inquiry-based learning (IBL), which enhances conceptual understanding, motivation, and real-world application (Kang & Chang, 2021; Weller, 2023). Globally, IBL is recognized for developing 21st-century skills, inclusivity, and deeper learning (Wilson, 2020; Bauld, 2024). In the Philippines, DepEd and DOST-SEI promote IBL through the K–12 curriculum, STEM initiatives, and innovation competitions to align with Sustainable Development Goal (SDG) 4. However, challenges such as resource limitations, time constraints, and teacher readiness persist.

IBL encourages autonomy, collaboration, and lifelong learning, supported by constructivist theories (Piaget, Vygotsky) and frameworks like Bloom's Taxonomy and the BRITE model (Brainstorm, Research, Interpret, Test, Evaluate). Research shows that structured, guided, confirmation, and open inquiry approaches each contribute to skill development in unique ways (Chaudhary & Lam, 2021; Alarcon et al., 2023). Multimedia and computer-assisted instruction enhance IBL but require pedagogical expertise and resources (Ranoptri et al., 2022). Localizing IBL for disaster preparedness in Abra demonstrates its relevance, as students apply scientific inquiry to real-world issues like earthquakes and typhoons.

Accordingly, this study aimed to determine the level of Grade 8 students' performance and cognitive skills development in science using the BRITE model in inquiry-based learning at Abra High School, SY 2024–2025. Specifically, it sought to: (1) assess students' pretest performance in Earthquakes, Typhoons, Comets, and Asteroids, (2) evaluate posttest performance after exposure to structured, open, confirmation, and guided inquiry approaches, (3) determine the effectiveness of instructional materials (modules, activity sheets, multimedia, CAI) with the BRITE model, (4) test for significant differences between pretest and posttest results (5) compare effectiveness across instructional materials, (6) identify challenges faced by students using the BRITE model, and (7) develop an instructional plan addressing learning challenges and enhancing academic performance.

Furthermore, this study aimed to evaluate the impact of the BRITE model within IBL on Grade 8 students' performance and cognitive skill development. It hypothesized that: (1) there is a significant difference between students' pretest and posttest performance across inquiry-based approaches, (2) there is a significant difference in the effectiveness of instructional materials when using the BRITE model, and (3) there is a significant difference among the effectiveness of the instructional materials when using the BRITE model.

II. MATERIALS and METHODS

This section is inclusive of the research design, participants, instrument, procedure, and data analysis.

Research Design

A mixed-method design was employed, integrating quantitative and qualitative approaches for a comprehensive understanding of the research problem. A time-series design assessed Grade 8 students' performance in earthquakes, typhoons, and comets/meteors/asteroids using the BRITE model across structured, open, confirmation, and guided inquiry. The quantitative component examined pretest–posttest differences and the effectiveness of instructional materials, with data analyzed through descriptive statistics, correlation, and ANOVA. The qualitative component explored students' challenges through interviews, with thematic analysis used to identify patterns and themes.

Participants

The study was conducted at Abra High School, Bangued Campus, with 192 Grade 8 students from four sections (Cassowary, Dove, Peacock, and Robin). The sample size, based on Cohen's (1988) power analysis using G*Power 3.1, exceeded the minimum requirement of 180 for a repeated measures ANOVA, ensuring sufficient statistical power. The study aimed to assess student performance using the BRITE model across four inquiry-based learning approaches: structured, open, confirmation, and guided inquiry.

Instruments

This study employed multiple instruments, including 40-item pretests and posttests, and four BRITE-based learning materials: modules, activity sheets, multimedia, and computer-assisted instruction (CAI). These were applied to Grade 8 Earth and Space Science topics (earthquakes, typhoons, comets, meteors, and asteroids) through four inquiry approaches: structured, open, confirmation, and guided. The tests, developed by the researcher and validated by expert science teachers, measured baseline and post-intervention performance. Learning materials were also quality-checked using DepEd Abra's evaluation tool.

A rotational intervention matrix was implemented over eight weeks, with each of the four sections experiencing all materials under their assigned inquiry approach. Each cycle lasted one week, with 45-minute daily sessions across five days. This design ensured fair comparison of materials and approaches while allowing cross-analysis of their effects on student performance. Additionally, interview questionnaires gathered qualitative data on challenges students faced when using the BRITE model.

Procedure

The pretest and posttest were pilot tested at Quidaoen National High School, San Juan, Abra, yielding reliability scores of 0.803 and 0.831, respectively, both rated "Very Good" for classroom testing. After validation, the study was implemented at Abra High School, Bangued Campus. Necessary approvals were obtained from school authorities, followed by coordination with the Grade 8 Coordinator, Science Department Head, and class advisers of the four participating sections (Cassowary, Dove, Peacock, and Robin). Parents were informed of the study's purpose, procedures, risks, and benefits, and consent was secured. The instruments were then administered to assess student performance using the BRITE Model across inquiry-based approaches, and the data collected were tallied and analyzed by the researcher.

Data Analysis

To support the description, interpretation, and analysis of data, the study employed the following tools: (1) Weighted Mean – to assess Grade 8 students' pretest and posttest performance across content areas (Earthquakes, Typhoons, Comets, and Asteroids) and evaluate the BRITE Model with different instructional materials (modules, activity sheets, multimedia, CAI); (2) T-test – to determine significant differences between pretest and posttest scores, and in the effectiveness of instructional materials; (3) ANOVA – to compare instructional materials across inquiry-based approaches, with assumptions tested using the Shapiro-Wilk (normality) and Levene's Test (homogeneity of variance); and (4) Thematic Analysis – to analyze qualitative data on student challenges using Braun and Clarke's framework, supported by peer debriefing, member checks, and inter-coder reliability checks.

III. RESULTS

Table 1. The level of performance of Grade 8 students in the pretest across the following content areas

Content Areas	Grade 8-Robin		Grade 8-Peacock		Grade 8-Cassowary		Grade 8-Dove		Overall	
	Mean	DR	Mean	DR	Mean	DR	Mean	DR	Mean	DR
Earthquakes	69.85	DNME	68.28	DNME	66.76	DNME	67.12	DNME	68.00	DNME
Typhoons	68.17	DNME	68.87	DNME	70.71	DNME	67.90	DNME	68.91	DNME
Comets, and Asteroids	72.25	DNME	68.89	DNME	70.13	DNME	71.67	DNME	70.74	DNME
Overall	69.58	DNME	68.37	DNME	68.18	DNME	68.06	DNME	68.55	DNME

Scale (DR)	***Descriptive Rating***
90-100	*Outstanding (O)*
85-89	*Very Satisfactory (VS)*
80-84	*Satisfactory (S)*
75-79	*Fairly Satisfactory (FS)*

Table 2. The level of performance of Grade 8 students in the posttest after being exposed to the four inquiry approaches

Content Areas	Structured		Open		Confirmation		Guided	
	Mean	**DR**	**Mean**	**DR**	**Mean**	**DR**	**Mean**	**DR**
Earthquakes	87.17	VS	83.94	S	83.80	S	80.71	S
Typhoons	88.73	VS	83.73	S	78.85	FS	79.91	FS
Comets, and Asteroids	85.79	VS	86.96	VS	81.22	S	77.80	FS
Overall	87.17	VS	84.41	S	81.37	S	78.91	FS

Scale	***Descriptive Rating (DR)***
90-100	*Outstanding (O)*
85-89	*Very Satisfactory (VS)*
80-84	*Satisfactory (S)*
75-79	*Fairly Satisfactory (FS)*
Below 75	*Did Not Meet Expectation (DNME)*

Table 3a. Structured Inquiry

Structured Inquiry	Learning Competency	Pretest		Posttest	
		Mean	**DR**	**Mean**	**DR**
	Using models or illustrations, explain how movements along faults generate an earthquake	69.460	DNME	79.690	FS
	Explain how typhoons develop and how they are affected by landmasses and bodies of water.	68.350	DNME	80.600	S
Module	Composite Mean	68.870	DNME	79.900	FS
	Differentiate the epicenter of an earthquake from its focus, intensity of an earthquake from magnitude	69.580	DNME	81.810	S
	Trace the path of typhoons that enter the PAR using a map and tracking data.	67.520	DNME	77.350	FS
Worksheet	Composite Mean	68.500	DNME	79.440	FS
	Differentiate active and inactive Faults	68.120	DNME	83.350	S
	Compare and contrast comets, meteors, and asteroids.	66.850	DNME	83.650	S
Multimedia	Composite Mean	67.370	DNME	83.440	S
	Explain how earthquake waves provide information about the interior of the Earth.	66.580	DNME	79.310	FS
	Simulating the impacts of comets, meteors, and Asteroids	67.480	DNME	89.420	VS
CAI	Composite Mean	66.960	DNME	84.100	S
	Overall	67.830	DNME	81.380	S

Scale	*Descriptive Rating (DR)*
90-100	*Outstanding (O)*
85-89	*Very Satisfactory (VS)*
80-84	*Satisfactory (S)*
75-79	*Fairly Satisfactory (FS)*
Below 75	*Did Not Meet Expectation (DNME)*

Table 3b. Open Inquiry

Open Inquiry	Learning Competency	Mean	DR	Mean	DR
Module	Explain how earthquake waves provide information about the interior of the Earth.	66.39	DNME	80.78	S
	Simulating the impacts of comets, meteors, and Asteroids	66.92	DNME	80.37	S
	Composite Mean	66.51	DNME	80.39	S
Worksheet	Using models or illustrations, explain how movements along faults generate earthquakes	69.22	DNME	85.37	VS
	Explain how typhoons develop and how they are affected by landmasses and bodies of water.	69.45	DNME	79.78	FS
	Composite Mean	69.31	DNME	82.16	S
Multimedia	Differentiate the epicenter of an earthquake from its focus, intensity of an earthquake from its magnitude	69.63	DNME	84.22	S
	Trace the path of typhoons that enter the PAR using a map and tracking data.	67.80	DNME	84.22	S
	Composite Mean	68.65	DNME	84.22	S
CAI	Differentiate active and inactive Faults	67.29	DNME	88.80	VS
	Compare and contrast comets, meteors, and asteroids.	66.67	DNME	91.18	O
	Composite Mean	66.90	DNME	89.90	VS
	Overall	67.76	DNME	83.90	S

Scale	*Descriptive Rating (DR)*
90-100	*Outstanding (O)*
85-89	*Very Satisfactory (VS)*
80-84	*Satisfactory (S)*
75-79	*Fairly Satisfactory (FS)*
Below 75	*Did Not Meet Expectation (DNME)*

Table 3c. Confirmation Inquiry

Confirmation	Learning Competency	Pretest	DR	Posttest	DR
Module	Differentiate active and inactive Faults	65.85	DNME	82.30	S
	Compare and contrast comets, meteors, and asteroids.	65.52	DNME	80.28	S
	Composite Mean	65.57	DNME	81.24	S
Worksheet	Explain how earthquake waves provide information about the interior of the Earth.	66.17	DNME	79.83	FS
	Simulating the impacts of comets, meteors, and Asteroids	66.74	DNME	82.37	S
	Composite Mean	66.33	DNME	89.70	VS
Multimedia	Using models or illustrations, explain how movements along faults generate earthquake	66.41	DNME	77.13	FS
	Explain how typhoons develop and how they are affected by landmasses and bodies of water.	67.09	DNME	80.09	S
	Composite Mean	66.63	DNME	78.35	FS
CAI	Differentiate the epicenter of an earthquake from its focus, intensity of an earthquake from magnitude	66.13	DNME	79.52	FS
	Trace the path of typhoons that enter the PAR using a map and tracking data.	66.00	DNME	80.09	S
	Composite Mean	65.96	DNME	79.67	FS
	Overall	66.04	DNME	81.83	S

Scale	***Descriptive Rating (DR)***
90-100	*Outstanding (O)*
85-89	*Very Satisfactory (VS)*
80-84	*Satisfactory (S)*
75-79	*Fairly Satisfactory (FS)*
Below 75	*Did Not Meet Expectation (DNME)*

Table 3d. Guided Inquiry

Guided	Learning Competency	Mean	DR	Mean	DR
Module	Differentiate the epicenter of an earthquake from its focus, intensity of an earthquake from magnitude	66.20	DNME	79.13	FS
	Trace the path of typhoons that enter the PAR using a map and tracking data.	66.31	DNME	79.78	FS
	Composite Mean	66.04	DNME	79.24	FS
Worksheet	Differentiate active and inactive Faults	65.69	DNME	77.53	FS
	Compare and contrast comets, meteors, and asteroids.	65.51	DNME	79.89	FS
	Composite Mean	65.42	DNME	78.33	FS
Multimedia	Explain how earthquake waves provide information about the interior of the Earth.	65.18	DNME	80.07	S
	Simulating the impacts of comets, meteors, and Asteroids	66.04	DNME	77.33	FS
	Composite Mean	65.44	DNME	78.33	FS
CAI	Using models or illustrations, explain how movements along faults generate earthquake	65.71	DNME	79.40	FS
	Explain how typhoons develop and how they are affected by landmasses and bodies of water.	65.62	DNME	76.82	FS
	Composite Mean	65.49	DNME	77.89	FS
	Overall	65.69	DNME	78.00	FS

Scale	***Descriptive Rating (DR)***
90-100	*Outstanding (O)*
85-89	*Very Satisfactory (VS)*
80-84	*Satisfactory (S)*
75-79	*Fairly Satisfactory (FS)*
Below 75	*Did Not Meet Expectation (DNME)*

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Table 4. Comparison of the significant difference between the pretest and posttest performance of Grade 8 students exposed to the four inquiry-based learning approaches

Inquiry-based Learning Approaches	Content Areas	Pretest	Posttest	Mean Gain	t-value	t-prob
Structured Inquiry	Earthquakes	69.85	87.17	17.32	17.76	<0.001
	Typhoons	68.17	88.73	20.56	20.05	<0.001
	Comets, and Asteroids	72.25	85.79	13.54	9.61	<0.001
	Composite Mean	69.58	87.17	17.59	24.57	<0.001
Open Inquiry	Earthquakes	67.12	83.94	16.82	16.61	<0.001
	Typhoons	67.9	83.73	15.83	13.97	<0.001
	Comets, and Asteroids	71.67	86.96	15.29	10.55	<0.001
	Composite Mean	68.06	84.41	16.35	24.74	<0.001
Confirmation	Earthquakes	68.28	83.8	15.52	19.58	<0.001
	Typhoons	68.87	78.85	9.98	7.97	<0.001
	Comets, and Asteroids	68.89	81.22	12.33	9.74	<0.001
	Composite Mean	68.37	81.37	13.00	20.31	<0.001
Guided	Earthquakes	66.76	80.71	13.95	11.24	<0.001
	Typhoons	70.71	79.91	9.20	7.78	<0.001
	Comets, and Asteroids	70.13	77.8	7.67	5.33	<0.001
	Composite Mean	68.18	78.91	10.73	14.33	<0.001

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Table 5a. Comparison of the significant effectiveness of the instructional materials when using the BRITE model along with the Structured Inquiry Approach

Structured Inquiry	Learning Competency	Pretest	Posttest	Mean Gain	t-value	t-prob
	Using models or illustrations, explain how movements along faults generate an earthquake	69.46	79.69	10.23	10.160	<0.001
	Explain how typhoons develop and how they are affected by landmasses and bodies of water.	68.35	80.60	12.25	14.770	<0.001
Module	Composite Mean	68.87	79.90	11.03	15.600	<0.001
	Differentiate the epicenter of an earthquake from its focus, intensity of an earthquake from magnitude	69.58	81.81	12.23	13.700	<0.001
	Trace the path of typhoons that enter the PAR using a map and tracking data.	67.52	77.35	9.83	16.840	<0.001
Worksheet	Composite Mean	68.50	79.44	10.94	20.140	<0.001
	Differentiate active and inactive Faults	68.12	83.35	15.23	14.450	<0.001
	Compare and contrast comets, meteors, and asteroids.	66.85	83.65	16.80	20.460	<0.001
Multimedia	Composite Mean	67.37	83.44	16.07	20.230	<0.001
	Explain how earthquake waves provide information about the interior of the Earth.	66.58	79.31	12.73	15.440	<0.001
	Simulating the impacts of comets, meteors, and Asteroids	67.48	89.42	21.94	20.680	<0.001
CAI	Composite Mean	66.96	84.10	17.14	25.470	<0.001
	Overall	67.83	81.38	13.55	28.820	<0.001

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Table 5b. Comparison of the significant effectiveness of the instructional materials when using the BRITE model along with Open Inquiry

Open Inquiry	Learning Competency	Pretest	Posttest	Mean Gain	t-value	t-prob
Module	Explain how earthquake waves provide information about the interior of the Earth.	66.39	80.78	14.39	15.190	<0.001
	Simulating the impacts of comets, meteors, and Asteroids	66.92	80.37	13.45	14.850	<0.001
	Composite Mean	66.51	80.39	13.88	19.800	<0.001
Worksheet	Using models or illustrations, explain how movements along faults generate earthquake	69.22	85.37	16.15	13.240	<0.001
	Explain how typhoons develop and how they are affected by landmasses and bodies of water.	69.45	79.78	10.33	11.160	<0.001
	Composite Mean	69.31	82.16	12.85	16.960	<0.001
Multimedia	Differentiate the epicenter of an earthquake from its focus, intensity of an earthquake from magnitude	69.63	84.22	14.59	20.580	<0.001
	Trace the path of typhoons that enter the PAR using a map and tracking data.	67.80	84.22	16.42	23.560	<0.001
	Composite Mean	68.65	84.22	15.57	24.220	<0.001
CAI	Differentiate active and inactive Faults	67.29	88.80	21.51	31.740	<0.001
	Compare and contrast comets, meteors, and asteroids.	66.67	91.18	24.51	28.190	<0.001
	Composite Mean	66.90	89.90	23.00	42.400	<0.001
	Overall	67.76	83.90	16.14	43.900	<0.001

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Table 5c. Comparison of the significant effectiveness of the instructional materials when using the BRITE model along with Confirmation Inquiry

Confirmation	Learning Competency	Pretest	Posttest	Mean Gain	t-value	t-prob
Module	Differentiate active and inactive Faults	65.85	82.30	16.45	21.30	<0.001
	Compare and contrast comets, meteors, and asteroids.	65.52	80.28	14.76	18.51	<0.001
	Composite Mean	65.57	81.24	15.67	30.19	<0.001
Worksheet	Explain how earthquake waves provide information about the interior of the Earth.	66.17	79.83	13.66	14.83	<0.001
	Simulating the impacts of comets, meteors, and Asteroids	66.74	82.37	15.63	17.09	<0.001
	Composite Mean	66.33	89.70	23.37	15.71	<0.001
Multimedia	Using models or illustrations, explain how movements along faults generate earthquake	66.41	77.13	10.72	13.81	t-prob
	Explain how typhoons develop and how they are affected by landmasses and bodies of water.	67.09	80.09	13.00	16.99	<0.001
	Composite Mean	66.63	78.35	11.72	19.90	<0.001
CAI	Differentiate the epicenter of an earthquake from its focus, intensity of an earthquake from magnitude	66.13	79.52	13.39	19.32	<0.001
	Trace the path of typhoons that enter the PAR using a map and tracking data.	66.00	80.09	14.09	22.69	<0.001
	Composite Mean	65.96	79.67	13.71	27.60	<0.001
Overall		66.04	81.83	15.79	30.62	<0.001

Table 5d. Comparison of the significant effectiveness of the instructional materials when using the BRITE model along with Guided Inquiry

Guided	Learning Competency	Pretest	Posttest	Mean Gain	t-value	t-prob
Module	Differentiate the epicenter of an earthquake from its focus, intensity of an earthquake from magnitude	66.2	79.13	12.93	15.70	<0.001
	Trace the path of typhoons that enter the PAR using a map and tracking data.	66.31	79.78	13.47	12.09	<0.001
	Composite Mean	66.04	79.24	13.2	17.62	<0.001
Worksheet	Differentiate active and inactive Faults	65.69	77.53	11.84	19.25	<0.001
	Compare and contrast comets, meteors, and asteroids.	65.51	79.89	14.38	17.11	<0.001
	Composite Mean	65.42	78.33	12.91	22.51	<0.001
Multimedia	Explain how earthquake waves provide information about the interior of the Earth.	65.18	80.07	14.89	16.37	<0.001
	Simulating the impacts of comets, meteors, and Asteroids	66.04	77.33	11.29	14.16	<0.001
	Composite Mean	65.44	78.33	12.89	19.71	<0.001
CAI	Using models or illustrations, explain how movements along faults generate earthquake	65.71	79.4	13.69	16.73	<0.001
	Explain how typhoons develop and how they are affected by landmasses and bodies of water.	65.62	76.82	11.2	17.67	<0.001
	Composite Mean	65.49	77.89	12.4	27.29	<0.001
	Overall	65.69	78	12.31	34.95	<0.001

Table 6a. Summary of ANOVA showing the Comparison of the significant difference between and among the effectiveness of the instructional materials when using the BRITE model

Instructional Materials	Structured Approach	Open Approach	Confirmation Approach	Guided Approach
Module	79.90[b]	80.39[c]	81.24[b]	77.89[a]
Worksheet	79.44[b]	82.16[bc]	89.89[a]	78.33[a]
Multimedia	83.44[a]	84.22[b]	78.35[b]	78.33[a]
Computer-Assisted Instruction	84.10[a]	89.9[a]	79.67[b]	79.24[a]
F-value	13.464	38.487	36.405	0.933
P-value	<0.001	<0.001	<0.001	0.426

6b. Comparison of the Significant difference between the effectiveness of using BRITE model when grouped by static and dynamic instructional Materials

Approach	Static (Module and Worksheet)	Dynamic (Multimedia and CAI)	Mean Diff	Effect Size (Cohen's d)	t-value	t-prob
Structured	79.67	83.77	4.10	3.66	5.71	<0.01
Open Inquiry	81.28	87.06	5.78	3.63	7.87	<0.01
Confirmation	85.57	79.01	6.56	4.44	7.07	<0.01
Guided	78.79	78.11	0.68	3.16	1.02	0.31
Overall	81.29	82.14	0.85	4.87	1.73	0.09

Norm:

Cohen's d Scale	***Descriptive Rating (DR)***
Effect size ≤ 0.2	*Very Small*
0.2 < Effect size ≤ 0.5	*Small*
0.5 < Effect size ≤ 0.8	*Medium*
0.8 < Effect size ≤ 2.0	*Large*
Effect size > 2.0	*Extremely Large*

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7. Challenges of Students when learning using the BRITE Model

Significant Statement	Code	Theme
"I can't effectively share ideas because I don't understand the concepts we are recalling."	Lack of prior knowledge	Brainstorming Barriers
"We're not used making suggestions. We just pay attention when our teacher instructs us."	Passive learner mindset	Brainstorming Barriers
"We planned our own steps in open inquiry, but it is confusing."	Lack of clear procedure planning	Brainstorming Barriers
"I wasn't sure what to look into when we had to generate questions."	Difficulty in formulating questions	Brainstorming Barriers
"We had to confirm a result, but I have a difficulty looking for reliable sources."	Limited access to credible materials	Research Roadblocks
"I misinterpret procedures."	Information overload	Research Roadblocks
"I find difficulty looking for resources to answer questions."	Inaccessible resources	Research Roadblocks
"I lacked confidence and didn't have enough knowledge on the topic."	Lack of prior knowledge	Research Roadblocks
"Even after finishing the experiment, I had difficulty understanding results."	Difficulty interpreting results	Interpretation Issues
"I couldn't explain why it happened, even though we followed all the procedures."	Surface-level understanding	Interpretation Issues
"Our results didn't match when we tested the suggested idea in confirmation inquiry, and I wasn't sure how to explain our findings."	Unexpected results confusion	Interpretation Issues
"Even with guidance, I am not very good at summarizing results after conducting the experiment."	Difficulty in synthesis	Interpretation Issues
"I feel uneasy because we are under pressured to finish activities on time."	Limited task time	Time Management Challenges
"We brainstormed so long that we didn't have enough time left to execute the task."	Poor time distribution	Time Management Challenges
"We only have 45 minutes. It's hard to explore and reflect within that period. Activities took longer than I expected".	Time constraint per session	Time Management Challenges
"During activities, I get nervous and forget what we planned. This, I started talking more with my group, and that helped me feel better about our answers."	Performance anxiety	Executing Performance Challenges
"I don't feel ready to perform activities in front of others. We needed more practice time."	Lack of rehearsal or preparation	Executing Performance Challenges
"Some members did not participate, so some of our group's activity was incomplete."	Unequal group participation	Executing Performance Challenges

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8. Instructional Learning Plan for Enhancing Academic Performance Based on BRITE Approaches and Material Effectiveness for Grade 8

Republic of the Philippines
Department of Education
Cordillera Administrative Region
SCHOOLS DIVISION OFFICE OF ABRA

Instructional Learning Plan for Enhancing Academic Performance Based on *BRITE Approaches and Material Effectiveness for Grade 8*

VI. Instructional Plan Matrix

Instructional Plan for Selected Earth and Space Science Topics Using the BRITE Approach

BRITE Approach	Possible Topic	Competencies	Recommended Instructional Material	Instructional Strategy	Assessment
Structured Inquiry	Faults and Earthquakes	Using models or illustrations, explain how movements along faults generate earthquakes	Computer-Assisted Instruction (CAI), videos	Teacher-led instruction with CAI simulations or tutorials followed by guided activities	Pre/post-tests, performance tasks, digital quizzes
	Earthquake's Epicenter and Magnitude	Differentiate the epicenter of an earthquake from its focus; and intensity of an earthquake from its magnitude.	CAI simulations, earthquake mapping tools	Guided explanation using real-time data and interactive tools	Multiple-choice tests, labeling diagrams, earthquake data analysis
	Active and Inactive Faults	Differentiate active and inactive faults.	CAI, interactive maps	Teacher-led exploration of fault types with visual support and guided practice	Concept checks, written responses, map-based analysis
	Earthquake Waves	Explain how earthquake waves provide information about the interior of the earth	CAI simulations, visual aids	Teacher explanation of different earthquake waves followed by demonstration with CAI	Performance tasks, multiple-choice questions, and wave identification
Confirmation Inquiry	Understanding Typhoons	Explain how typhoons develop and how they are affected by landmasses and bodies of water.	Worksheets, graphic organizers	Review-based session using problem sets, immediate feedback, and error analysis tasks	Worksheet analysis, mastery quizzes, formative rubrics
	Tracking the Path of a Typhoon	Trace the path of typhoons that enter the Philippine Area of Responsibility (PAR) using a map and tracking data.	Concept worksheets, interactive maps	Guided review of typhoon tracking through maps with structured questions	Error analysis tasks, map interpretation, comprehensio n quizzes

Figure 4: Instructional Learning Plan using the four different inquiry-based approaches

IV. DISCUSSION

Table 1: Level of performance of Grade 8 students in the pretest across the topics of earthquakes, typhoons, comets, meteors and asteroids

Table 1 presents the pretest performance of four Grade 8 sections (Robin, Peacock, Cassowary, and Dove) in Earth and Space Science topics—Earthquakes, Typhoons, and Comets/Meteors/Asteroids. Across all areas, mean scores (66.76%–72.25%) fell below 75%, with an overall mean of 68.55%, categorized as *Did Not Meet Expectations (DNME)*. This indicates limited mastery of key concepts prior to instruction.

One major factor is the lack of foundational knowledge from Grade 7, where coverage of related topics is minimal or superficial. The spiral progression of the K to 12 curriculum often leads to weak retention and gaps across grade levels, further misaligned with global standards like PISA (Roca, 2023; Barredo, 2020). Pretest items required higher-order thinking—analysis, interpretation, and application—rather than rote recall, exposing students' struggle with cognitive demands expected in MELCs and global benchmarks (NRC, 2013).

Additional barriers include language difficulties, as science is taught in English, and emotional responses to disasters such as typhoons, which hinder engagement (Alcontin & Villalon, 2022; MDPI, 2020). Students performed better on comets, meteors, and asteroids, which are often taught through engaging media and visuals (NASA, 2021). Learning disruptions from the COVID-19 pandemic and recent climate-related class suspensions also contributed to weak performance (Landicho, 2021; Reuters, 2024).

Students' underperformance stems from curriculum gaps, limited cognitive readiness, language and emotional barriers, and systemic disruptions. Addressing these requires shifting from passive teaching to inquiry-based, student-centered approaches that integrate real-life applications, hands-on exploration, and reflective learning, consistent with UNESCO's (2022) call for 21st-century competencies.

Table 2: Posttest performance of Grade 8 students after exposure to four inquiry-based approaches

Table 2 presents the posttest performance of Grade 8 students after exposure to four inquiry-based approaches. Structured Inquiry yielded the highest mean score (M = 87.17, *Very Satisfactory*), followed by Open Inquiry (M = 84.41, *Satisfactory*), Confirmation Inquiry (M = 81.37, *Satisfactory*), and Guided Inquiry (M = 78.91, *Fairly Satisfactory*).

Structured Inquiry proved most effective, particularly in typhoons (M = 88.73), as students could connect real-life experiences and use authentic data for analysis. Though comets, meteors, and asteroids scored lower (M = 85.79) due to abstraction, scaffolding and multimedia aided comprehension. Open Inquiry (M = 84.41) fostered curiosity and independence, with strong results in celestial topics (M = 86.96). However, students struggled to design investigations for complex systems like typhoons, underscoring the need for guidance. Confirmation Inquiry (M = 81.37) reinforced learning through verification activities, with best results in earthquakes (M = 83.80). Typhoons scored lowest (M = 78.85) as processes were difficult to model. While effective for observable phenomena, additional scaffolding is needed for abstract content. Guided Inquiry (M = 78.91) emphasized scaffolding and collaboration, showing strengths in earthquakes (M = 80.71). Yet, students struggled with abstract space concepts and time constraints limited deeper exploration.

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Results show Structured and Open Inquiry produced higher gains, while Confirmation and Guided Inquiry require stronger support for abstract or complex topics. These findings affirm the importance of scaffolding, experiential tasks, and authentic data in strengthening Earth and Space Science learning under the BRITE model.

Table 3: Level of effectiveness of the BRITE Model matched with the four developed materials

Data on table 3 showed that under the Structured Inquiry approach of the BRITE Model, Computer-Assisted Instruction (CAI) produced the highest posttest composite mean (84.10), followed by Multimedia (83.44), Modules (79.90), and Worksheets (79.44). CAI was most effective in simulating the impacts of comets, meteors, and asteroids, where scores improved from 67.48 (*DNME*) to 89.42 (*Very Satisfactory*), reflecting strong conceptual gains through interactive simulations and real-time feedback. Multimedia also enhanced performance, particularly in differentiating active and inactive faults, raising scores from 68.12 to 83.35. Modules helped students visualize fault movements (69.46 → 79.69), while Worksheets supported understanding of epicenter, focus, intensity, and magnitude (69.58 → 81.81).

Structured Inquiry with BRITE increased the mean from 67.83 (*DNME*) to 81.38 (*Satisfactory*). The integration of CAI, multimedia, and other materials promoted active engagement and deeper understanding across competencies. These findings confirm that inquiry-based, technology-integrated instruction strengthens science learning, aligning with research (Minner et al., 2024; Dizon & Capulong, 2024) and UNESCO's advocacy for multimodal strategies to advance SDG 4 on Quality Education.

Results show that under the Open Inquiry approach of the BRITE Model, student performance improved notably, with the overall composite mean rising from 67.76 (*DNME*) to 83.90 (*Satisfactory*). Among the instructional materials, Computer-Assisted Instruction (CAI) yielded the highest gain (66.90 → 89.90, *Very Satisfactory*), particularly excelling in the competency *"Compare and contrast comets, meteors, and asteroids"* which reached an *Outstanding* score of 91.18. Interactive simulations and virtual astronomy tools enabled learners to model faults, analyze seismic activity, and explore celestial bodies—findings consistent with Gonzales et al. (2022), Reyes & Bautista (2023), and Wang & Lim (2024) on CAI's role in fostering autonomy, engagement, and metacognition.

Multimedia ranked second (68.65 → 84.22), supporting spatial reasoning in competencies such as tracing typhoon paths and differentiating seismic terms. This aligns with Young (2022), Victoria (2021), and Gillies (2023), who emphasize multimedia's power in visualizing complex phenomena. Worksheets followed (69.31 → 82.16), effectively reinforcing earthquake modeling and data analysis tasks, as supported by Ranoptri et al. (2022). Modules, though with the smallest gain (66.51 → 80.39), still enhanced abstract learning by guiding independent research and data interpretation.

Overall, Open Inquiry with the BRITE Model significantly enhanced mastery across competencies, with CAI standing out for delivering interactive, visually rich, and student-driven learning experiences. These findings affirm UNESCO's (2023) call for technology-enhanced, inquiry-based education that develops autonomy, creativity, and resilience in alignment with SDG 4. Table 3c shows the pretest and posttest results of students exposed to the BRITE Model using confirmation inquiry with worksheets, modules, CAI, and multimedia. Pretest scores ranged from 65.57 to 66.63, indicating limited prior knowledge, but posttest means rose significantly to 81.83 (*Satisfactory*).

Worksheets proved most effective, with the highest posttest mean (89.70, *Very Satisfactory*). Scaffolded and sequential tasks—such as drills, matching, and reflections—enabled students to master competencies like interpreting earthquake waves and simulating celestial impacts. Literature supports their effectiveness in promoting conceptual understanding, real-world application, and retention (Bourgonjon et al., 2022; Diaz & Ramos, 2023; Pangilinan et al., 2023).

Modules (81.24) also enhanced learning, particularly in fault differentiation and celestial comparisons, offering flexibility for self-paced study though less interactive than worksheets (Tinio & Dela Cruz, 2021). CAI (79.67) improved visualization of complex processes like earthquake epicenters and typhoon paths, but engagement was less sustained compared to worksheets (Zhao et al., 2022). Multimedia (78.35) supported visual learning but was least effective when used alone, echoing Pangilinan et al. (2023) who emphasized its value in interactive settings.

Confirmation inquiry paired with worksheets best fostered active engagement, higher-order thinking, and conceptual mastery. The results affirm that aligning instructional materials with inquiry approaches under the BRITE Model significantly enhances student performance and science learning outcomes.

Table 3d shows the impact of the Guided Inquiry approach with different instructional materials on student performance. Pretest means (65.18–66.31) were in the *Did Not Meet Expectations* range, reflecting limited prior knowledge of earthquake dynamics, typhoon tracking, and celestial phenomena.

Posttest scores improved across all formats. Modules yielded the highest mean (79.24, *Fairly Satisfactory*), effectively enhancing competencies like distinguishing epicenter and focus and tracing typhoons, supported by visual aids and guided reflection tasks (Mazida et al., 2023). Worksheets and Multimedia followed (78.33). Worksheets strengthened fault and celestial body concepts, while Multimedia aided in understanding seismic waves (80.07) and celestial impacts, though with limited interactivity. CAI scored lowest (77.89), hampered by lack of interactivity, limited access, and digital literacy challenges (Unlu & Dokme, 2020; Dorfman et al., 2020).

Guided Inquiry worked best with active-learning materials like Modules and Worksheets, aligning with Pangilinan et al. (2023), while CAI and Multimedia required stronger interactive features to maximize their potential. These findings affirm Zhao et al. (2022) and UNESCO (2023) that inquiry-based, student-centered resources are most effective for fostering higher-order thinking and conceptual mastery in science.

Table 4: Students' pretest and posttest performance under four inquiry-based approaches

Table 4 compares Grade 8 students' pretest and posttest performance under four inquiry-based approaches. Open Inquiry showed the highest t-value (24.74), reflecting consistent improvement despite a slightly lower mean gain (16.35) than Structured Inquiry (17.59). Its strength lies in autonomous tasks such as designing experiments on wave speeds or tracking typhoons with PAGASA data, which foster independence and critical thinking (Lee et al., 2022).

Structured Inquiry ranked second in t-value (24.57) but achieved the highest mean gain. Through scaffolded activities like fault movement models, typhoon simulations, and classification charts, students built strong conceptual foundations, leading to high mastery scores (Lin & Wang, 2021). Confirmation and Guided Inquiry showed smaller gains (13.00 and 10.73) and lower t-values (20.31 and 14.33). Confirmation reinforced prior knowledge but limited originality (Chen & Hong, 2023), while Guided Inquiry allowed partial autonomy yet challenged students still reliant on teacher direction.

Findings align with Constructivist Theory (Bruner, 2020) and underscore that effective inquiry depends on matching cognitive readiness with instructional support (Almalki, 2024; UNESCO, 2023). A strategic blend of Structured and Open Inquiry is most effective: the former scaffolds foundations, while the latter develops independence and higher-order skills, advancing SDG 4 goals for quality education.

Table 5: Effectiveness of Instructional materials under BRITE teaching models

Table 5a compares the effectiveness of instructional materials under the Structured Inquiry Approach with the BRITE model, covering Modules, Worksheets, Multimedia, and Computer-Assisted Instruction (CAI). All materials showed significant mean gains, as confirmed by very low p-values (<0.001).

CAI emerged as the most effective, with the highest composite mean gain (17.14) and t-value (25.47). Interactive models of seismic wave movement and cosmic impact simulators allowed students to manipulate variables, enhancing engagement and conceptual understanding of complex topics. Multimedia also yielded strong results (mean gain 16.07; t = 20.23), reinforcing concepts through visual aids.

Modules (mean gain 11.03; t = 15.60) supported steady conceptual growth through structured texts, while Worksheets (mean gain 10.94; t = 20.14) strengthened analytical and retention skills. Overall, technology-based tools—CAI and Multimedia—proved more effective than traditional materials, creating dynamic learning environments that aid comprehension and retention. These findings align with Zhou (2022), Hockley et al. (2023), and Anderson & Liu (2021), who highlight the power of multimedia and structured inquiry with technology in improving science learning.

Table 5b compares the effectiveness of instructional materials used with the BRITE model under the Open Inquiry approach, including Modules, Worksheets, Multimedia, and CAI. All materials showed significant gains (p < 0.001), though at varying levels. Modules improved conceptual understanding of seismic waves and celestial impacts (mean gain 13.88; t = 19.8), supporting structured comprehension. Worksheets (mean gain 12.85; t = 16.96) enhanced learning on typhoon formation and earthquake generation, reinforcing knowledge through self-directed exploration. Multimedia achieved higher gains (15.57; t = 24.22) by helping students identify earthquake epicenters and track typhoons with visual aids. CAI produced the greatest impact (mean gain 23.00; t = 42.4), as interactive tectonic maps and space simulators fostered critical inquiry, hypothesis testing, and deeper engagement.

CAI was most effective, followed by Multimedia, Worksheets, and Modules, showing that technology-enhanced resources are vital in maximizing Open Inquiry learning outcomes (Anderson & Liu, 2021; Zhou, 2022).

Table 5c compares the effectiveness of instructional materials under the BRITE model with the Confirmation Inquiry approach, including Modules, Worksheets, Multimedia, and CAI. All materials showed significant gains ($p < 0.001$), though at varying levels. Worksheets emerged as the most effective (mean gain 23.37; t = 15.71), helping students validate concepts through guided fault diagrams, seismic wave tables, and impact comparison charts. Modules followed (mean gain 15.67; t = 30.19), reinforcing content mastery with structured exercises like Venn diagrams and guided questions. CAI (mean gain 13.71; t = 27.60) supported interactive validation of concepts through simulated faults and celestial comparisons, while Multimedia produced the lowest but still significant gain (11.72; t = 19.90).

Generally, results show that combining Confirmation Inquiry with varied instructional resources—particularly worksheets and modules—effectively enhances science learning. The findings support Hockley et al. (2023), Johnson & Lee (2024), and Garcia & De La Cruz (2022), who highlight how technology tools and structured approaches improve comprehension, retention, and critical thinking in inquiry-based learning.

Table 5d compares the effectiveness of instructional materials under the BRITE model with the Guided Inquiry approach, covering CAI, Modules, Worksheets, and Multimedia. All showed significant gains in pretest–posttest performance ($p < 0.001$).

Modules yielded the highest composite mean gain (13.2; t = 17.62), particularly in tracing typhoon paths and distinguishing an earthquake's epicenter from its focus. This aligns with Anderson et al. (2021), who emphasized the role of modules in enhancing critical thinking in Earth and Space Science. Worksheets followed closely (composite gain 12.91; t = 22.51), supporting competencies on celestial comparisons and fault activity, consistent with Brown and Williams (2023). Multimedia also showed notable gains (12.89; t = 19.71), reinforcing engagement and conceptual mastery (Chang et al., 2024). CAI achieved a composite gain of 12.4 (t = 27.29), enabling interactive simulations of faults and typhoons that promoted deeper understanding, as supported by Zhao & Li (2022).

Guided Inquiry under the BRITE model significantly improved learning across competencies, with the greatest impact observed in Modules and Worksheets, while CAI and Multimedia further enriched engagement and conceptual depth.

Table 6: ANOVA results comparing modules, worksheets, multimedia, and CAI across the four BRITE approaches and the effectiveness of instructional materials

Table 6a summarizes the ANOVA results comparing modules, worksheets, multimedia, and CAI across the four BRITE approaches: Structured, Confirmation, Guided, and Open Inquiry. Significant differences were observed in three approaches (Structured, Confirmation, and Open Inquiry), while no difference was found in Guided Inquiry.

Under Structured Approach, CAI (84.10) and multimedia (83.44) outperformed modules and worksheets, with $p < 0.001$. This highlights the advantage of technology-enhanced tools in boosting engagement and learning outcomes, echoing findings by Cabansag (2020), Baretto (2021), and Cavanaugh et al. (2004). In Open Inquiry Approach, CAI (89.9) was most effective, followed by multimedia (84.22), while modules lagged. The interactive and adaptive features of CAI align with the inquiry-driven nature of this approach. Local (Cruz, 2021; Santos, 2023) and international studies (Khan & Ali, 2022) similarly emphasize CAI and multimedia in fostering active inquiry. In Confirmation Approach, worksheets (89.89) proved most effective, reflecting the structured reinforcement this approach requires. While other materials showed moderate results, worksheets best supported practice and concept validation. These findings agree with Slavin (2008), Alayon (2020), and Garcia (2021) on the strength of structured written tasks. Lastly, for Guided Approach, no significant differences emerged ($p = 0.426$), suggesting flexibility for teachers to use either traditional or digital tools based on context. Evidence from Cruz (2020), Mendoza (2021), and Jenson & Friesen (2013) supports the effectiveness of both resource types in guided learning.

Table 6.b compares the effectiveness of static (modules, worksheets) and dynamic (multimedia, CAI) instructional materials under the BRITE model across four teaching approaches. Dynamic materials were significantly more effective in the Structured ($d = 3.66$, $p < 0.01$) and Open Inquiry approaches ($d = 3.63$, $p < 0.01$), showing their value in interactive and inquiry-based learning. Conversely, the Confirmation Approach favored static materials (mean difference = 6.56, $d = 4.44$, $p < 0.01$), supporting the structured reinforcement that worksheets and modules provide. The Guided Approach showed no significant difference ($p = 0.31$), suggesting flexibility in material choice.

Although the overall comparison showed no significant difference ($p = 0.09$), the large effect size ($d = 4.87$) suggests dynamic tools may have broader impact in certain contexts. These findings align with Hughes & Cartwright (2020) and Smith & Roberts (2021), who emphasized the benefits of dynamic tools in inquiry-based learning, while De Guzman & Tan (2022) and Reyes & Dizon (2023) highlighted the enduring effectiveness of static materials in structured approaches.

7. Challenges Faced by the Students

Challenges faced by students in learning through the BRITE model can be summarized using the acronym BRITE: Brainstorming Barriers, Research Roadblocks, Interpretation Issues, Time Management Troubles, and Executing Performance Challenges. Brainstorming barriers arise when students struggle to generate questions due to limited prior knowledge, uncertainty, and a passive learning mindset, highlighting the need for scaffolding and guided support. Research roadblocks reflect difficulties in finding reliable resources and interpreting procedures, often linked to insufficient background knowledge and lack of access to credible materials. Interpretation issues emerge when students encounter problems synthesizing data, recognizing patterns, or explaining results, revealing gaps in data literacy and conceptual understanding. Time management troubles are common as students struggle to complete all inquiry stages within limited class periods, leading to rushed activities and stress. Finally, executing performance challenges include anxiety, unequal group participation, and lack of preparation, which hinder students from confidently demonstrating learning. Overall, these challenges show that while the BRITE model fosters inquiry and engagement, effective scaffolding, structured support, and collaborative strategies are crucial in helping students overcome barriers and fully benefit from inquiry-based learning.

8. Learning Plan aligned to the BRITE teaching models

The learning plan aims to improve academic achievement in Earth and Space Science by strategically aligning the BRITE teaching model (Structured, Confirmation, Guided, and Open) with instructional resources such as worksheets, modules, multimedia, and computer-assisted instruction. Though designed for Grade 8, it can be adapted across K–12 and STEM courses, drawing from educational theories such as Mayer's Multimedia Learning Theory, Constructivism, Cognitive Load Theory, and principles of Differentiated Instruction and Universal Design for Learning. The plan focuses on three goals: raising student achievement, enhancing higher-order thinking through technology-based lessons, and supporting teachers in instructional decisions. Organized as a matrix linking Earth and Space Science topics with BRITE approaches, strategies, and assessments, it pairs guided inquiry with CAI simulations for earthquake waves and open inquiry with multimedia projects for typhoons and global earthquake patterns. Implementation involves curriculum integration, material development, teacher training, and ongoing monitoring, with DepEd-approved platforms and workshops for building local resources. Both formative and summative assessments will evaluate progress. Expected outcomes include higher student performance and retention, greater engagement in inquiry-based learning, and improved teacher competence. For sustainability, the framework should be embedded in School Improvement Plans (SIPs), Learning Action Cells (LACs), and continuous research-based refinements.

V. CONCLUSIONS

The study concludes that the performance of the Grade 8 respondents did not fully meet the expected competency level of their grade, yet significant improvements were observed when the BRITE model was integrated with inquiry-based approaches. Structured Inquiry emerged as the most effective strategy, building strong conceptual foundations across topics such as earthquakes, typhoons, comets, meteors, and asteroids. Open Inquiry, while slightly less effective, encouraged creativity and critical thinking and proved valuable in developing higher-order skills. Confirmation and Guided Inquiry were rated satisfactory but were less effective overall due to the greater cognitive demands they placed on students and the variation in learners' prior knowledge. Nevertheless, student performance across all approaches improved considerably when instructional resources such as modules, worksheets, multimedia, and computer-assisted instruction (CAI) were employed. Among these, CAI consistently demonstrated the strongest results, particularly in Structured and Open Inquiry, while worksheets were most effective under Confirmation Inquiry and modules under Guided Inquiry. The study emphasizes the significant role of integrating technology-based and traditional resources with the BRITE model to enhance cognitive skills, engagement, and conceptual understanding. However, challenges such as limited prior knowledge, weak time management, resource inaccessibility, group participation issues, and performance anxiety were also identified as barriers that require attention.

In light of these findings, the study recommends that individualized instruction and targeted interventions be provided to fill students' knowledge gaps, with professional development for teachers prioritized to strengthen their capacity in implementing context-based and inquiry-driven science teaching. Structured Inquiry is encouraged for complex topics, while Open Inquiry may be best suited for exploratory and creative learning tasks. Confirmation and Guided Inquiry approaches should be strategically used to reinforce understanding and promote independent learning. Teachers may benefit from training modules focused on aligning BRITE phases with inquiry types, integrating digital tools, and practicing reflective teaching strategies. Schools are encouraged to integrate more multimedia and CAI components into lessons,

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particularly within Structured and Open Inquiry, while continuing to value the role of worksheets and modules in supporting reinforcement and guided learning. Scaffolding techniques, time management support, collaboration protocols, and opportunities for practice should also be provided to reduce barriers and increase student confidence and participation. By aligning inquiry approaches and instructional materials with specific Earth and Space Science topics, teachers can create dynamic and meaningful learning environments that enhance performance, foster engagement, and develop critical thinking among learners.

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