Alternative Assessment in an Inquiry Based Classroom using 5E Model

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Abstract

Purpose and Research Question - The study describes the use of alternative assessment in a science classroom using the 5E model. The use of alternative assessment is seen as an alternative approach against traditional assessment harnessing on rote learning capabilities of students. This use of alternative assessment is believed to correctly measure students' comprehension of science concepts using inquiry based science learning (IBSL).

Methodology – This study Year 6 students from Brunei Darussalam. The samples comprised of 20 students. A 5E lesson plan was introduced for a Physics topic of electricity. The lesson plan contained detailed activities for students learning.

Findings – The analyses showed that generally students had positive learning using the 5E model. Students were observed to be able to identify the basic components and symbols of a simple electric circuit, they were able to build their own simple electric circuit and sketch a complete simple electric circuit with the correct components and symbols. The lesson followed a consistent sequence where the teacher introduces a topic where the goal is to briefly generate interest, activate prior knowledge, or link to the day's activities to what has come before (engage). Next, in their own small groups, the students did a hands-on exploration where collaboration with peers is encouraged (explore). Finally, the students were given opportunities to reflect and discuss with the teacher on what they have observed, share ideas and data, and reflect on the day's activities.

Significance and Contribution in Line with Philosophy of LSM Journal - This article illustrates lesson exemplar piloted with findings that could be used as a tool to adopt a 5E instruction model in a science classroom utilizing alternative assessment rubrics. The research findings could also be used as springboard for further research exploring deeper alternative assessment and a number of rubrics in measuring students' grasping of science concepts. Furthermore, the assessment rubric could be used to provide intervention in teachers' training curriculum that would increase the interest of students in learning and exploring science.

Keywords: Alternative assessment; 5E model; Inquiry based science learning; ICT; Electric circuit

Introduction

Low grades of students in science and mathematics draw the attention of authorities and effort made to search for the cause of this is endless. Many researches on ways to increase students' grades were undertaken. The cause for the low grades may be due to teaching, learning or assessments (Malik et al., 2019). Parents are concern of school not performing and these pose a concern to the ministry and also to the society in general. Many researches were done on pedagogy and improving learning difficulties but less on assessments. Thus, this study addresses the paucity of such research in the areas of educational testing.

Continuously monitoring students' progress in learning adopts many strategies. One approach is to have an assessment. Traditionally, assessments were focused on examinations and confined to paper-and-pencil testing, requiring candidates to read questions and respond in writing (Bawaneh & Moumene, 2021). For example, tests as well as inventories, and the common response formats may be multiple-choice, short answer and essays. Teachers spend most of their time planning and delivering their lesson aligning with curriculum standards using traditional assessment in quantifying their achievements. Over the years these testing evolved into alternative assessment, providing teachers with options to evaluate students' performance against traditional methods (Espiritu et al., 2018).

Hence the Research Objectives of this study are:

(a) To devise lesson exemplar incorporating an alternative assessment instrument in an inquiry-based science classroom integrating ICT;
(b) To utilize the assessment instrument developed in the 'Evaluation' Phase of 5E model in the science lesson.

Literature Review

Assessment

The primary purpose of classroom assessment is to obtain information to inform teachers' pedagogy and improve students' learning. Classroom assessment may be used to evaluate and classify students' performance and to monitor student progress in achieving learning outcomes throughout a course (Sulaiman et al., 2020). Hence, classroom assessment is always an integral component of instructional activities. However, often needing to achieve standardisation, traditional testing has been commonly adopted, particularly in consideration to big class size and managing timing in grading consequently compressing an entire semester of work into a short time of testing that is used to account for a major portion of a grade is surely a misrepresentation of the efforts of students. The role of assessment must be meaningful and holistic in presenting students' performance and not aims at measuring the retention of knowledge (Bawaneh & Moumene, 2021). In the teaching and learning of science, assessment must be closely related to its contents, pedagogies used and classroom instructional practices. The various perspectives assume' by assessment as learning, assessment of learning, and assessment for learning are fundamental for effective science teaching and learning providing adequate knowledge to promote positive changes in the teaching and learning process. Over the years these assessments tended to be rigid and did not allow measuring student real potential. Sherrington (2018) argues that assessment too often fails to prioritise students'

learning and therefore, there is a crucial need to rethink how teachers need to assess students' work crystallizing alternative assessments method.

Alternative assessment refers to a term comprising innovative classroom assessment that forms other ways to traditional approach of standardized testing (Bawaneh & Moumene, 2021). Alternative assessment is also known under various terms, such as formative, performance, portfolio and authentic assessment, based on oral and written responses and presentations, project work or using rubric to measure proficiency.

In traditional assessment, student performance were based on grades of a cumulative set of work for a given time period. Yet, in alternative assessments, students are encouraged to provide their own responses rather than simply selecting from a given list of options. In logical perspectives, alternative assessments should be used to determine what students can and cannot do, in contrast to what they do know or do not know. In other words, alternative assessment measures applied proficiency more than measuring knowledge. In other words, alternative assessment aims to assess students' skills, not their knowledge (Sulaiman et al., 2020).

Typical examples of alternative assessments include portfolios, project work, and observation of students in action while doing science experiments and other activities that are accompanied with some type of rubric. Specifically, a portfolio is an alternative assessment that allows a student to select or develop the presentation he or she thinks best depicting his or her study skills and understanding of concepts. Therefore, student portfolios, grading with rubrics, and other alternative assessment strategies forms great measurement that can help to determine more accurately how well learning outcomes have been achieved especially assessment in science.

To assess students' science knowledge, skills, strategies, and attitudes, teachers require a variety of tools and approaches ranging from asking questions, observing students engaging in a variety of learning activities and processes, and examining students' work in progress. They also engage students in peer assessment and self- assessment activities. However, the real challenge for teachers is to choose the right assessment for students.

Alternative assessment in science spurs the student to wear his or her thinking hat, and creatively apply the scientific knowledge to solve a problem. Alternative assessments can promote the scientific skills needed in the 21st century incorporating technology in education.

The Role of Information and Communication Technology (ICT) in Science Classrooms

In this 21st century, technology is an integral part of education. Integrating technology into classroom instruction is certainly more than teaching basic computer skills and software programs in a separate computer class. Effective tech integration occurs across the curriculum in ways that research shows deepen and enhance the learning process (Ebrahimi & Jiar, 2018).

In particular, it must support four key components of learning: active engagement, participation in groups, frequent interaction and feedback, and connection to real-world experts. Technology helps change the student/teacher roles and relationships: students take responsibility for their learning outcomes, while teachers become guides and facilitators, technology revolutionizes the learning process (Ibáñez et al., 2016). They also explained that another reason why

technology integration is important in today's students is for them to have the necessary 21st century skills which includes planning, critical thinking, reasoning, and creativity.

Free online communication tools such as Zoom, Microsoft teams, Google Meet have been widely used to communicate with the students and software such as teachers for their distance online-learning (Fuady et al., 2021). However, the use of ICTs for education during the COVID-19 crisis and beyond is a reality for which teachers and learners must be better prepared. Digital technologies need to be integrated to create effective student learning experiences. Countries need to make the necessary preparations to better map teaching and learning needs for future crises in education. Schools have been reopened slowly towards the end of year 2020 and yet it is seen that teachers are still implementing ICT in their lessons as a permanent practice with their students until now.

Integrating ICT into school-based alternative assessment will bring benefits not only to the teacher but also to the students in science primary lessons promoting Inquiry based science education (IBSE).

Inquiry-based Science Education (IBSE)

Science teaching method in secondary schools is of concern to the declining achievement standards and may cause students losing their fascination for the subject (Baharom et al., 2020). An alternative approach moving away from traditional instruction needs to be placed. One such approach is the Inquiry-based Science Education (IBSE). This approach of constructing knowledge or knowledge building is seen as the solution to restore students' interest. In structured inquiry, students investigate questions posed by teachers based on the prescribed processes and able to raise the cognitive processes (Damopolii et al., 2021). In addition, inquiry based learning demands more activities compared to traditional learning (Nikou & Economides, 2018). Increasingly IBSE is seen as key to developing students' scientific literacy, enhancing their understanding of scientific concepts and amplify their appreciation of how science works.

Scientific inquiry requires the use of evidence, logic, and imagination in developing explanations about the natural world. Inquiry is thus grounded in knowledge, issues and questions that relate to the roles played by science in daily life, society, and the environment. Inquiry-based science challenges students' thinking by engaging them in investigating scientifically oriented questions where they learn to give priority to evidence, evaluate explanations of alternative explanations and learn to communicate and justify their decisions utilizing the 5E instruction model.

The 5E's Instruction Model

According to Fatimah (2020), the 5Es are an instructional model encompassing the phases Engage, Explore, Explain, Elaborate, and Evaluate, steps which educators have traditionally taught students to move through in phases. The 5E Model, promotes collaborative, active learning in which students work together to solve problems and investigate new concepts by asking questions, observing, analysing, and drawing conclusions.

Methodology

Participants

For this study, the subjects are comprised of 20 students from Year 6A of Lambak Kanan Jalan 49 Primary School, Brunei Darussalam. Lambak Kanan Jalan 49 Primary School is a government school in Brunei built in 2004 and started its operations in 2006. The school is situated northwest of Sungai Hanching, close to Masjid Perpindahan Lambak Kanan. To date, the school has a population of 544 students and 50 teachers. The study comprised of eleven (11) males and nine (9) females. All subjects were provided with informed consent forms. Majority of participants were medium to high achievers (mixed-ability) based on their Year 5 (Year 2020) end-of-year examination results.

Assessment Instrument

In this study, alternative assessment criterion achievement standards are developed for three stages. The reasons for these three rating scales for performance levels were created with only three and four stages are due to the early group discussions the teacher had discussed with her colleagues in which they catered the rubric according to the ability levels they believed their students were able to achieve and based on the criteria stated in the first, second and the third stage. The third stage has a more challenging criteria, thus, the rating scales have been increased to four. The teacher did not make any amendments to the original rubric and continued to use the rubric for the school try-out session. In the future, the teacher would like to develop a more comprehensive rubric and make certain that the indicators reflect equal steps along the scale as presented in Table 1 (Note: For 3rd stage, there are no available data as scores are only students. The 'Explain' stage was conducted fully by teacher. Hence no score for the student in 3rd stage).

Table 1 Alternative Assessment Criterion

1st STAGE: ENGAGE			
SCORE/ CRITERIA	**2**	**1**	**0**
Student's response on why the light is turned off.	Students can respond orally with more than one answer • Cut off the electricity power • Turn off the switch • The bulb/wire is broken	Students can respond orally with one answer • Cut off the electricity power • Turn off the switch • The bulb/wire is broken	No response
Student's response on why the light is turned on.	Students can respond orally with more than one answer • There is electricity power • Turn on the switch	Students can respond orally with one answer • There is electricity power • Turn on the switch	No response

2nd STAGE: Explore			
SCORE/ CRITERIA	**3**	**2**	**1**
Build a complete electric circuit with components provided	Able to build a complete electric circuit **without errors**	Able to build a complete electric circuit with some **errors**	Able to build a complete electric circuit **with lots of errors**

4th STAGE: Elaborate				
SCORE/ CRITERIA	**4**	**3**	**2**	**1**
Sketch a complete electric circuit using correct symbols and electrical current direction	Able to sketch a complete electric circuit using correct symbols and electrical current direction without error	Able to sketch a complete electric circuit using correct symbols and electrical current direction but with one error.	Able to sketch a complete electric circuit using correct symbols and electrical current direction but **with two errors.**	Able to sketch a complete electric circuit using correct symbols and electrical current direction but **with three errors.**

Topic under Investigation

The topic investigated for this research is Electric circuit, path for transmitting electric current. An electric circuit includes a device that gives energy to the charged particles constituting the current, such as a battery. Devices that use current, such as lamps, electric motors and the connecting wires or transmission lines.

Technological Tools Used

Applications and technological tools used for this lesson plan includes PowerPoint, YouTube videos, the Wheel of Names, and Socrative were incorporated in the lesson plan. Students were asked to evaluate different apps in order to mimic different scenarios and issues that might arise during the demonstration to ensure their familiarity in using the applications.

The detailed lesson plan used primarily during the actual school try-out is illustrated in Table 2 while the powerpoint slides and activity sheet in Appendix A and B respectively.

Table 2 Actual Lesson Plan for School Try Out and Relevant Figures

Venue:	Sekolah Rendah Lambak Kanan Jalan 49, Brunei Darussalam
Type of	Face-to-Face
Year/class:	Year 6 A
Subject:	Science
Theme:	Energy and Forces
Topic:	Electric Circuits
Day/date:	Thursday, 22nd April 2021
Time allocation:	9am - 10:30am (1 hour)
No. Of students:	22 students
Students' ability:	Mixed ability students (One special-needs student in a wheel-chair)
Learning competency	Able to build a basic complete circuit in order for a device to work
Outcomes of Learning	At the end of the lesson, students should be able to: • Identify the basic components and symbols of a simple electric circuit. • Build a simple electric circuit. • Sketch a complete simple electric circuit with the correct components and symbols.
Content	Electric Circuits
Learning resources	• Year 6 Star Science Textbook (Page 10-17)
Other learning resources/aids	Light bulbs • Bulb holders • Wires • Batteries • Switches • Mini whiteboards and marker pens • Assessment observation sheets (rubric) • iPads • Vertable (interactive whiteboard) • Speakers • Good internet connection / Teacher's wifi hotspot
Multimedia resources used:	• Youtube video. URL link: https://www.youtube.com/watch?v=9dYxs5sWkM8 • Wheel of Names. URL link: https://wheelofnames.com/45f-jst • Socrative Quiz. URL link: https://b.socrative.com/teacher/#import-quiz/57485551 • iPads • Serial bulb lite application (IOS)
Learning model / learning strategy	5E Inquiry-Based Instructional Model

STAGE 1	**TEACHER'S ROLE DURING ENGAGE STAGE**	**STUDENTS' ACTIVITY DURING ENGAGE STAGE**
ENGAGE	Teacher intends to talk about electricity and how it works, how it turns on and off.	1.Students experience the light turn on and off.
	Activities:	2. Students answer teachers' questions.
(5 mins)	• Teacher turns out the lights and asks students what happened (The lights went out). Why? (You turned off the switch). • Then, the teacher turns on the switch. (Turned on the electricity). 2. After that, the teacher introduces the lesson objective and what she/he expects the students to achieve. a) Identify basic components of electric circuits b) able to light up the bulb by building a simple electric circuit c) identify the symbols of the components and sketch a complete electric circuit with correct symbols.  	a)"(The lights went out). Why? Expected answer: there is no electricity. b) The light is on. "Why?" expected answer: There is electricity. 3. Students listen to teachers' explanation on the objectives of the lesson.
STAGE 2	**TEACHER'S ROLE DURING EXPLORE STAGE**	**STUDENTS' ACTIVITY DURING EXPLORE STAGE**
EXPLORE (20 mins)	Teacher intends to make students explore by themselves how to use all 4 components provided to makes the bulb lights up and can be switch off too. Activities: • Teacher asked the students to sit in a group of four or five. • Teacher gives every group a set of electric circuit components but without telling the students on what to do. The students will just build anything based on what they have been provided. • Teacher gives students 15 minutes to complete the experiment. Teacher uses the timer. • While the students are building their electric circuits, the teacher will assess each group by observing their circuits and interviewing the members of the group. The teacher will	1. Students are given a set of 4 components of electric circuit (bulb, battery, wire and switch) 2. Students try by themselves how to build the electric circuit and make sure it works. -Advanced level: adding a switch 3. Students listen to the teacher's explanation about closed circuit and open circuit and its connection to light the bulb

	use the observation assessment sheet to record marks and jot down any remarks. • Teacher asks students (in groups) to sketch/draw a diagram of the circuit that they just build and guide the students to draw the flow of the electric current in the diagram using red/any colour.  	4. Students draw a diagram of a complete circuit that they just built.
STAGE 3	**TEACHER'S ROLE DURING EXPLAIN STAGE**	**STUDENTS ACTIVITY DURING EXPLAIN STAGE**
EXPLAIN (10 mins)	Teacher explains about the components' names in the electric circuits and its functions. Teacher shows the path of electricity flow in a complete simple electric circuit and the concept of open and closed circuit. • Teacher explains about the four basic components of a simple electric circuit. • Teacher gives explanation on how a correct electric circuit looks like. • Teacher gives feedback on the four groups' electric circuit. • Teacher shows the switch and relate it to the situation in the early lesson where she turns off the light. Teachers explain that switch is used to open and switch off the conductive path. • Teacher explains about closed circuit and open circuit and the function of the switch. -Teacher explain on the concept of the closed circuit (the bulb lights up) and the concept of open circuit (the bulb turns off) due to a 'gap' in the electric circuit. The 'gap' can be anything: for e.g., switch is off. • Teacher guides the students to draw the flow of the electric current in the diagram using red/any colour. • Teacher will assess students understanding on each of the components' function using oral quiz by "wheels of name" application/web tools.	Pupils listens to teacher explanation about 4 components of the electric circuits. 2. Pupils look at their own electric circuit to see whether they have included all the basic components. 3. Students listens to teacher's explanation about closed circuit and open circuit and its connection to light the bulb -includes the function of a switch. 4. Pupils draw the flow of the current in the diagram using red/any colour. 5. Students are assessed on the components names and functions using the Wheel of Names

	 	
STAGE 4	**TEACHER'S ROLE DURING ELABORATE STAGE**	**STUDENTS ACTIVITY DURING ELABORATE STAGE**
ELABORATE (10 mins)	Teacher intends to introduce the components and the symbols. • Teacher shows a video about symbols of the electric components in an electric circuit. • Teacher asks the students to sketch the flow chart of electricity flows. • Teacher guides the students to sketch their electric circuit drawing which they have drew earlier (based on what they have built). • Teacher asks students to present their sketch in front of the class. 	1. Students watch a video of an electric circuit symbols. 2. Students relate to the video they have watched. 3. Students will sketch the symbols and draw the electrical current flow 4. Students will present to the entire class.
STAGE 5	**TEACHER'S ROLE DURING EVALUATION STAGE**	**STUDENTS' ACTIVITY DURING EVALUATION STAGE**

EVALUATION (15 mins)	Teachers intends to do more assessment for checking the students' understanding. • Teacher use Socrative on their mini-iPad to test students understanding using multiple choice questions and true or false questions. • Teacher recaps the lesson by asking students what they are learning today. • Teacher guides the students on how to log in via Socrative. • Teacher guides the students on how to use the Serial Bulb Lite application on the ipads.  	1. Students will answer questions using the Socrative 2. Teachers and students conclude together what they have learnt just now. 3. Students try the Serial Bulb Lite application on their Ipads.

Discussion

This work project applied some of the learnt knowledge which is implementing school-based alternative assessment in primary science education where the teacher has implemented 5E Inquiry-Based Instructional Model building a simple electric circuit with Year 6 students. Compared to 2020, 2021's COVID19 pandemic situation in Brunei Darussalam is well under-control and the teacher was able to carry out an actual face-to-face school try-out for this project.

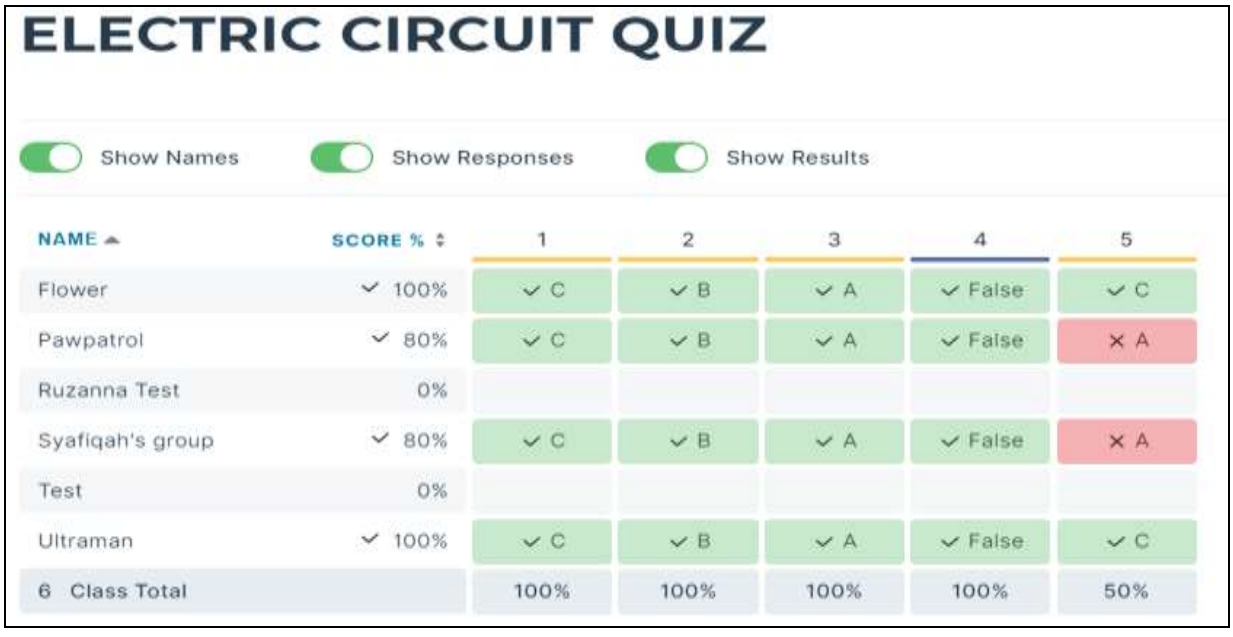
The idea about current electricity and electrical circuits that most students bring with them is a one-way "source-consumer" model. They believe that the battery is a source of electric current, the light bulb is a consumer of current, and one just touches the ends of the wire to each for the bulb to light. They envision the process as being a one-way flow of electric current from battery to bulb. One reason for this belief may be the view of an electrical cord as a single wire coming from an outlet (not knowing that the cord has several wires inside it). From the 5E lesson conducted, when they conducted their hands-on experiments, though, the students discovered that a one-way configuration did not work. After trial-and-error, they discovered that the two terminals of the battery must be included, as well as the metal parts of the light bulb. By the end of the lesson, the students not only have discovered the necessary components to make a simple electric circuit works but they are not able to describe the correct path on how electrical flow in a simple electric circuit. Additionally, they have extended their investigations by adding a 'switch' into their electric circuits in their explorations. During the lesson, the teacher used an alternative assessment rubric together with a number of alternative assessment methods to assess the students' grasp of the electric circuit concepts. In general, this study is similar to the findings by Garneli and Chorianopoulus (2018) comprising of 44 Greece middle school students aged 15 learning of electric circuit showing increased understanding. However, the alternative assessment used computational thinking assessment skills such as sequences, loops, conditionals, operators, and data.

This project aims to see how alternative assessment give the students an opportunity to demonstrate the depth and scope of what they have learned rather than being limited to just a few responses on a traditional test/exam. They are encouraged to provide their own responses rather than simply selecting from a given list of fixed options. Their work allows them to select and develop the presentation of what he/she thinks best depicting from their study skills and understanding of concepts, determining accurately how well learning outcomes have been achieved.

This project also aimed to apply skills in using information and communications technology (ICT) in assessment so as improve teaching and learning in primary science where digital tools and online/web-based resources for assessment have been selected for this topic.

All in all, students were motivated and performed up to expectations during work activities, discussions, and class presentations. The results in the Explore Stage and the Evaluation stage were recorded on an alternative assessment self-created rubric and Socrative. Results (Figure 2) shown that students did well obtaining scores above passing rate.

Figure 2 Students' Socrative Result



NAME	SCORE %	1	2	3	4	5
Flower	✓ 100%	✓ C	✓ B	✓ A	✓ False	✓ C
Pawpatrol	✓ 80%	✓ C	✓ B	✓ A	✓ False	✗ A
Ruzanna Test	0%					
Syafiqah's group	✓ 80%	✓ C	✓ B	✓ A	✓ False	✗ A
Test	0%					
Ultraman	✓ 100%	✓ C	✓ B	✓ A	✓ False	✓ C
6 Class Total		100%	100%	100%	100%	50%

Conclusion

Summary and Implications

Based on the experiences and outcomes of the work project. The utilization of alternative based assessment with the help of interactive technology tools and applications boosted students' interests and helped them to strengthen their understanding of the topic in a fun and productive way. The utilization of school-based alternative based assessments helped the teacher to monitor students' progress in learning based on oral, written responses and presentations, project work and rubric to measure proficiency.

Recommendations

Based on author's observation, future alternative assessments using other applications such as Padlet, Rubistar, Jamboard, Mentimeter, Quizizz and Edmodo may be explored. Other forms of assessment measures would also be taken into consideration with the purpose to improve my own teaching in science classrooms.

Acknowledgement

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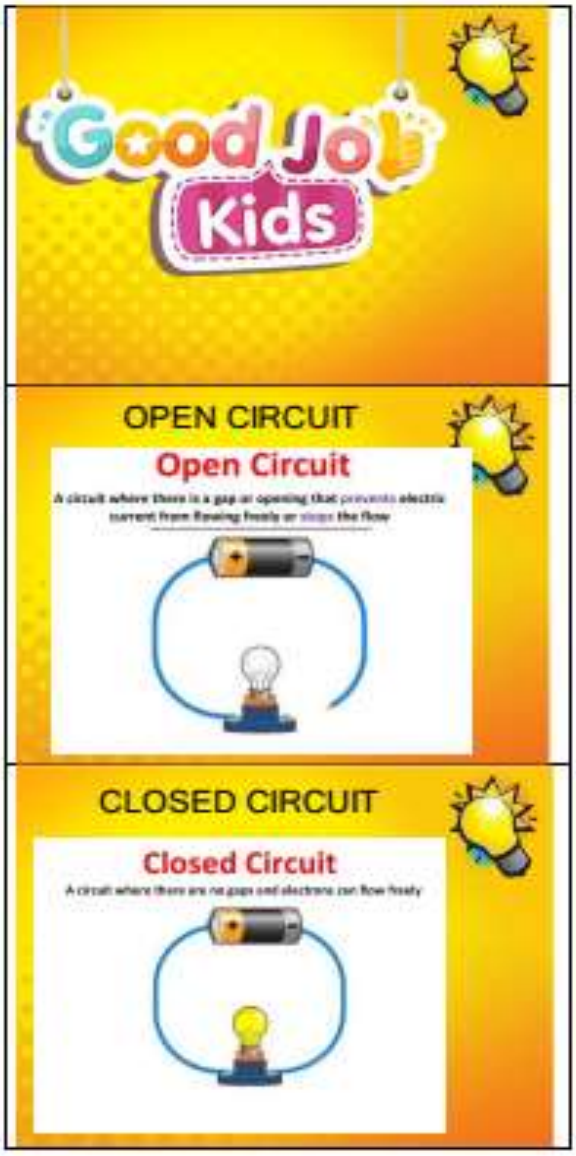
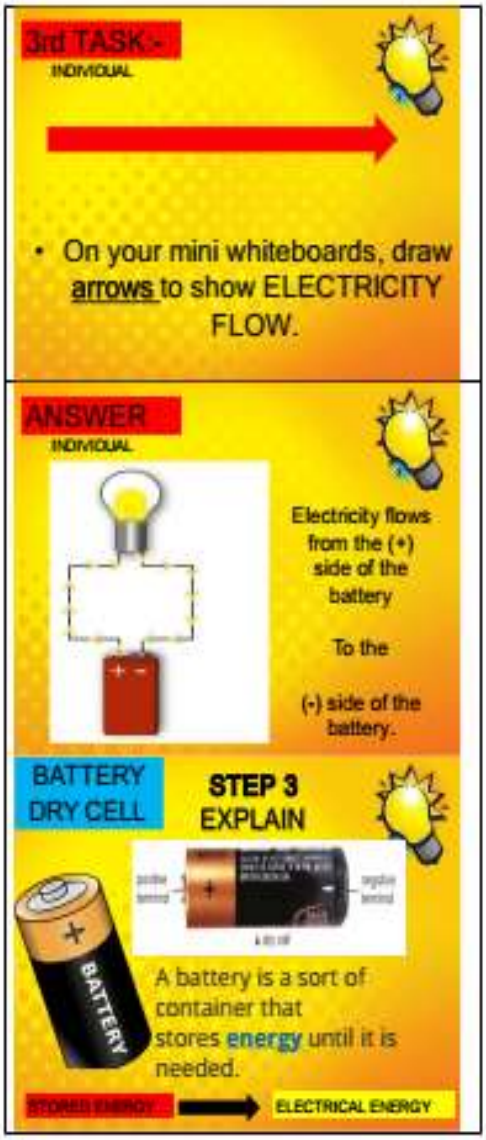
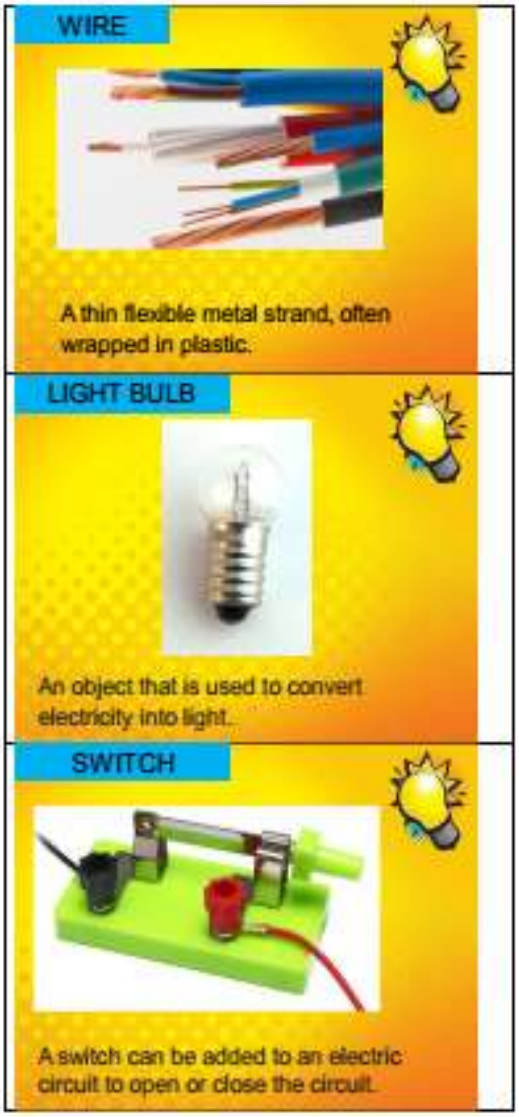
Appendix A

Powerpoint slides

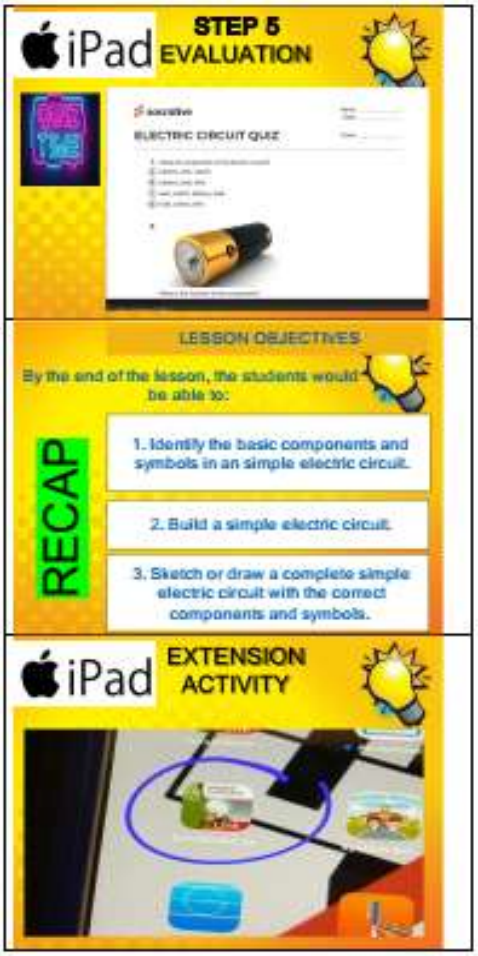

Good Job
Kids
OPEN CIRCUIT
Open Circuit
CLOSED CIRCUIT
Closed Circuit


3rd TASK :-
INDIVIDUAL
• On your mini whiteboards, draw arrows to show ELECTRICITY FLOW.
ANSWER
INDIVIDUAL
Electricity flows from the (+) side of the battery
To the
(-) side of the battery.
BATTERY DRY CELL
STEP 3 EXPLAIN
BATTERY
A battery is a sort of container that stores energy until it is needed.
STORED ENERGY
ELECTRICAL ENERGY


WIRE
A thin flexible metal strand, often wrapped in plastic.
LIGHT BULB
An object that is used to convert electricity into light.
SWITCH
A switch can be added to an electric circuit to open or close the circuit.


A COMPLETE ELECTRIC CIRCUIT
Bulb
Battery
Switch
DIY Electric Circuit
WATCH THE VIDEO
STEP 4
ELABORATE
5TH TASK -
INDIVIDUAL
• Based from the electric circuit which you have build, draw your complete electric circuit into your mini whiteboards - USING SYMBOLS


8TH TASK:-
INDIVIDUAL
• On your mini whiteboards, once again draw arrows to show ELECTRICITY FLOW.
7TH TASK:-
INDIVIDUAL
PRESENTATION TIME
iPad
STEP 5
EVALUATION
QUIZ TIME
socrative
RUZANNA1255


iPad
STEP 5
EVALUATION
QUIZ TIME
ELECTRIC CIRCUIT QUIZ
LESSON OBJECTIVES
By the end of the lesson, the students would be able to:
RECAP
1. Identify the basic components and symbols in an simple electric circuit.
2. Build a simple electric circuit.
3. Sketch or draw a complete simple electric circuit with the correct components and symbols.
iPad
EXTENSION ACTIVITY

Appendix B

Activity sheet: Sample questions

SOCRATIVE QUESTIONS
socrative

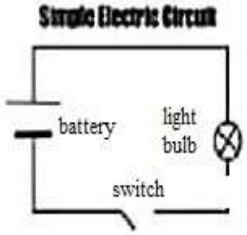
ELECTRIC CIRCUIT QUIZ

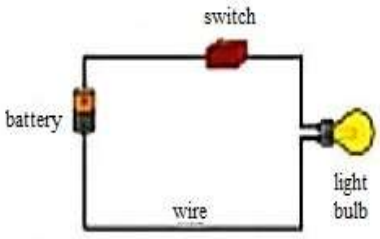
Name: _____
Class: _____
Score: _____

1. Based on the diagram, the bulb will light up.

A. True

B. False





2. Why the bulb does not light up though it is a complete circuit?

A. It is a closed circuit.

B. We use a new battery.

C. The bulb is broken.