Faculty of Cognitive Sciences and Human Development

SCAFFOLDING IN LEARNING OF SCIENCE AND ITS IMPACT ON ACHIEVEMENT AMONG RURAL STUDENTS IN BAU

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SCAFFOLDING IN LEARNING OF SCIENCE AND ITS IMPACT ON ACHIEVEMENT AMONG RURAL STUDENTS IN BAU

IRIS TIA ANAK MEKUNG

A project submitted
in partial fulfillment of the requirements for the degree of
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The project entitled **Scaffolding in Learning of Science and its Impact on Achievement Among Rural Students in Bau** was prepared by Iris Tia anak Mekung and submitted to the Faculty of Cognitive Sciences and Human Development in partial fulfillment of the requirements for the degree of Master of Science (Learning Sciences).

It is hereby confirmed that the student has done all the necessary amendments for examination and acceptance.

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(DR. PHILIP NULI ANDING)

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STEM	Science. Technology, Engineering and Mathematics
ZPD	Zone of Proximal Development
UPSR	Ujian Penilaian Sekolah Rendah
TIMMS	Trends International Mathematics and Science
WISE	Web-based Inquiry Science Environment
PBL	Problem-based Learning
SPSS	Statistical Package for the Social Science
M	Mean
LCD	Liquid-crystal Display

ABSTRACT

Teachers need to provide appropriate support to their students as they are struggling to understand the learning content. This study investigated scaffolding in learning of science and its impact on achievement among rural pupils in a primary school located at Bau, Sarawak. It also investigated the effects of gender on pupils' achievement using scaffolding and conventional teaching method. This study adopted an experimental research design. A total of 60 pupils, comprised of 30 males and 30 females took part in this study. The sample was divided into two groups, control and experimental with equal numbers of males and females. The control group was taught using the conventional teaching method, while the experimental group was taught using a scaffolding teaching method. Two research questions and three hypotheses tested at 0.05 level of significance guided the study. The instrument for data collection was constructed on the topic of Energy in primary Year 5 science curriculum. The reliability of the instrument was accessed using a test-retest reliability method, analyzed using the Pearson correlation coefficient and was found to be 0.947. Mean was used to answer the research questions, while two-way ANOVA was used to test the hypotheses. Results showed that pupils taught using scaffolding teaching method performed significantly better than their counterparts who were taught using conventional teaching method. However, there was no statistically significant difference between the mean scores of male and female pupils when taught using both teaching methods. Thus, educators are recommended to shift from conventional teaching to the method that relies on support and assistance to improve students' achievement in science.

Keywords: Science, scaffolding, achievement, gender

ABSTRAK

SCAFFOLDING DALAM PEMBELAJARAN SAINS DAN KESANNYA TERHADAP PENCAPAIAN MURID LUAR BANDAR DI BAU

Guru perlu memberi sokongan yang sewajarnya kepada murid semasa mereka berusaha untuk memahami kandungan pembelajaran. Kajian ini dijalankan untuk mengkaji scaffolding dalam pembelajaran sains dan kesannya terhadap pencapaian murid luar bandar di sebuah sekolah rendah yang terletak di Bau, Sarawak. Ia juga menyiasat kesan jantina pada pencapaian murid menggunakan kaedah pengajaran scaffolding dan konvensional. Kajian ini menggunakan kaedah penyelidikan eksperimen. Seramai 60 orang murid yang terdiri daripada 30 orang lelaki dan 30 orang perempuan mengambil bahagian dalam kajian ini. Sampel dibahagikan kepada dua kumpulan, kawalan dan eksperimen dengan jumlah murid lelaki dan perempuan yang setara. Kumpulan kawalan diajar dengan menggunakan kaedah pengajaran konvensional manakala kumpulan eksperimen diajar menggunakan kaedah pengajaran scaffolding. Kajian ini dibimbing dengan dua soalan penyelidikan dan tiga hipotesis yang diuji pada tahap signifikasi 0.05. Instrumen bagi tujuan pengumpulan data dibina dari tajuk Tenaga dalam kurikulum sains Tahun 5. Kebolehpercayaan instrumen telah diakses mengunakan kaedah 'test-retest' yang dianalisis dengan menggunakan pekali korelasi Pearson dengan keputusan 0.947. Min digunakan untuk menjawab soalan-soalan penyelidikan, manakala ANOVA dua hala digunakan untuk menguji hipotesis. Keputusan menunjukkan bahawa murid-murid yang diajar menggunakan kaedah pengajaran scaffolding menujukkan pencapaian yang lebih baik berbanding rakan-rakan mereka yang diajar menggunakan kaedah pengajaran konvensional. Walau bagaimanapun, statistik menujukkan tidak ada perbezaan yang signifikan antara skor murid lelaki dan perempuan apabila diajar menggunakan kedua-dua kaedah. Oleh itu, para pendidik disarankan untuk beralih dari pengajaran konvensional kepada kaedah yang menitik beratkan sokongan dan bantuan untuk meningkatkan pencapaian pelajar dalam sains.

Kata kunci: Sains, scaffolding, pencapaian, jantina

1. INTRODUCTION

Malaysia emphasizes on the significance of STEM education in order to meet the challenges of becoming a developed nation and stay competitive in STEM-driven economy. STEM initiative mainly aims to provide students with adequate skills to overcome the science and technology challenges and to guarantee that Malaysia has an adequate number of qualified STEM graduates (Malaysia Education Blueprint, 2013) that further achieved the targeted number of STEM workforce. Teachers play a significant role in delivering effective science knowledge, processes and practice, which further equipped students' various opportunities to apply these processes across many experiences. STEM skills obtained through class activities are the competence to explore, solve problems, designing and producing products (Hafizan, Shahali, Ismail, & Halim, 2016). Teachers and students are required to be creative to encourage higher order thinking skills by using the data they generated from the investigation of how and why phenomena are happening.

Studies have shown that young children are more open to learning and enriched by the experience they gained which will shape their typical cognitive development (Rao, Sun, Wong, Weekes, Shaeffer, & Lee, 2014). Since young children have cognitive capacities that are far beyond, thus promoting science inquiry and learning in the classroom is crucial. The children are required to be active learners and engaged in their learning activities to construct knowledge. Cognitive development happens in the context of the child's interactions with others such as peers, teachers, communities and with the surrounding. Meanwhile, learning is the result of the child's assisted construction of knowledge instead of transmission and absorption from the teachers. Traditional science teaching relied mostly on teachers, textbooks, and teacher-led demonstrations. Various alternative approaches have been encouraged in the teaching of science classroom including inquiry-discovery approach, contextual learning, mastery learning and so on. Students should not be taught directly but should allow them to discover things by themselves through hands-on activities, experimenting and problem-solving.

However, teachers need to give essential support to the students as they are struggling to understand the learning content. This support is known as scaffolding, as defined by Wood, Bruner, & Ross (1976), where learners complete the tasks that are within their range of competence while the components of tasks that are beyond of the learner’s capability are controlled by an adult. Certain topics such as energy, motion, electricity, atomic, molecular structure and others are abstract in nature that include concepts and calculations brings frustration to students if insufficient support were given because they are difficult to learn. Therefore, providing scaffolding for difficult topics are crucial. Their learning process must be guided by a more capable peer or adult to allow them to move through the Zone of Proximal Development (ZPD), (Vygotsky, 1978). As the learner’s abilities to understand the content increased, the scaffolding provided will be withdrawn. By using the scaffolding strategy, the learners will be able to accomplish more complex learning tasks and engage more advance in thinking and problem solving (Bransford, Brown & Cocking, 2000).

1.1 Scaffolding

The term scaffolding was originally used by Bruner (1975) to describe the engagement between a parent with a child or between an instructor with a student, where support given was just enough based on the child ongoing progress. Subsequently, Wood et al. (1976) explained scaffolding as support given by an adult in completing the components of tasks that are beyond the learner's capability and focused only on the components that are within the child competency. Vygotsky (1978) argued that learning happened initially at the social or interindividual level, thus social interactions play a vital role in cognitive development. In his work, Vygotsky introduced the term zone of proximal development (ZPD) which is defined as "distance between the child's actual developmental level as determined by independent problem solving and the higher level of potential development as determined through problem solving under adult guidance and in collaboration with more capable peers" (Vygotsky, 1978, p. 86). Meanwhile, scaffolding in classroom context is described as the temporary assistance provided by teachers to assist their students in completing a task or develop an understanding on new knowledge in order to complete identical tasks independently in the future. Apart from that, scaffolding is viewed as a key component of cognitive apprenticeship, where learners become problem solvers with appropriate assistance from teachers who scaffold students through teaching, tasks and hints, without giving the essential answers (Quintana et al., 2004).

In spite of numerous interpretations and definitions of scaffolding, Van de Pol, Volman & Beishuizen (2010) have recognized three characteristics of scaffolding which include contingency, fading, and the transfer of responsibility.

Contingency. Scaffolding given by teachers is relying on the students' capability and present level of their performance. Puntambekar (2009) opined that contingency is one of the most crucial characteristics of scaffolding since adult or teacher usually performs a continuous assessment on the learner's ongoing progress and offers suitable assistance in the certain tasks that are beyond their ability. Wood (2003) categorized contingency into three types: (i) Instructional contingency which describe the ways to support the learning activities; (ii) Domain contingency which cover the things teacher needs to focus on the next step or next lesson; and (iii) Temporal contingency which relates to the matter of if and when is the perfect time to intervene the support or learning tasks. There are several ways on how to apply contingency support to students in the classroom. One effective way to provide contingent support to the learners is through utilizing ongoing diagnostic approaches. Thus, teachers must fully master the tasks and understand the learners' abilities, together with their learning progress (Puntambekar & Huscher, 2002). After determining the students' current capability, the teacher will continuously monitor each of their learning progress at certain points of time. The continuous monitoring will help the teacher to plan suitable tasks or activities for his or her students for the next lesson. Another way is by applying intervention to the current tasks based on the ability of the student, an advanced student may need more challenging task compared to a weak student, which more simple task is suitable to enable the student to complete the task independently.

Fading. The scaffolding is fading at certain points where the learner will able to attain mastery of the new knowledge or task, solve a problem or achieve the desired goal independently. Fading is important for a successful scaffolding because it enables students to complete the task and prepare them for the similar or advanced task independently in the future. This process is known as Internalization by Vygotsky (1978), which stated that the scaffolding support can be removed whenever the student has internalized the support. However, the level of fading needed is relying on the student's present level of development and capability to complete the task (Van de Pol et al., 2010). This characteristic is closely associated with the third characteristic of scaffolding which is the transfer of responsibility.

Transfer of responsibility. The learner internalizes the new knowledge or skill in order for a change in cognition or effects to occur. As the scaffolding fades over time, learners will gradually improve in their competency until they are able to master their own learning independently. The responsibility of completing a task is transferred slowly from teacher to learner (Van de Pol et al., 2010). A perfect scaffolding will benefit the learners as they internalize the assistance given (Rogoff, 1990). Transfer of responsibility is also directly associated with the learner's mastery on the subject matter and perceptions of self-efficacy.

Forms of Scaffolding

There are three known forms of scaffolding mainly one-to-one, peer, and computer or paper-based scaffolding.

One-to-one scaffolding. Described as the relation of one teacher with one student to continuously assess the present level of the student, allocate the relevant amount of guidance for the student to achieve and acquire skill at the given task, and adjust the guidance as needed until the scaffolding can be fully withdrawn and the student can take responsibility (Belland, 2014; Chi, 1996; Graesser, Bowers, Hacker & Person, 1997; Lepper, Drake and O'Donnell-Johnson, 1997; Van De Pol et al., 2010). This form of scaffolding is believed to be a perfect form of scaffolding that fit the needs of the learner through instructional, domain and temporal contingency. In reciprocal teaching, teachers model the process of summarizing, questioning, explaining and clarifying in reading text passages that guide the students to enhance their reading comprehension and remain stable for a longer period of time (Palincsar & Brown, 1984). By focusing on the four components of readings motivate students to actively involved in the learning process and access reading on a deeper level. Thus, it is a great strategy for students to be responsible for their own learning and thinking. However, one-to-one scaffolding is often not practical when involving a large classroom which consists of 20-30 students.

Peer scaffolding. Involves the support obtained from more capable and knowledgeable peers. Rogoff (1990) declares that peers can be considered as valuable scaffolding agents in terms of providing motivation and encouragement, which are vital elements in a learning context since peers commonly encourage each other to think and contribute ideas. This type of scaffolding can help in a large classroom and is a cost-effective way to scaffold the whole classroom. Students that have different capabilities can assist their peers to enhance their higher-order thinking. Even though peer scaffolding could be beneficial, but sometimes in a certain condition, it also could be undesirable (Rogoff, 1990). For example, when there is a broad gap between their partner's and learner's capability, the partner may not be able to assist the learner to reach their potential if too much or not enough assistance is provided. Similarly, if the students in the classroom are of the same abilities, effective peer scaffolding cannot be provided. In order to nurture effective peer scaffolding, students need to be given an opportunity to engage in peer tutoring and also a framework to assist their delivery of scaffolding. Students should be encouraged to critically access or assist their peers rather than expecting them to automatically engage in peer tutoring without providing the opportunity to do so. As an example, in the *Learning by Design* model (Kolodner et al., 2003), students articulate design ideas in a poster session and require to debate each other's ideas. In this design, it is reported that students performed well on collaboration and also metacognitive skills. Moreover, *Learning by Design* technique also helps average-achieving students to perform better compared to high-achieving students who learned through the traditional method. Apart from that, peer scaffolding needs a clear framework to guide the scaffolding with the correct strategies and to use them when needed (Belland, 2014). Students need to be taught the technique to ask critical thinking questions and frameworks to evaluate their own work as well as others.

Computer or paper-based scaffolding. Involve a computer or paper-based tools that can assist students to engage and obtain skill at tasks that are far beyond their capabilities (Belland, 2014). By using a computer-based tool, students can be guided to solve complex and ill-structured problems. This form of scaffolding is often used in self-contained learning environments, online discussion and as addition to classroom-based instruction. Self-contained environments are made up of an enabling context, resources, scaffolds and tools (Hannafin, Land & Oliver, 1999). As an example, Web-based Inquiry Science Environment (WISE) used by Linn, Clark & Slotta (2003) enable students to explore the problems that are related to the tasks then, scaffolds are provided to assist students to articulate their critical thinking on the possible solutions to the problems. The WISE provide scaffolds that focus on the epistemology of science, and the students need to observe their progress and create predict the results (Lin et al., 1999). Meanwhile, online discussion that integrates computer-based scaffolds also able to promote critical thinking among students. For example, Choi, Land and Turgeon (2005) develop an online argumentation which showed that the scaffolds provide in the system have significantly promoted more problem-solving action and increase the generation of coherent arguments.

Techniques of Scaffolding

It is teachers' responsibility to guide students to become independent learners, even sometimes motivated students are unwilling to be responsible for their own learning. However most teachers usually only give instruction, step back and monitor what their students do, rather than provide scaffolds that guide, continuously assesses the suitability of the instruction over time and gradually remove the responsibility to the students. This technique is known as guided instruction where the teacher provides scaffolding with prompts, cues, and questions through modelling for the students, followed by working together until they are able to become more independent. Later, integrate a collaborative learning feature during the lesson where students are provided with the opportunity to discuss and negotiate among themselves about the task. Finally, the learners will work independently by applying the knowledge that has been learned through the lessons, guided exercise and collaborative work to create new and authentic outcomes. Fisher and Frey (2010) describe the utilization of these scaffolds constitutes the combination of the art and the science of teaching.

Scaffold need to be done when a learner does not show any progress on some stage of a task or unable to understand a certain concept. Literature has revealed various techniques of scaffolding. Ellis and Larkin (1998), as cited in Larkin (2002) outline the steps where scaffolds can be done successfully in a classroom:

First, the teacher does it. The teacher shows or models the way to do a new or difficult task. For example, the teacher demonstrates a process to represent the content that they are expected to perform independently to build their understanding of the content.

Second, the class does it. The teacher and students work together to complete the task. During this stage, the teacher assists the students through prompts and cues to ensure that they are in the correct track.

Third, the group does it. Students collaborate with their partner or in a small group to perform the task. At this point, students are given the opportunity to give ideas and support each other to achieve the goal.

Fourth, the individual does it. This is the point where students work independently without external support. Now, the learning responsibility has been transferred completely to the learner. In the future, the learners will able to perform the same task or skill by themselves.

On the other hand, Silver (2011) reported four general steps to scaffold instruction in a classroom: (1) assess learner's prior knowledge and experience, (2) connect the learning content with students' understanding and capability, (3) chunk the task in a manageable form and provide feedback, and (4) integrate verbal cues and prompts to guide students.

Another techniques developed by Fisher and Frey (2010) for effective scaffolding also involve four steps which are: (1) questioning to assess students understanding, (2) prompting to promote students' cognitive and metacognitive processes, (3) cueing to enable students to pay attention on particular information, error or partial understandings, and (4) explaining and modelling whenever is needed in completing the task.

Despite the diverse techniques to implement scaffolding in learning, the most crucial part is to apply appropriately and continuously depending on the environment, age and capability of the learner and the content or skill to be introduced. These elements are important to make sure the success of the scaffolding.

Implementation of Scaffolding

In present educational practice and research, the interpretation of scaffolding is exceedingly diverse resulting to inconsistent implementation and operationalization of scaffolding metaphor and it "is sometimes used loosely to refer to rather different things" as mentioned by Hammond (2002, p.2). With the growth of project-based and design-based environments for teaching science and mathematics in a classroom context, scaffolding is widely used in describing the prompts and hints given in tools to assist learning (Putambekar & Hubscer, 2005). Hence, scaffolding does not only refer to the interactions between individuals but also involves resources, artifacts and environments themselves which are used as tools to scaffolds. Tools and resources, as well as curriculum and artifacts are needed to assist student learning in the classroom. Linn (1998) suggested that tools and resources are used for showing appropriate features of the activities or approaches and making furtive processes observable that further encourage peer interactions.

According to Wood et al. (1976), there are six types of guidance that an adult can offer: (1) enlisting the child's interest, (2) decreasing the levels of independence by simplifying the task, (3) sustaining direction, (4) stressing the essential task features, (5) managing frustration, and (6) showing the best ways of solution. However, different learners may have different stages of assistance needed over a period of time-based on their learning or cognitive ability. At these different stages of learning progress, different scaffolding methods or strategies are needed. The adult may apply several strategies such as model the best solutions (Wood et al., 1976) or the suitable techniques (Palincsar & Brown, 1984) or supply assorted types of assistance such as providing explanations, promote participation, modelling ideal behavior and supply clarifications (Roehler & Cantlon, 1997). Appropriate sequencing of activities and ideal assistance are crucial in order to challenge as well as to expand students' capabilities. Through participation in such tasks, students are forced to learn beyond their present capabilities and degree of understanding, where learning and internalization of new understanding occur (Burns & de Silva Joyce, 2005). Thus, scaffolding is not only supported by a teacher but through the designed activities to guide learners to work with increasing independence, apply higher order thinking and problem solving so that the new skills or knowledge can be used in different contexts in the future. Effective scaffolding needs clearly articulated aims in line with structures learning activities in order to allow learners to expand their current understanding. The aims for any specific task require to be placed within the wider framework of a planned activity.

1.2 Teaching and Learning of Science

Subject Matter Content Knowledge

Subject knowledge is related to content, process and personal knowledge. Wineburg and Wilson (1991) propose that the representation of a subject matter domain in a classroom context is related to the content knowledge own by the teacher and the way the teacher understand his or her students learning abilities. Deep and rigid subject matter content knowledge is very important in a constructivist classroom which requires an understanding of the structure of discipline and also its epistemological framework. The knowledge guides teachers to design learning tasks that assist students in understanding concepts and hypotheses, in assisting a discussion to develop a shared understanding, offer support on sources for supplementary formal knowledge and correct misconception at the same time.

In science, content knowledge or propositional knowledge is defined as the knowledge of facts, theories and ideas, and understanding of the arranged principles and main contexts of the discipline (Baker, 1994). For example, a study of the human body may involve knowledge of human control systems, their response to stimuli and homeostasis and other forms and functions associated with the human body. This scientific phenomenon is ubiquitous in students' daily life. Even though, students faced with science-related matters in both formal and informal situations, yet systematic and sustained participation with scientific inquiries develop through their educational experiences in school. Classroom instructional quality is vital in expanding students' experiences and prerequisites their learning in an individual's background since it offers the opportunity to methodically assist their domain-specific learning processes and further expands their scientific literacy systematically.

In a constructivism learning environment, the role of a teacher is to enhance content knowledge together with the development of skills and attitudes. Baird (1986) argued that not only curriculum or technology, but teachers also play a crucial role in shaping the future of science education. However, the knowledge in subject matter does not instantly determine the standard of their instruction but is determined by the ways or techniques they employ to teach content knowledge and developing students' experience in certain topics based on the different types of students (Brophy, 1991). Hence, teachers need to know how students perceive their learning in a particular context. As stated by Vygotsky (1978) on the theory of cognitive development, children are believed to actively construct knowledge through their social interaction with skillful individual around them. Teachers need to be aware of their students' progress so that they are able to adjust their ways of delivering content knowledge from time to time.

Constructivist Teaching and Learning

Since teachers play a vital role to develop children learning in a school context, thus the knowledge of specific teaching strategies is another important element to consider in order to enable them making progress in the conceptual understanding of the science content (Smith & Neale, 1989). A constructivist teacher and classroom show several distinct qualities as compared to conventional or direct instruction classroom. Meanwhile, a constructivist teacher manages to creatively adjust current experience in the classroom into debates and construction of knowledge with small groups and individuals. In a constructivist learning environment, the tasks are interactive and student-centered and facilitate by the teacher. Constructivist classrooms are structured to enable learners to immerse in experience within which they engage in meaning-making inquiry, response, creation, imagination, synthesizing and personal reflection. Learning science could be more efficient when taught and learned in contexts where students can make connections between their prior knowledge, the experience gained in the classroom and the new knowledge to be learned. These are needed in order to create a democratic classroom surrounding that offers a meaningful learning experience for the independent learner.

According to Piaget (1977), learning takes place by active construction of meaning by the learners rather than receiving the knowledge passively. When learners face a situation or problem that dispute their present knowledge, a state of disequilibrium or imbalance is produced. During this stage, the learners need to reconstruct their knowledge to restore equilibrium or balance by connecting the new information with their previous knowledge or restructuring them to a higher level of thinking. Thus, constructivist teaching facilitates critical thinking, promote active and motivated learners. However, teachers need to be aware of their students' cognitive development so that they can critically plan or create a curriculum that is contingent on their logical growth. Learning in science subject area requires inventing and constructing new ideas and skills. Seimears, Graves, Schroyer, and Staver (2012) argue that the construction of knowledge is a long-lasting process that occurs at any time, the knowledge that individuals have constructed are meaningful and drives them in interpreting and predicting phenomena in their experiential world. Individuals built their own understanding from their viewing, reflections, and logical thought. After that, constructivists seek to understand their experiential world by arranging their experience through coherence (Staver, 1998). There are two known forms of constructivism which are social constructivism and psychological constructivism. The centre points in social constructivism are the language and the group, meanwhile, in psychological constructivism, the centre points are cognition and the individual itself (Staver, 1998). In other words, social constructivism highlights the significance of culture and language-based social interactions and knowledge at a group level meanwhile, psychological constructivism highlights the significance of cognition in understanding the way individual constructs and applies the knowledge.

Driver (1989) suggest that constructivist-based teaching enable learners to become actively engaged in appropriate real-world matters through step-by-step process : (1) Learners employ previous knowledge to attain numerous solutions in solving science problems, (2) learners share social importance via social interaction in the classroom, (3) science is available to learners at various levels, (4) science can be exciting and interesting for both learners and teachers in the classroom, (5) technology is or can be used in a meaningful way, (6) science is or may be disclosed to a larger audience, and (7) instruction highlights science as inquiry using science process skills. The learning activities are various ranging from simple to complex according to the learning objectives. The learning objectives will guide the teacher to create a meaningful activity. Past studies have shown that students do not come into science instruction without any previous instructional knowledge or ideas on the concept to be taught. Rather, they already possess some ideas or have a misconception on the concept to be introduced to them depending on the abilities or exposure to the concept.

One way of connecting conceptual, procedural and nature of science is by modelling the interactions of theory or evidence and critically investigate the connection between various kinds of outcomes by argumentation (Hipkins et al, 2002). The literacy development in science instruction involves the skill to do observation, prediction, analyzing, summarizing and deliver information in various formats such as oral and written. Low achievement students may need more concrete experiences and opportunities to use language functions in social contexts before they are able to use them academically. Apart from that, hands-on science activities provide more opportunities for language development in a social context that further lead to academic learning, as students enhance capabilities for logic, reasoning and critical thinking that are required for either literacy or science learning (Lee & Fradd, 1998). Through these learning process, the students are encouraged to involve actively in creating new ideas or concepts based on the present and past knowledge. There are various constructivist instruction approaches such as situated learning, collaborative learning, problem-based learning, discovery learning, cognitive apprenticeship, and scaffolding.

1.3 Previous Studies

Effects of using scaffolding on student's achievement

Academic achievement is relating to a student's achievement in accomplishing the short or long term objectives of a learning process that are usually measured in the forms of examinations or ongoing assessment to demonstrate the extent to which the established objectives have been met (Bansal, 2017). The techniques that teachers use when interacting with students commonly will affect students' achievement. Scaffolding can be perceived as part of "contextualized holistic approaches" that emphasize real-world learning activities to achieve the objective where learners can use the knowledge in their daily life (Reiser & Tabak, 2014). In a scaffold learning environment, teachers offer initial guidance in terms of hints, prompts, scripts and so on to manage the sequence of appropriate learning according to learner's responses. From time to time, the learner will get used with the support and begin to handle their own learning process. Contrary to traditional methods, in scaffolding, teachers continuously monitor students' performance along the learning process. If the level of guidance is too little for a student, deep processing could not happen due to the failure of associating the input with his or her prior knowledge. However, if the amount of support suits the students' understanding on the subject matter, the student would have enough cognitive resources to actively process the input given and manage to associate the new input with the previous knowledge in the long-term memory (Wittwer, Nu'ckles & Renkl, 2010).

Scaffolding has been widely used in several studies and has shown a positive outcome in science learning. Two studies done in Nigeria by using scaffolding strategy in science corroborated this. In the study done by Alake and Ogunseemi (2013) on effects of scaffolding strategy on student's academic achievement in integrated science at the junior secondary school found out that students treated by scaffolding techniques performed significantly better compared to those were taught using the traditional method. This study also revealed that students in the urban area were more independent as compared to those in the rural area due to the accessibility to ICT facilities that facilitate their learning. Another study conducted by Omiko (2015) on the impact of instructional scaffolding on students' achievement in chemistry indicate that instructional scaffolding method enhances students learning and achievement better than the conventional method of instruction. A similar trend was reported by Uduafemhe (2015) where students exposed to scaffolding approaches possess high psychomotor achievement in Basic Electronics, one of the vocational courses taught at the upper-level secondary school in Nigeria. In the recent study by Bansal (2017) revealed that students who taught science by scaffolding strategies performed better as compared to those taught by traditional methods based on a significant difference in the mean scores in academic achievement of both groups. Apart from that, students that exposed to different scaffolding strategies showed a positive attitude towards their learning. Van de Pol and Elbers (2013) had done a non-experimental microlevel research that explores the connection between several patterns of contingency (the manipulation of support given based on students' abilities) in a classroom setting. The findings of this study agreed that contingent support was able to increase student understanding resulting in better student achievement in the subject matter.

Choo et al. (2011) have studied the effect of worksheets as a scaffolding tool on students' learning achievement in Biomedical Science-related subject (Immunology) by using a problem-based learning (PBL) environment. However, the findings of this study show that there was no significant difference between the achievement of groups of students treated with worksheet and groups of students treated without a worksheet. The students perceived that the tutor, team and class dynamics are the factor that impacts their learning in a PBL context rather than the worksheets. Another study by Franco-Castillo (2013) indicates that the incorporation of scaffolding using metacognitive strategies enhances students' reading comprehension and science achievement. These findings also reveal that early childhood students benefit from the combination of reading and writing when using authentic materials (science textbooks) in the classroom. Even though the students are able to improve metacognitive awareness according to their maturation, the results suggested the importance of cognitive engagement due to the ability of the students to construct new meaning and apply metacognitive and self-regulatory strategies to make sense of the text. In other study drawn by Rahmani, Abbas, and Alahyarizadeh (2013) to examine the effects of peer scaffolding in inquiry-based games on the inclination towards engagement in double-loop learning and performance in integrated science process skills resulting in a positive improvement on the participants' achievement.

Effects of using scaffolding on student's gender

Gender is defined as the facts of being male or female. The previous studies argue that gender is one of the factors that affect the academic achievement of the student (Gupta, Sharma, & Gupta, 2012; Abubakar & Oguguo, 2011). However, there are several issues raised on this matter. Some studies presumed that male students commonly performed better than female in most subjects area, while some studies reported differently (Maliki, Ngban & Ibu, 2009; Jabor, Machtmes, Kungu, Buntat, & Nordin, 2011). As an example, Omiko (2015) conclude in their findings that male students performed better than their counterparts in chemistry when taught using scaffolding method. Contrary to a study done by Uduafemhe (2015), in which both scaffolding and collaborative methods used in teaching Basic Electronics are not gender biased. Similar trends of findings also have been reported to observe the effects of gender on academic achievement in sciences and other disciplines (Afolabi & Akinbobola, 2009; Abubakar & Bada, 2012; Nwagbo & Obiekwe, 2010; and Ogbuanya & Owodunni, 2013).

However, Gibson, Jardine-Wright and Bateman (2015) concluded that scaffolding preferentially benefits female students in their study when treated with different question structure in physics, the first exam applies greatly scaffolded questions, and the second one applies conventional exam style questions. The results from their study revealed that between the low and high scaffolding styles, female students performed better in exam score by 13.4% as compared to male students who only achieved a gain of 9.0%. The recent study by Dawkins, Hedgeland, and Jordan (2017) reacted to the study done by Gibson et al. (2015) where they identify the questions that show real bias in favor to male students by taking into account of both student achievement level and the level of question scaffolding. They argued that both of the multidimensional context and the usage of diagrams are mainly the components of such questions. In their present study, they used similar analysis but with a larger number of students and more variety of exam content which resulting in the amount of scaffolding cannot sufficiently clarify the gender gap.

The studies reviewed above illustrate a positive trend in the use of scaffolding in learning science. Most studies reported that scaffolding has assisted in students' achievement in diverse science subjects. However, several issues raised on the effects of gender on students' achievement who are taught using scaffolding strategy. Some studies revealed that scaffolding favorably benefits male, while some studies reported the other way round.

1.4 Statement of the Problem

There is a decline of interest in science among the students due to the level of difficulties to excel in the subject (Malaysia, 2016). Moreover, the urban schools perform better by 4 percentage points compared to rural school in the UPSR examination (Malaysia Education Blueprint, 2013). On average, states that consist of more rural schools such as Sabah and Sarawak perform poorer as compared to states with less rural schools. A recent analysis of the academic achievement of pupils for UPSR in 2016 indicates that only 6.8% of candidates scored A in the science subject (Zahrom, 2016). Based on an international study on Trends International Mathematics and Science (TIMMS) in 2015, Malaysian students' performance has a significant improvement compared to the results in 2011 (Malaysia Education Blueprint, 2013). Yet, Malaysia ranking among other countries that participated in the study is still not satisfied. The integration of applied science questions that require the pupils to challenge their cognitive development and higher order thinking skill has contributed to this low ranking. Teachers' use of inappropriate teaching methods especially the traditional method could also be attributed to this performance. Therefore, teachers need to embrace a learner-centered teaching method emphasized on contextualized and constructive processes and further provide pupils with higher-order thinking skills for better adaptability and flexibility.

Literature revealed positive effects of using scaffolding as an approach to strengthen knowledge acquisition in several contexts (Alake & Ogunseemi, 2013; Omiko, 2015; Raes, Schellens, De Wever &Vanderhoven, 2012). In Malaysia, several researchers have studied scaffolding strategy in various disciplines such as in language development (Sidek, 2011), in blended learning to enhance writing (Majid & Stapa, 2017), in journal writing (Veerappan, Suan, & Sulaiman, 2011), and in science and mathematics (Yamat, Maarof, Maasum, Zakaria & Zainuddin, 2011). However, most studies focused on the intervention of learning context with better learning environment, teacher-student interactions, peer interactions and learner's effect toward science learning, but less concern about assessment and gender issues (Lin, Hsu, Lin, Changlai, Yang & Lai, 2012). Hence, the present study mainly aims to investigate scaffolding in learning of science through its impact on achievement among rural students in Bau. Specifically, this study attempts to investigate the effects of scaffolding on pupils' achievement for the topic of energy and to identify if there are any differences in achievement between male and female pupils who are taught using scaffolding and conventional method.

1.5 Research Objectives

The main research objective of this study was to investigate scaffolding in learning of science through its impact on achievement among rural pupils in Bau. Specifically, this study viewed the following research objectives:

1. To determine the effects of scaffolding on pupils' achievement for the topic of energy.

2. To investigate if there is any difference in achievement between male and female pupils who are taught using scaffolding and conventional methods.

1.6 Research Questions

This study was guided by the following research questions.

1. What are the effects of scaffolding strategy on pupils' achievement for the topic of energy?
2. Are there any differences in achievement between male and female pupils who are taught using scaffolding and conventional methods?

1.7 Research Hypotheses

Three null hypotheses tested in the study were:

H_{01}: There is no significant difference between the mean scores of pupils' achievement taught using conventional and those taught science using scaffolding methods.

H_{02}: There is no significant difference between the mean scores of male and female pupils who are taught science using conventional and scaffolding methods.

H_{03}: There is no significant interaction effect of teaching methods used and gender on the mean scores of pupils' achievement.

2. METHODOLOGY

2.1 Research Design

The present study uses 2 (Teaching Method: Scaffolding against Conventional) x 2 (Gender: Male against Female) between-subject design. All of the pupils were pretested and then divided into two groups, the experimental group was taught science (topic of Energy) by scaffolding method through the activities prepared by the researcher as described in the lesson plan (Appendix 4A), while the control group was taught the same topic by the conventional method (chalk and talk based on Year 5 science textbook). The experiment lasted for three weeks from January to February 2019. Each of the group was taught three lessons that consist of three objectives of the topic. Each of the lessons was taught once a week for one hour for each of the control and experimental group. Participants in the control group were taught on every Monday while participants in the experimental group were taught on every Tuesday. All the lessons were taught in the afternoon after school sessions. After that, a post-test was administered to both groups at the same time and the results were analysed. Figure 1 shows the design employed in this study.

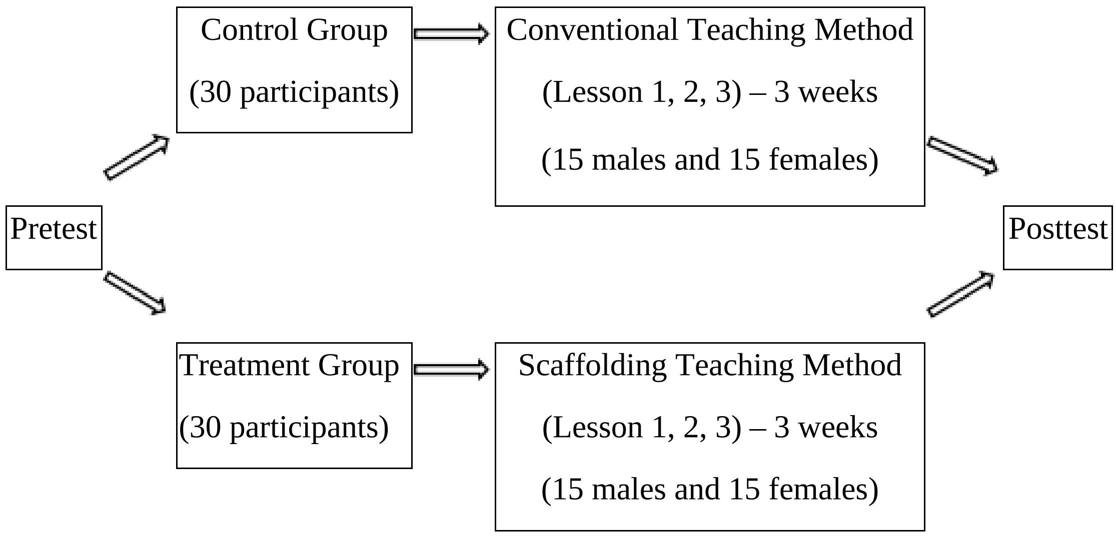

Figure 1 Research design

2.2 Population, Sample and Sampling

The population of the study was consist of all pupils in two classes in Sekolah Kebangsaan Segong, Bau that have not been taught of the topic before. The pupils were in Year 4 and Year 5 class, ages ranged between 10 - 11 years. A sample of sixty (60) pupils was selected from the two classes in the school. The sample was consisting of 30 males and 30 females. Each of the pupils in both classes was further split into both experimental and control groups with mix abilities, age, and gender. The sample for each of the groups was selected based on the preliminary screening by using the pretest results so that each of the groups will have about the same abilities. A simple random sampling technique was applied for the selection. The list of the selected participants in each group was then shown to two science senior teachers for further verification. After some minimal modification on the list of participants in each group, the distribution of the sample was finalized as shown in Table 1.

Table 1

The distribution of the sample according to the groups

Group	Experimental		Control	
Gender	Male	Female	Male	Female
Number of pupils	15 (8:Year 4, 7:Year 5)	15 (8:Year 4, 7:Year 5)	15 (7:Year 4, 8:Year 5)	15 (8:Year 4, 7:Year 5)

2.3 Instrument

The instrument used for data collection in this study was designed by the researcher from the topic of Energy in Year 5 science curriculum perceived to be difficult by pupils. The instrument was later checked by two science senior teachers in the school for verification and suitability. The achievement test was constructed on the topic of Energy based on the standardized UPSR format for science subject. It consists of two sections. Section A consists of twenty (20) multiple choice questions with four (4) answer options (A-D) while section B consists of four (4) structured questions. The achievement test was used as a pre and posttest (Appendix 1). The pretest was used to measure the pupils' level in the topic before the experimentation and to make sure pupils in both groups were at the same level of abilities before starting the experiment. Meanwhile, the post-test was used to investigate the effects of scaffolding on pupils' achievement for the topic of energy. The pretest and the posttest consist of similar contents to prevent any bias due to the contents. The items specification were as presented in Table 2.

Table 2

Table of Items of Specification

Context	Number of question		Total	Percentage
	Objective	Subjective		(%)
Knowledge	7	8	15	45.5
Understanding	6	3	9	27.3
Higher Order Thinking Skills	5	2	7	21.2
Science Process Skills	2	0	2	6.0
Total	20	13	33	100

2.4 Pilot Study

The pupils from the same school that have learned the topic were selected for the pilot study. The number of pupils that participated in the study was thirty one (31) pupils which were selected from Year 5 class of 2018. The main purpose of the pilot study was to determine the reliability of the instruments. The test-retest reliability method was employed to achieve this purpose. The pretest was administered to all of the pupils followed by the post-test which was carried out a week later. The result of the pilot study was analysed using a statistical technique which was the Pearson product-moment correlation coefficient.

2.5 Validity and Reliability

The content validity of the instrument was achieved by distributing it to two experts on the rank of senior science domain teachers from the school. As a result of the review by the experts, it was stated that the content validity of the achievement test has been provided and suitable for the purpose and the level of the pupils' chosen. The test has been made ready after minor corrections on some of the questions has been done by taking the suggestions in the result of the review.

The data collected from the pilot study was used for the computation of the reliability of the instruments (pre and posttest). The output obtained from a Pearson product-moment correlation coefficient indicated a strong, positive relationship between the pretest and posttest (r=0.947, p<0.05). The reliability coefficient indicates that the instrument is acceptable for the purpose of the study.

2.6 Ethics of the Study

Permission from the management of the school, students and parents involved was obtained before this study was carried out. Informed consent forms were distributed and signed by the parents of the students if they agreed to take part in the study (Appendix 2). They were brief thoroughly about the purpose of the study and the risks that may arise. Approval letters for application to conduct research in the school were obtained from the Ministry of Education and Sarawak State Education Department (Appendix 3).

2.7 Data Collection Procedure

The instrument was administered by the researcher to the two groups simultaneously. The respondents answered the questions to the best of their knowledge. The answers of the instrument were marked by the researcher in order to minimize deviation and to bring uniformity. For multiple questions, one mark was awarded for each correct answer, while no mark awarded for the incorrect answer. For subjective questions, marks were awarded according to the pupil’s answers and marks allocation. Total of scores obtained for each of the tests was converted to a percentage. The data collected were used to analyse and answer the research questions and as well as to test the hypotheses that guided this study.

2.8 Lesson Plan

Two (2) sets of lesson plans were prepared for teaching the topic of Energy which was selected for this research. Each set consists of three lesson plans that were used to teach the pupils to learn the sources and forms of energy as stated in the content standard in ‘Dokumen Standard Kurikulum dan Pentaksiran’ for Year 5 science. Each lesson lasted for 60 minutes (double period). This research spanned over a period of three weeks. One set of the lesson plans were prepared based on the scaffolding technique to teach experimental group throughout all the stages of the treatment period (Appendix 4A). The scaffolding instruction employed in this study has four stages as described by Fisher & Frey (2010) in a structure for effective instruction which were focus lesson, guided instruction, collaborative work and independent work. The scaffolding approach and activities used throughout the lessons follow the following steps:

Step 1: Preparatory activities: It refers to assessing previous knowledge possess by the pupils through discussion or questioning.

Step 2: Motivation: Introducing the topic through various media representations to arouse the pupils’ interest.

Step 3: Presentation of the lesson: Pupils were taught about the learning contents through various media representations. This stage is known as focus lesson, where the teacher was focusing on delivering the learning content. Then, several questions were asked after the explanation in order to provide opportunities for the pupils to verbalize their thought.

Step 4: Modelling: Teacher first model the task for pupils, the pupils begin the task and worked through the task in a group. At the beginning of the task, the teacher guides the pupils to work on the task by giving an example. During this stage which is known as guided instruction, the teacher provides scaffolding with prompts and cues when the pupils make mistakes. As they become more independent, the teacher gradually transferred the responsibility to the pupils to complete the task with their group members (Collaborative work).

Step 5: Enrichment activity: Pupils completed the worksheet individually. During this stage (Independent work), the learning responsibility was transferred completely to the pupils. They completed the task without support from the teacher or their peers.

The other set of the lesson plans were prepared based on conventional technique (chalk and talk based on Year 5 science textbook) to teach control group throughout all the stages of the treatment period (Appendix 4B). The conventional technique involved two stages which were focused instruction and independent learning, as described by Fisher & Frey (2010) in a structure for ineffective instruction. The conventional technique and activities used throughout the lessons follow the following steps:

Step 1: Opening activity: Introducing the topic by using the pictures in the textbook. Several questions were asked about the pictures.

Step 2: Lesson delivery: Pupils read the information on the textbook and the teacher explained the details. During this stage of focused instruction, the teacher was focusing on delivering the facts and learning contents. Then, several questions were asked after the explanation.

Step 3: Enrichment activity: Pupils completed the worksheet individually. During this independent learning, pupils were expected to apply the facts and learning contents that have been taught in completing the individual task.

All of the lessons for both of the groups were carried out by the researcher. This step was chosen to control any other unwanted factors related to the differences in the teachers that will affect the results.

2.9 Data Analysis Procedure

The data collected for this research were analysed using mean statistics and two-way analysis of variance (ANOVA) using Statistical Package for the Social Science (SPSS) version 22. Mean statistics were used to answer the two research questions of the study. The null hypotheses were tested using two-way between-groups ANOVA at a level of significance of 0.05. Two-way between-groups ANOVA was considered suitable for the purpose of this study to compare the mean differences between the groups which have been split on two independent variables (teaching methods and gender). It was also used to determine if there is an interaction between the independent variables on the pupils' achievement.

3. RESULTS

The results were presented in both descriptive and inferential analysis based on the research questions and hypotheses that guided this study.

Table 3

Summary of Two-Way ANOVA for test of significance of three effects: Teaching method, gender and interaction on pupils' achievement in science

Tests of Between-Subjects Effects

Dependent Variable: Posttest

Source	Type III Sum of Squares	*df*	Mean Square	*F*	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[b]
Corrected Model	924.067[a]	3	308.022	1.790	.160	.088	5.370	.441
Intercept	68141.400	1	68141.400	395.985	.000	.876	395.985	1.000
Method	735.000	1	735.000	4.271	.043	.071	4.271	.528
Gender	129.067	1	129.067	.750	.390	.013	.750	.136
Method * Gender	60.000	1	60.000	.349	.557	.006	.349	.089
Error	9636.533	56	172.081					
Total	78702.000	60						
Corrected Total	10560.600	59						

a. R Squared = .088 (Adjusted R Squared = .039)

b. Computed using alpha = .05

3.1 Research Question and Hypothesis Testing One

RQ_{01}: What are the effects of scaffolding teaching method on pupils' achievement for the topic of Energy?

H_{01}: There is no significant difference between the mean scores of pupils' achievement taught using conventional and those taught science using scaffolding methods.

The data in Table 3 shows the two-way ANOVA result used to analyse the significance of three effects which are the teaching method, gender and interaction on pupils' achievement in science. The *F*-calculated value for the teaching method was 4.271 with a significance of *F* at 0.043 which was less than 0.05. This result indicates that there was a significant difference between the mean scores of pupils' achievement when taught using conventional and scaffolding teaching method. Therefore, the null hypothesis was rejected at 0.05 level of significance, $F(1,56)=4.271$, $p=0.043$. Further examination of the descriptive statistics of mean scores of pupil's achievement in posttest for both teaching methods in science learning showed that pupils taught using scaffolding method ($M=37.20$) performed better than pupils taught using conventional method ($M=30.20$).

Table 4

Mean description of scaffolding strategy on pupils' achievement for the topic of Energy

Group	*n*	Mean Pretest	Mean Posttest	Mean Gain
Control Group	30	22.63	30.30	7.67
Experimental Group	30	22.27	37.20	14.93

Table 4 indicates that the control group (group treated with conventional teaching method) had a pretest mean of 22.63 and posttest mean score of 30.30. These scores gave a mean gain of 7.67. Meanwhile, the experimental group (group treated with scaffolding teaching method) had a pretest mean score of 22.27 and posttest mean score of 37.20. These scores gave a mean gain of 14.93. These results indicate that there was a distinct mean difference of 7.26 exist between the experimental and the control group. With these mean difference, the experimental group pupils outperformed their counterparts in the control group. Thus, this proved that scaffolding teaching method is more effective than the conventional teaching method to improve pupils' performance in science subject.

3.2 Research Question and Hypothesis Testing Two

RQ_{02}: Are there any differences in achievement between male and female pupils who are taught using scaffolding and conventional methods?

H_{02}: There is no significant difference between the mean scores of male and female pupils who are taught science using conventional and scaffolding methods.

The *F*-calculated value for gender as shown in Table 3 was 0.750 with a significance of *F* at 0.390 which was more than 0.05. This result shows that there was no significant difference between the mean scores of male and female pupils' achievement when taught using conventional and scaffolding teaching method. Therefore, the null hypothesis was accepted at 0.05 level of significance, $F(1,56)=0.750$, $p=0.390$. The mean scores of pupils' achievement in the posttest were not much varied between male and female pupils taught using conventional and scaffolding teaching method in science learning.

Table 5

Mean description of gender on pupils' achievement for the topic of Energy using conventional and scaffolding teaching method

	Conventional Teaching Method				Scaffolding Teaching Method			
Gender	*n*	Mean Pretest	Mean Posttest	Mean Gain	*n*	Mean Pretest	Mean Posttest	Mean Gain
Male	15	23.13	27.73	4.6	15	21.93	36.73	14.8
Female	15	22.13	32.67	10.54	15	22.60	37.67	15.07

Table 5 indicates that male pupils taught using the conventional teaching method had a pretest mean score of 23.13 and posttest mean score of 27.73, while female pupils had a pretest mean score of 22.13 and posttest mean score of 32.67. These scores gave a mean gain difference of 4.6 for male and 10.54 for female pupils who were taught using the conventional teaching method. This result indicates that female pupils performed better than male pupils when taught using the conventional method. On the other hand, male pupils taught using the scaffolding teaching method had a pretest mean score of 21.93 and posttest mean score of 36.73, while female pupils had a pretest mean score of 22.60 and posttest mean score of 37.67. These scores gave a mean gain difference of 14.8 for male and 15.07 for female pupils who were taught using the scaffolding teaching method. These results reveal that male and female pupils taught using the scaffolding teaching method had a higher mean gain score in their achievement test as compared to the pupils who were taught using the conventional teaching method. However, the mean gain difference between male and female pupils when taught using the scaffolding method did not show much difference which was 0.27.

3.3 Hypotheses Testing Three

H_{03}: There is no significant interaction effect between teaching methods used and gender on the mean scores of pupils' achievement.

The *F*-calculated value for the interaction of teaching method and gender as illustrated in Table 3 was 0.349 with a significance of *F* at 0.557 which was more than 0.05. This result implies that there was no significant interaction effect of teaching methods exposed to pupils on their gender according to their mean scores on the posttest. Thus, the null hypothesis was accepted at 0.05 level of significance, $F(1,56)=0.349$, $p=0.557$. In conclusion, there was no interactive effect between teaching methods and gender on pupils' achievement in science as both male and female pupils' performance were almost at the same level.

4. DISCUSSION

4.1 Effects of scaffolding on pupils' achievement

The analysis of the result in Table 4 was concerned with the mean description of scaffolding on pupils' achievement as compared to the conventional teaching method. It was confirmed by statistical analysis using two-way ANOVA in Table 3 which indicates that there was a significant difference between the mean scores of pupils' achievement taught with scaffolding teaching method. The finding indicated that pupils taught with scaffolding teaching method performed much better than pupils taught with conventional teaching method. This study implies that instructional scaffolding is effective for improving pupils' achievement in science particularly. This result agrees with studies conducted by Alake & Ogunseemi (2013) and Omiko (2015) whose reported that students exposed to scaffolding have better performance than their counterparts that did not receive appropriate support in their learning. The assistance provided by the teacher in this study was on a just appropriate basis to challenge the pupils so that they will actively process the learning content and connected it with the learning activities. The pupils in the experimental group in this study not only received support from the teacher but also from their peers when completing the group work.

Peer scaffolding is one of the important forms of scaffolding that induced in this study to enable the pupils to support each other in completing the task given. This form of scaffolding is a cost-effective way to scaffold pupils, especially in a large classroom. Pupils that possess different abilities can help their peers to enhance their higher-order thinking. Vygotsky (1978) opined that learning happened initially at the social or interindividual level, hence social interactions are important for cognitive development. However, teachers need to encourage and provide an opportunity for pupils to take part in peer tutoring. For instance, Kolodner et al. (2003) discovered that in their study of *Learning by Design* model, students performed better on collaboration and metacognitive skills as they need to articulate their idea in a poster session and debate on their peers' ideas. The tasks introduced to the pupils in the treatment group enable them to challenge and apply the knowledge that they received during the lesson. Burns & de Silva Joyce (2005) mentioned that through participation in appropriate sequencing of activities and tasks supported with ideal assistance, students are stimulated to learn beyond their current abilities involving internalization of new knowledge.

Apart from the integration of collaborative learning, the pupils in the treatment group also exposed to various resources that assist their learning such as media presentations and videos in contrast with pupils in control group which learned only through the textbook. Different types of resources are used to represent ideas and concepts which act as scaffolding tools. Linn (1998) mentioned that tools and resources are useful to demonstrate related features of the contents or activities in assisting students' understanding and make furtive processes to be more observable. It also can improve students' engagement and therefore increase knowledge retention as they are actively participating in the learning.

Another element of scaffolding implemented in this study that may attribute to better achievement among the pupils as compared to the conventional teaching method is modelling. The tasks are demonstrated and modeled first before transferring the responsibility to the pupils. This technique is known as guided instruction, one of the four stages opined by Fisher & Frey (2010) in a structure for effective instruction. The modelling process can assist the pupils to represent the ideas and possible outcome from the tasks given. It also used to motivate pupils to model their thought process and carry out the tasks that are beyond their capabilities. Teacher gives essential support to the pupils as they struggling to make sense of the tasks with the learning content. Concepts that are abstract in nature can bring frustration to pupils if sufficient supports are not provided. Wittwer, Nu’ckles & Renkl (2010) stated that when the amount of support given is enough to fits the students’ understanding on the subject matter, they would have enough cognitive resources to process the knowledge given and able to associate them with their prior knowledge.

Therefore, the difference observed between the scores of the experimental and control group is a result of the scaffolding teaching method being more effective in increasing pupils’ achievement in science compared to the conventional teaching method.

4.2 Effects of scaffolding on pupils’ gender

The data presented in Table 5 was focused on the mean description of gender on pupils’ achievement treated with the conventional and scaffolding teaching method. The finding indicated that female pupils who were taught using the conventional teaching method performed slightly better than male pupils. However, both male and female pupils that were taught using the scaffolding teaching method did not show much difference in their mean scores gain in the posttest. This was supported by the statistical analysis using two-way ANOVA in Table 3 which implies that there was no significant effect of gender on pupils’ achievement either taught using conventional or scaffolding teaching method. These results inferred that both of the teaching methods are not gender bias to improve pupils’ achievement in learning science subject. This is due to the pupils learning ability is not affected by gender.

This result is in line with the study done by Uduafemhe (2015) which reported that students that exposed to scaffolding in teaching subject like Basic Electronics are not gender biased. Several other works that conducted on the effects of gender on pupils' achievement in science and other subjects also reported the same trend (Afolabi & Akinbobola, 2009; Abubakar & Bada, 2012; Nwagbo & Obiekwe, 2010; and Ogbuanya & Owodunni, 2013). Regarding the interaction of the teaching method and gender, the results in the analysis of data revealed that there was no significant interaction between teaching method and gender on pupils' achievement in science subject. These results concluded that when male and female pupils were taught with two different teaching methods by the same teacher, their academic achievement will not differ significantly. This shows that classroom instructional approaches and teacher-student's interaction during the learning process will affect the performance of both male and female pupils. However, the result of this study proves that there is no influence of teaching methods on male and female pupils' academic achievement in science subject. This finding suggested that gender differences only had minimal influences on pupils' understanding towards the learning content.

5. Conclusion

It is important to discover the most suitable instructional approach to assist the development of science education through academic activities, motivate and sustain students' interest in science particularly. Building students' interest is the main key to be successful in academic performance in any discipline. Hence, this study aims to investigate the impact of scaffolding as compared to conventional teaching method on pupils' achievement in learning of science among primary school pupils in Bau, Sarawak. The results of this study indicated that scaffolding teaching method is more effective to increase pupils' academic achievement in science subject than a conventional teaching method. Another finding found out in this study was that pupils' achievement does not influence by gender. Pupils perceived better performance in science when taught using a scaffolding teaching method regardless of gender. These results indicated that scaffolding teaching method is feasible to be implemented for science subject. It can improve the achievement of academic aims and effective to motivate students to pursue their learning actively. Hence, educators are recommended to shift from the traditional methods and choose to take up the method that relies on support and assistance to improve students’ achievement in science.

6. Implications

The results of this study offer several pedagogical implications to educators and students. Even though instructional scaffolding has been used in teaching for years, however appropriate scaffolding activities need to be carefully planned. It allows students to take part in advanced activities and promote critical thinking and problem-solving skills. This can only be accomplished with suitable support from teachers and more capable peers. Teachers need to know when and how much assistance should be provided depending on the aim of the lesson and must help the students to move from their ZPD to achieve more advanced knowledge. Scaffolding is provided only when needed and it should be gradually released when the students are able to independently perform the task given. The responsibility will be now transferred to the students to enable them to solve similar tasks or problems in the future. A good teacher will furnish students with an explicit explanation, modelling and scaffolding to assist students to mental model the learning content. successfully.

Science teachers particularly need to strengthen their pedagogical content knowledge in order to develop a thorough understanding of the learning content to guides them to design learning activities that are suitable for their students of various abilities. Prior knowledge of the students needed to be accessed before proceeding to the new knowledge to enable students to make connections between the knowledge. Teachers must alert with their students' development and abilities so that they can alter the techniques of delivering the content knowledge accordingly. When implementing collaborative work, students must be assigned to each group based on their abilities. Each group needs to have members with different abilities in order to promote peer scaffolding. During collaborative learning, students are provided with an opportunity to exchange ideas and assist each other through questioning and prompting. Provide appropriate feedback also crucial to encourage students to develop their thinking process during the lesson.

It is proven that teacher who integrate scaffolds in their teaching and learning process is able to improve students' achievement, especially in science. Students are able to maximize their potential through the scaffolding activities and promote their higher order thinking skills to complete the tasks given. Scaffolding motivates students to take part actively in the learning session and encourage them to pursue their learning and complete the tasks. This is because of the assistance given to them is based on their progress and potential zones. The type and level of scaffolding are depending on the learning contents, the difficulty level of the task, requirements and interest of the students and opportunities. Students learn more effectively when they are given necessarily support by a teacher compared to when learning without any assistance which can bring frustration to the students, especially low achievers. There should be a positive interaction between teachers and students.

Scaffolding can help in the development of science education through the recommended strategy implemented in this study. It does not only contribute to increase the achievement of the students but also helps in choosing the best ways to enhance problem-solving and higher order thinking skills. Teachers must able to adjust their teaching strategy to suit the students and prepare them with the needs of the economy driven era. This study has presented several scaffolding activities and steps to implement proper assistance to students especially in a large classroom with different abilities.

Policy maker should take note that the curriculum should fit students' needs, abilities and interests. The findings of this study show that scaffolding is one of the suitable techniques that suited students, especially in rural school. Appropriate assistance should be given until the students are able to master the knowledge and work independently in the future. This can also build students' interest in pursuing their study in science stream. By using various media representation, modelling and integrating collaborative work in learning of science not only can motivate students but also enhance their understanding of the learning content.

7. Recommendations

Based on the results of this study, there are a few recommendations addressed. These recommendations may be beneficial for the development of science education.

7.1 Making teachers aware of scaffolding teaching method

Even though scaffolding is not a new strategy in teaching, but most teachers did not aware of the importance of appropriate ways to implement scaffolding in their teaching and learning process. Thus, this method should be introduced comprehensively among teachers in teaching institutions and schools.

7.2 Encourage teachers to shift from conventional teaching method

Teachers should vary their teaching approaches based on the abilities of the students. Various resources should be used in the classroom instead of 'chalk and talk' and textbooks only.

7.3 Curriculum developers should enrich the curriculum with a scaffolding strategy

Curriculum developers should integrate a significant amount of instructional scaffolding in the curricula and textbooks based on the abilities of the students, ranging from low to high achievers. A detail guide module for teachers will help teachers to properly plan their teaching and learning activities that assist their students to learn best.

7.4 Integrate peer scaffolding to ease teachers' role in a large classroom

Social interaction is crucial to encourage students to communicate among each other and promote critical thinking skills and problem-solving skills in completing the tasks given. They are encouraged to give ideas and debate the ideas until all the group members agree on the final solution. By assembling the group members of different abilities will enable them to learn from each other. For example, high achiever students can assist the less capable members in completing the assigned tasks.

7.5 Conduct training workshops on proper scaffolding strategy for teachers

These workshops aim to introduce appropriate scaffolding techniques with different skills according to students' abilities, interests and needs in science learning. Teachers that properly trained will be more knowledgeable and motivated to adopt this strategy in their teaching and learning process.

8. Limitations of The Study

There are several numbers of limitations observed during conducting this study. First, due to the limitation of sample size of Year 5 pupils in the selected school, the control and treatment group were consist of two different classes of different age and abilities (Year 4 and Year 5). This limitation may be the reason for their poor performance in the test instrument. Second, this study employed a case study method conducted in one primary school located at a rural area in Bau, Sarawak. Thus, the findings of this study may not be generalizable to other study treated under the same conditions.

Another limitation is that the classes were conducted after school session thus, the pupils were exhausted and affect their feedback during the activities. Some of the day pupils did not attend all of the class sessions, which in turn may affect their performances. Moreover, the school environment and other ongoing activities in the school compound may affect the pupils' attention in the lesson.

Furthermore, the three class sessions for each of the group were conducted in a long time span which was three weeks; each of the session was conducted once a week. This challenge may also affect their performance in the posttest. Lastly, limited resources (for example; LCD projector for the experimental group, textbooks for the control group) were another challenge that affected the study and the flow of activities that have been planned.

9. Suggestions for Future Study

There are a few suggestions for researchers of the similar interest to be conducted in the future.

9.1 Utilizing a qualitative method of research

Qualitative method is recommended in the future studies to provide an in-depth understanding on the impact of scaffolding on students' behavior, interactions and motivation towards learning of science.

9.2 Study the impact of scaffolding among students from rural and urban school

The impact of scaffolding between students from these two different locations is worth to study to investigate its influence on students' performance. The findings from this study will surely benefit the practitioners in the education field.

9.3 Use a larger sample size from different schools

Larger sample size should be selected from several schools of a different zone. Each of the selected schools is divided into two groups which are control and experimental group in order to provide a more insightful comparison of the impact of scaffolding on students' performance, particularly in science.

9.4 Employ different forms of scaffolding such as one-to-one and computer-based scaffolding

Other forms of scaffolding (instead of peer scaffolding) can be employed to investigate their impact on students' learning and performance. Through this study, the practitioners are able to compare and identify the best forms of scaffolding that suit their students.

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APPENDICES

APPENDIX 1 : INSTRUMENT (PRETEST/POSTTEST)

Mark:
Markah:

PRETEST / POSTTEST
UJIAN PRA / UJIAN PASCA

SCIENCE
SAINS

TOPIC : ENERGY
TOPIK : TENAGA

ONE HOUR (1 HOUR)
SATU JAM (1 JAM)

DO NOT OPEN THIS QUESTION PAPER UNTIL INSTRUCTED TO DO SO
JANGAN BUKA KERTAS SOALAN SEHINGGA DIBERITAHU

Instructions:
***Arahan*:**

1. This question paper consists of **20** multiple choice questions and **4** subjective questions.
   Kertas soalan ini mengandungi **20** *soalan objektif dan* **4** *soalan subjektif.*
2. Answer **all** of the questions
   Jawab ***semua*** soalan.
3. For section A, each of the questions followed by four answer options, **A, B, C** and **D**. Choose **one** answer only for each question. Circle your answer option.
   Bagi bahagian A, *tiap-tiap soalan diikuti oleh empat pilihan jawapan,* **A, B, C** dan **D**. *Bagi setiap soalan, pilih* ***satu*** *jawapan sahaja. Bulatkan jawapan pilihan kamu.*
4. For section B, answer all the questions on the spaces provided.
   Bagi bahagian B, jawab pada tempat yang telah disediakan.

   Name / Nama: …………………………………….

   Class / Kelas: ……………………………………..

   Date / Tarikh: …………………………………….

This question paper consists of 11 printed pages excluding the front page
Kertas soalan ini mengandungi 11 halaman bercetak tidak termasuk muka hadapan

SECTION A

BAHAGIAN A

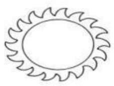
1 What is the meaning of energy?
Apakah yang dimaksudkan dengan tenaga?

A The ability to work
Kebolehan untuk melakukan kerja
B Object that can be seen by the eye
Objek yang boleh dilihat oleh mata
C Energy produced by a friction
Tenaga yang dihasilkan daripada geseran
D Tools that are produced and destroyed by humans
Peralatan yang dihasilkan dan dihapuskan oleh manusia

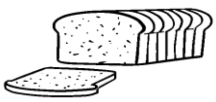
2. Which of the following produces light energy and heat energy only?
Yang manakah antara berikut menghasilkan tenaga cahaya dan tenaga haba sahaja?

A Television
Televisyen
B Radio
Radio
C Candle
Lilin
D Fan
Kipas

3 Which of the following gives energy for carrying out work?
Manakah antara berikut memberikan tenaga untuk menjalankan aktiviti harian?


A


B


C

D

4 Which of the following uses wind as its source of energy?
Yang manakah menggunakan angin sebagai sumber tenaga?

A Lorry / *Lori*
B Cooking stove / *Dapur memasak*
C Battery / *Bateri*
D Kite / *Layang-layang*

5 Which of the following are classified as fuels?
Yang manakah antara berikut dikelaskan sebagai bahan api.

A Sun and Wind / *Matahari dan Angin*
B Petroleum and Coal / *Petroleum dan Arang*
C Wind and Natural gas / *Angin dan Gas asli*
D Sun and Dry cell / *Matahari dan Sel kering*

6 Diagram 1 shows a group of objects that contain chemical energy.
Rajah 1 menunjukkan sekumpulan objek yang mengandungi tenaga kimia?

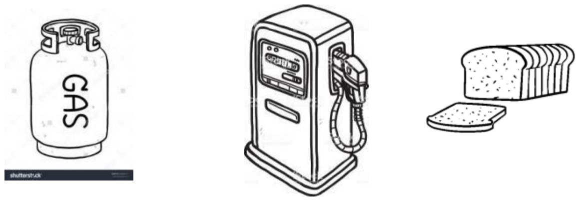
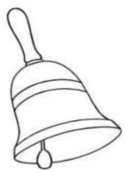


Diagram 1 / *Rajah 1*

Which of the following can be classified into this group?
Yang manakah antara berikut boleh dikelaskan dalam kumpulan ini?

A Battery / *Bateri*
B Solar cell / *Sel suria*
C Bulb / *Mentol*
D Windmill / *Kincir angin*

7 Which of the following have potential energy?
Yang manakah antara berikut mempunyai tenaga keupayaan


W


X

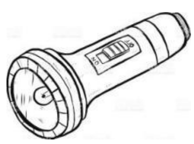

Y


Z

A W and X / *W dan X*
B X and Z / *X dan Z*
C Y and Z / *Y dan Z*
D W and Y / *W dan Y*

8 Which of the following objects uses solar energy to function?
Manakah antara objek berikut menggunakan tenaga suria untuk berfungsi?


A


B


C


D

9 When an electric kettle is used, the electrical energy changes into …
Apabila cerek elektrik digunakan, tenaga elektrik akan berubah kepada…

A Kinetic energy / *Tenaga kinetik*
B Heat energy / *Tenaga haba*
C Solar energy / *Tenaga suria*
D Chemical energy / *Tenaga kimia*

10 Diagram 2 shows an appliance.
Rajah 2 menunjukkan satu pekakas elektrik.

Diagram 2 / *Rajah 2*

Which of the following appliances has the same transformation of energy as this appliance when it is being used?
Manakah antara pekakas berikut mempunyai perubahan tenaga yang sama seperti pekakas di rajah 2 apabila yang digunakan?

A Rice cooker / *Periuk nasi*
B Water heater / *Pemanas air*
C Electric fan / *Kipas elektrik*
D Computer / *Komputer*

11 Diagram 3 shows a car used in a race .
Rajah 3 menujukkan kereta digunakkan pada perlumbaan.

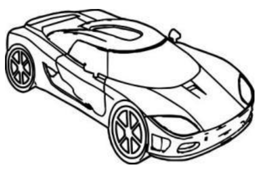


Diagram 3 / *Rajah 3*

What is the transformation of energy that occurs?
Apakah perubahan tenaga yang berlaku?

A Electrical energy → light energy ＋heat energy
Tenaga elektrik → tenaga cahaya ＋tenaga haba
B Chemical energy → electrical energy ＋kinetic energy ＋ sound energy
Tenaga kimia → tenaga elektrik ＋tenaga kinetik ＋ tenaga bunyi
C Electrical energy → kinetic energy ＋light energy
Tenaga elektrik → tenaga kinetik ＋tenaga cahaya
D Kinetic energy → electrical energy ＋light energy ＋ heat energy
Tenaga kinetik → tenaga elektrik ＋tenaga cahaya ＋ tenaga haba

12 Diagram 4 shows a home appliance?
Rajah 4 menunjukkan satu perkakas di rumah?

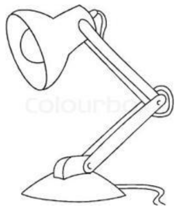


Diagram 4 / *Rajah 4*

Which home appliance uses similar energy as the appliance above?
Manakah antara alat berikut menggunakan tenaga yang sama seperti alat di atas?

A Candle / *Lilin*
B Pot / *Periuk*
C Fan / *Kipas*
D Telephone / *Telefon*

13 Diagram 5 shows pupils of Year 5 Cerdik and their teacher pitching a tent in a jungle?
Rajah 5 menunjukkan murid-murid Tahun 5 cerdik dan gurunya sedang mendirikan khemah di hutan?

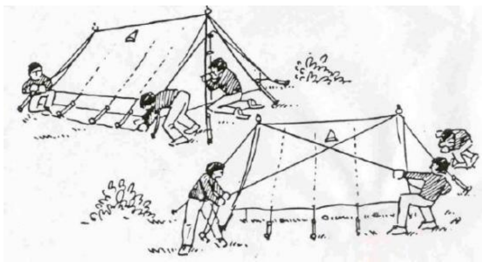


Diagram 5 / *Rajah 5*

What source of heat energy is the most appropriate for heating up their body at night?
Apakah sumber tenaga yang paling sesuai digunakan untuk memanaskan badan mereka pada waktu malam?

A Lighter / *Pemetik api*
B Torchlight / *Lampu suluh*
C Light bulb / Lampu m*entol*
D Camp fire / *Unggun api*

14 Diagram 6 shows an activity done by Shahril?
Rajah 6 menunjukkan satu aktiviti yang dilakukan oleh Shahril?

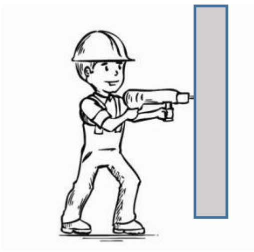


Diagram 6 / *Rajah 6*

Which energy changes is correct for the activity above?
Manakah perubahan tenaga yang betul untuk aktiviti di atas?

A Kinetic energy →Sound energy
Tenaga Kinetik → Tenaga bunyi

B Electrical energy → Kinetic energy ＋Sound energy
Tenaga elektrik → Tenaga kinetik ＋Tenaga bunyi

C Chemical energy → Kinetic energy ＋Heat energy
Tenaga kimia → Tenaga kinetik ＋Tenaga haba

D Electrical energy → Heat energy ＋Sound energy
Tenaga elektrik → Tenaga haba ＋Tenaga bunyi

15 Diagram 7 shows an electrical device.
Rajah 7 menunjukkan satu alat elektrik.

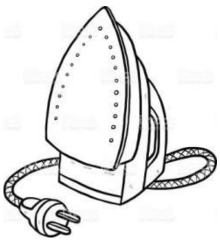


Diagram 7/ *Rajah 7*

Which of the following device has the same transformation of energy as the device above?
Manakah antara alat berikut berikut mempunyai perubahan tenaga yang sama seperti aat di atas?

A Radio / *Radio*
B Microwave / *Ketuhar*
C Washing machine / *Mesin basuh*
D Computer / *Komputer*

16 The diagram below shows two sources of energy.
Rajah di bawah menunjukkan dua sumber tenaga.

X *Y*

Which energy source that can be classified as same as X and Y?
Sumber tenaga manakah yang boleh dikelaskan sama dengan X dan Y?

	X	*Y*
A	*Biomass / Biojisim*	*Sun / Matahari*
B	*Battery / Bateri*	*Fossil fuel / Bahan api fosil*
C	*Water / Air*	*Battery /Bateri*
D	*Fossil fuel / Bahan api fosil*	*Food / Makanan*

17 The following information is about three sources of energy.
Pernyataan berikut ialah maklumat tentang tiga sumber tenaga.

Q -Primary source of energy / Sumber tenaga utama
R - Burned organic material / Bahan organik yang dibakar
S - Produce kinetic energy / Menghasilkan tenaga kinetik

Which of the following, represent Q, R and S?
Antara yang berikut, yang manakah mewakili Q, R dan S?

	Q	**R**	**S**
A	Sun / *Matahari*	Biomass / *Biojisim*	Wind / *Angin*
B	Food / *Makanan*	Fossil fuel / *Bahan api fosil*	Water / *Air*
C	Nuclear / *Nuklear*	Sun / *Matahari*	Food / *Makanan*
D	Fossil fuel / *Bahan api fosil*	Food / *Makanan*	Nuclear / *Nuklear*

18 The diagram below shows an activity carried out by a boy.
Rajah di bawah menunjukkan satu aktiviti yang dijalankan oleh seorang budak lelaki.

What is the transformation of energy involved in the activity above?
Apakah perubahan bentuk tenaga yang terlibat dalam aktiviti di atas?

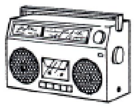
A Chemical energy →Sound energy
Tenaga Kimia → Tenaga elektrik
B Chemicall energy → Electrical energy
Tenaga Kimia → Tenaga kinetik
C Chemical energy → Kinetic energy →Electrical energy
Tenaga kimia → Tenaga kinetik →Tenaga elektrik
D Chemical energy → Eletrical energy →Kinetic energy
Tenaga kimia → Tenaga elektrik →Tenaga kinetik

19 The diagram shows a coconut falling to the ground.
Rajah di bawah menunjukkan sebiji buah kelapa jatuh ke tanah.

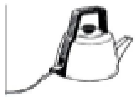
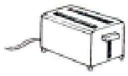
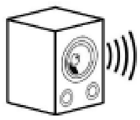
What is the transformation of energy involved in the activity above?
Apakah perubahan bentuk tenaga yang berlaku?

A Wind energy →Kinetic energy → Sound energy
Tenaga Angin → Tenaga kinetik → Tenaga bunyi
B Potential energy → Kinetic energy → Soundl energy
Tenaga Keupayaan → Tenaga kinetik → Tenaga bunyi
C Solar energy → Chemical energy →Potential energy
Tenaga suria → Tenaga kimia →Tenaga keupayaan
D Chemical energy → Potential energy →Kinetic energy
Tenaga kimia → Tenaga keupayaan →Tenaga kinetik

20 The diagram shows two types of electrical devices, M and N.
Rajah di bawah menunjukkan dua jenis perkakasan elektrik M dan N.

M	N
	

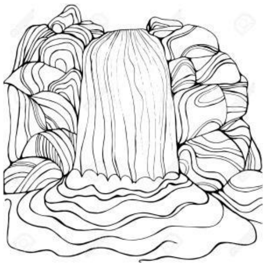
Which are the following devices have the same transformation of energy as M and N?
Antara berikut, alat manakah yang sama dengan M dan N berdasarkan perubahan bentuk tenaga?

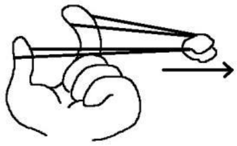
	M	N
A		
B		
C		
D		

SECTION B

BAHAGIAN B

1 The diagram below shows two situations.
Rajah di bawah menunjukkan dua situasi.





Situation 1 / *Situasi 1*   Situation 2 / *Situasi 2*

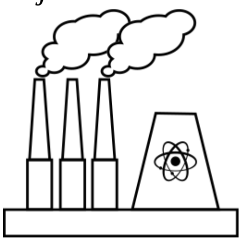
(a) State the form of energy that exists in the above situations? [1 mark]
Nyatakan bentuk tenaga yang terdapat pada situasi di atas? [1 *markah*]

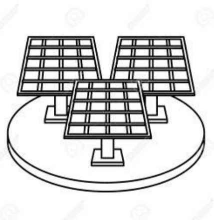
....

(b) Explain the form of energy that is stated in the answer in (a)? [1 mark]
Terangkan bentuk tenaga yang anda nyatakan di soalan (a)? [1 *markah*]

....

(c) The diagram below shows two sources of energy, P and Q? [1 mark]
Rajah di bawah menunjukkan dua sumber tenaga, P dan Q? [1*markah*]





P   Q

i State the sources of energy for... [1 mark]
Nyatakan sumber tenaga untuk… [1 *markah*]

P: ………………………………………… *Q:* …………………………………..

ii Write the transformation of energy that occurs in... [1 mark]
Tuliskan perubahan bentuk tenaga yang berlaku di… [1 *markah*]

P: …………………………………………………………………………

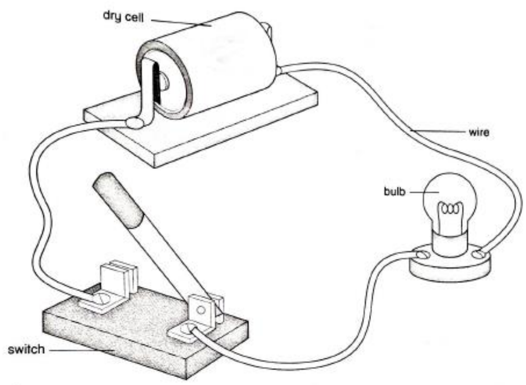
Q: …………………………………………………………………………..

iii Give two advantages of using the source of energy Q. [1 mark]
Nyatakan dua kebaikan menggunakan sumber tenaga Q. [1 *markah*]

1.………………………………………………………………………….

2.…………………………………………………………………………

2 The diagram below shows the apparatus set up to investigate the transformation of energy. When the switch is on, the bulb lights up.
Rajah dibawah menunjukkan susunan alat radas untuk menyiasat perubahan tenaga. Apabila suis ditutup, mentol akan menyala.



(a) Name the source of energy used in this circuit. [1 mark]
Namakan sumber tenaga yang digunakan dalam litar ini. [1 *markah*]

…………………………………………………………………………………………

(b) What is the form of energy stored in the source of energy named the answer in (a)? [1 mark]
Apakah bentuk tenaga yang tersimpan dalam sumber tenaga yang dinyatakan di (a)? [1 *markah*]

…………………………………………………………………………

(c) What is the transformation of energy involved when the bulb in the circuit lights up? [1 mark]
Apakah perubahan bentuk tenaga yang terlibat apabila mentol pada litar itu menyala? [1 *markah*]

…………………………………………………………………………

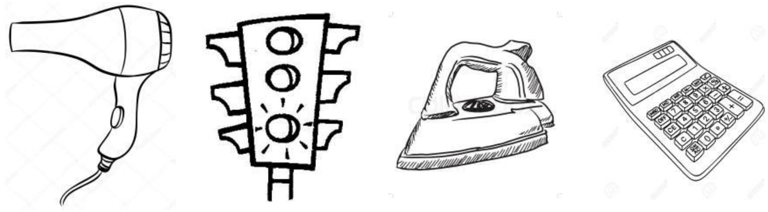
(d) State how the following sources of energy can generate electricity? [2 marks]
Nyatakan bagaimana sumber tenaga yang berikut boleh menghasilkan tenaga elektrik? [2 *markah*]

Water / *Air*: ……………………………………………………………

Wind/*Angin:*

……………………………………………………………………………………

3 The diagram below shows four devices.
Rajah dibawah menunjukkan empat jenis alat.



K L M N

(a) Write the transformation of energy involved in each of the above devices. [2 marks]
Tuliskan perubahan bentuk tenaga yang terlibat pada alat-alat di atas. [2 *markah*]

Device / *Alatan*	Transformation of energy / *Perubahan bentuk tenaga*
K	
L	
M	
N	

(b) Based on the answer in (a), what can you explain about energy?. [1 mark]
Berdasarkan jawapan anda di (a), apakah penerangan anda mengenai tenaga? [1 *markah*]

…………………………………………………………………………

(c) State the energy stored in... [3 marks]
Nyatakan tenaga yang tersimpan di… [3 *markah*]
i: A stretched spring / *spring yang diregangka*n:

…………………………………………………………………………

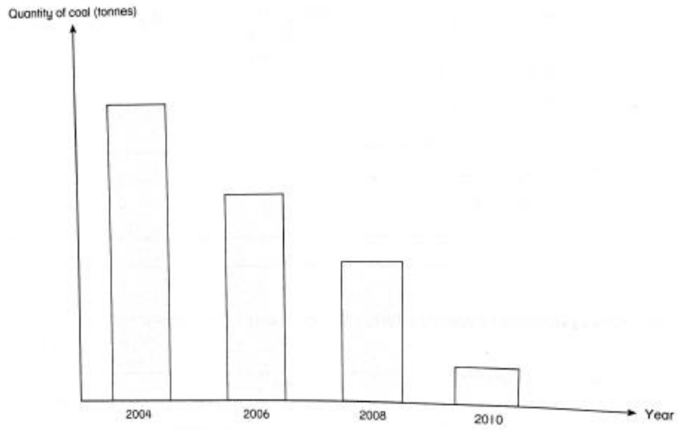
ii: A walking pupil / *murid yang sedang berjalan*:

…………………………………………………………………………

iii. Burning wood / *kayu yang sedang terbakar*:

……………………………………………………………………………

4 The diagram below shows a bar graph of the quantity of coal found by a company in an area for four years.
Rajah di bawah menunjukkan graf bar mengenai kuantiti arang yang dijumpai oleh sebuah syarikat di satu kawasan selama empat tahun.



(a) State two information that can be obtained from the graph. [1 mark]
Nyatakan dua maklumat yang diperoleh daripada graf di atas. [1 *markah*]

1.………………………………………………………………………………

2.……………………………………………………………………………

(b) What is the trend of change in the quantity of coal found by the company? [1 mark]
Apakah corak perubahan kuantiti arang yang dijumpai oleh syarikat tersebut? [1 *markah*]

……………………………………………………………………………

(c) Predict the quantity of coal in 2011. [1 mark]
Ramalkan kuantiti arang pada tahun 2011. [1 *markah*]

……………………………………………………………………………

END OF QUESTION / *SOALAN TAMAT*

APPENDIX 2: LETTERS, CONSENT FORMS AND DEBRIEFING LETTERS

2A: Parental Consent Letter

Address

Date

Dear (insert name)

I am Iris Tia anak Mekung, a student of MSc Learning Sciences in the Faculty of Cognitive and Human Development, University Malaysia Sarawak. As part of the requirement in this course, I am carrying out a study to investigate scaffolding in learning of Science and its impact on achievement among rural students in Bau. I hope that this study will gain important information to help students to learn in a better way.

I am writing to ask if you would be willing to allow your child to participate in my research. This will involve attending extra classes after schooling hours. The lessons would take place at SK Segong and will last for about one hour for each lesson. Your child's participation in this research will be treated confidentially and all information will be used only for research purposes.

You can contact me using details provided overleaf if you have any comment or doubt regarding this research.

Many thanks in advance for your consideration of this project. Please let me know if you need more information. I would appreciate it if you could complete the attached permission slip and return it to me.

Regards,

Iris Tia anak Mekung

(Student of Msc. Learning Sciences)

2B : Research Information & Parental or Guardian Permission Form

Title of Study: Scaffolding in Learning of Science and its Impact on Achievement Among Rural Students in Bau

The purpose of the study

The purpose of this study is to investigate scaffolding in learning of Science and its impact on achievement among rural students in Bau

What is involved

In this study, your child will be learning about Energy (a topic in Year 5 Science subject) by using a conventional method or scaffolding method whereby he or she will be tested at the beginning and at the end of the experiment. Participation in this study will involve 3 lessons that will take approximately 1 hour for each of the lessons.

Participation and withdrawal

Participation in this study is voluntary and your child is free to withdraw from this study at any time without prejudice or penalty.

Confidentiality and security of data

All data collected in this study will be confidential. Specifically, participants will not be asked to provide their name or any other data that could identify them. The data from this study will only be used for research purposes.

Risks

Participation in this study should involve no physical or mental discomfort and no risks beyond those of everyday living.

Thank you for your participation in this study.

Iris Tia anak Mekung.

Researcher

This study has been approved by the Ministry of Higher Education (Reference No: KPM.600-3/2/3-eras(2668)) and Sarawak State Education Department (Reference No: JPNSW.SKPP.LAT.600-1/1/1Jld3(80)). Signing the form below will allow your child to participate in the study after school hours without your presence. If you do not sign and return this form, the researchers will understand that you do not wish to allow your child to participate.

Parent Signature Box

I, the parent or guardian of ______________________, permit his/her participation in this study entitled above and being conducted by Iris Tia anak Mekung.

____________________________ ______________________

Signature of Parent/Guardian Date

Student Signature Box

I, ______________________, agree to participate in this study entitled above and understand that my participation is voluntary.

____________________________ ______________________

Signature of Student Date

2C: Parental Debriefing Letter

Thank you for giving permission for your child to take part in this study. The aim of this study is to investigate scaffolding in learning of Science through its impact on achievement among rural students in Bau. Scaffolding refers to the support given to the students by teachers or more capable person to complete a task that is beyond their capability.

This study is experimental in nature. Participants are randomly assigned to each condition, whether taught by a conventional method (chalk and talk) or scaffolding method (modelling). Their performance after each condition will be measured by using achievement test.

Literature revealed positive effects of using scaffolding as an approach to enhance knowledge acquisition in several contexts (Alake & Ogunseemi, 2013; Omiko, 2015; Raes, et al, 2012). However, most studies focused on the intervention of learning context with better learning environment, teacher-student interactions, peer interactions and learner's effect toward science learning, but less concern about assessment and gender issues (Lin et al., 2012). Thus, it is my interest to examine this matter.

If you wish to know more about the effects of scaffolding on pupil's achievement, you may consult the following references:

1. Alake, E. M., & Ogunseemi, O. E. (2013). Effects of scaffolding strategy on learners' academic achievement in integrated science at the Junior Secondary School Level. *European Scientific Journal, ESJ, 9*(19).

2. Omiko, A. (2015). Impact of instructional scaffolding on students' achievement in chemistry in secondary schools in Ebonyi State of Nigeria. *International Journal of Education, Learning and Development (IJELD), 3*(7), 74-83.

3. Lin, T. C., Hsu, Y. S., Lin, S. S., Changlai, M. L., Yang, K. Y., & Lai, T. L. (2012). A review of empirical evidence on scaffolding for science education. *International Journal of Science and Mathematics Education*, *10*(2), 437-455.

4. Raes, A., Schellens, T., De Wever, B., & Vanderhoven, E. (2012). Scaffolding information problem solving in web-based collaborative inquiry learning. *Computers & Education*, *59*(1), 82-94.

If you have any questions, please contact me using the details provided overleaf. Your child participation in this study is much appreciated.

Iris Tia anak Mekung

Researcher

APPENDIX 3: APPROVAL LETTERS

3A: From Ministry of Education

KEMENTERIAN PENDIDIKAN MALAYSIA
BAHAGIAN PERANCANGAN DAN PENYELIDIKAN DASAR PENDIDIKAN
ARAS 1-4, BLOK E8
KOMPLEKS KERAJAAN PARCEL E
PUSAT PENTADBIRAN KERAJAAN PERSEKUTUAN
62604 PUTRAJAYA

TEL : 0388846591
FAKS : 0388846579

Ruj. Kami : KPM.600-3/2/3-eras(2668)
Tarikh : 27 Disember 2018

IRIS TIA ANAK MEKUNG
NO. KP : 860316525680

SK SEGONG, BAU
D/A PEJABAT PENDIDIKAN DAERAH BAU 94000 BAU
SARAWAK

Tuan,

KELULUSAN BERSYARAT UNTUK MENJALANKAN KAJIAN :
SCAFFOLDING IN LEARNING OF SCIENCE AND ITS IMPACT ON ACHIEVEMENT AMONG RURAL STUDENTS IN BAU

Perkara di atas adalah dirujuk.

2. Sukacita dimaklumkan bahawa permohonan tuan untuk menjalankan kajian seperti di bawah telah diluluskan dengan syarat :

" KAJIAN TIDAK MENGGANGGU PROSES PENGAJARAN DAN PEMBELAJARAN "

3. Kelulusan adalah berdasarkan kepada kertas cadangan penyelidikan dan instrumen kajian yang dikemukakan oleh tuan kepada bahagian ini. Walau bagaimanapun kelulusan ini bergantung kepada kebenaran Jabatan Pendidikan Negeri dan Pengetua / Guru Besar yang berkenaan.

4. Surat kelulusan ini sah digunakan bermula dari **2 Januari 2019** hingga **30 April 2019**

5. Tuan dikehendaki menyerahkan senaskhah laporan akhir kajian dalam bentuk *hardcopy* bersama salinan *softcopy* berformat pdf dalam CD kepada Bahagian ini.Tuan juga diingatkan supaya mendapat kebenaran terlebih dahulu daripada Bahagian ini sekiranya sebahagian atau sepenuhnya dapatan kajian tersebut hendak diterbitkan di mana-mana forum, seminar atau diumumkan kepada media massa.

Sekian untuk makluman dan tindakan tuan selanjutnya. Terima kasih.

"BERKHIDMAT UNTUK NEGARA"

Saya yang menjalankan amanah,

Ketua Sektor
Sektor Penyelidikan dan Penilaian
b.p. Pengarah
Bahagian Perancangan dan Penyelidikan Dasar Pendidikan
Kementerian Pendidikan Malaysia

salinan kepada:-

JABATAN PENDIDIKAN SARAWAK

* SURAT INI DIJANA OLEH KOMPUTER DAN TIADA TANDATANGAN DIPERLUKAN *

3B: From Sarawak State Education Department

KEMENTERIAN PENDIDIKAN MALAYSIA
Jabatan Pendidikan Negeri Sarawak
Jalan Diplomatik, Off Jalan Bako
Petra Jaya, 93050 Kuching, Sarawak

Tel : 082-473445
Faks : 082-473684
Emel : *unitlatihan007@gmail.com*

Ruj Kami : JPNSW.SKPP.LAT.600-1/1/1Jld3(80)
Tarikh : 3 Januari 2019

Iris Tia Anak Mekung

SK Segong, Bau
D/A Pejabat Pendidikan Daerah Bau
94000 Bau
Sarawak

Puan,

KEBENARAN UNTUK MENJALANKAN KAJIAN DI SEKOLAH-SEKOLAH, INSTITUT-INSTITUT PERGURUAN, JABATAN PENDIDIKAN DAN BAHAGIAN-BAHAGIAN DI BAWAH KEMENTERIAN PENDIDIKAN MALAYSIA

Dengan hormatnya saya merujuk kepada perkara di atas.

2. Sukacita dimaklumkan bahawa pada dasarnya Jabatan Pendidikan Negeri Sarawak tiada sebarang halangan untuk membenarkan puan menjalankan kajian bertajuk :

“ Scaffolding in Learning of Science and its Impact on Achievement among Rural Students in Bau ”

3. Diingatkan bahawa sepanjang tempoh kajian tersebut, puan adalah tertakluk kepada peraturan yang sedang berkuatkuasa dan menjalankan kajian seperti tajuk yang diluluskan oleh Bahagian Perancangan dan Penyelidikan Dasar Pendidikan, Kementerian Pendidikan Malaysia bil. KPM.600-3/2/3-eras(2668) bertarikh 27 Disember 2018.

4. Jabatan ini memohon agar sesalinan laporan kajian dihantar ke Unit Latihan Dan Kemajuan Staf, Jabatan Pendidikan Negeri Sarawak sebaik sahaja selesai untuk tujuan rekod dan rujukan.

Sekian, terima kasih.

“BERKHIDMAT UNTUK NEGARA”

Saya yang menjalankan amanah,

[KUSWADY BIN CHIL]
Sektor Khidmat Pengurusan Dan Pembangunan
b.p Pengarah Pendidikan
Jabatan Pendidikan Negeri Sarawak.

"MENJULANG PENDIDIKAN NEGERI SARAWAK"
"FLY KENYALANG FLY,FLY HIGH"

APPENDIX 4: LESSON PLANS

4A: Scaffolding Teaching Method

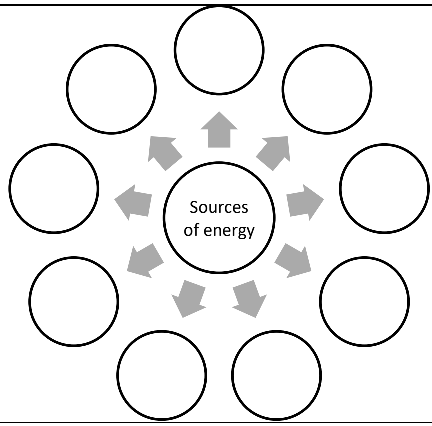
Objectives 1:

State and describe the 9 sources of energy

Procedure:

Teacher’s Activity	Pupil’s Activity
A. <u>Preparatory Activities</u> 1. Good morning class. 2. What do you have for your breakfast? 3. Why do you need to eat? 4. Yes, good. Today we will learn about energy.	1. Good morning teacher. 2. Sandwich, fried noodles, fried rice…. 3. For energy
<u>Motivation</u> 1. Let us view this short video. https://www.youtube.com/watch?v=wyVF6R9e6xE 2. What can you see in the video?	1. Pupils watch the video. 2. Pupils answer the questions asked by teacher.
B. <u>Presentation of the lesson</u> **<u>(Focus Lesson)</u>** 1. Today, we will be describing the 9 sources of energy. 2. Teacher will be explaining the sources of energy by using power point presentation.  3. Teacher asked several questions during	1. Pupils listen to the explanation. 2. Pupils answer the questions asked by teacher.

the explanation.	
C. Modelling **(Guided Instruction)** 1. You are needed to create an interesting story to help you remember the sources of energy. 2. But before that, I will tell my version of story to help me remember the 9 sources of energy. Sun's Best Friends (Renewable) **S**un's - **S**un **B**est - **B**iomass **F**riends - **F**ood **3W** - **W**ind, **W**ater, **W**ave Sun have 5 best friends. Each of his friends have different characteristics: 1. Biomass - organic matter from plants and animals 2. Food - from plants and animals 3. Wind - from moving air 4. Water - moves through a hydroelectric dam 5. Wave - provides energy that moves turbines in the sea Sun's Enemies (Non-renewable) 1. Battery 2. Nuclear 3. Fossil Fuels (Petroleum, Coal, Natural gas)	* Teacher provides scaffolding with guided examples through modelling for the pupils.
D. Collaborative Work 1. Please get into a group of 5 and create your own version of story. 2. After you have done, please present your story in front of the class.	1. Pupils collaborate with their group members to complete the task.
E. Enrichment Activity (Independent Work) 1. Please complete the worksheet given. 2. Teacher discuss the answer with pupils. 3. Teacher concludes the lesson.	Worksheet State and describe the 9 sources of energy in the bubble map.

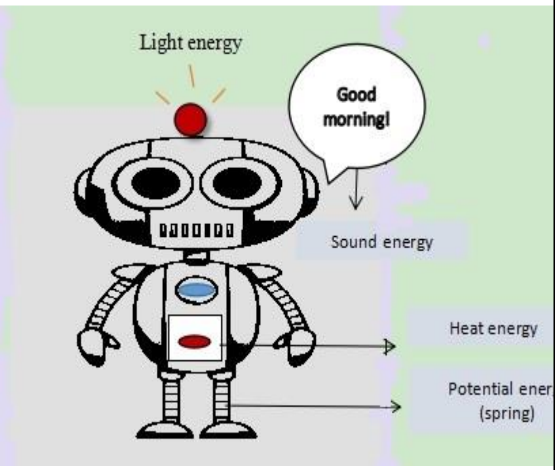
	

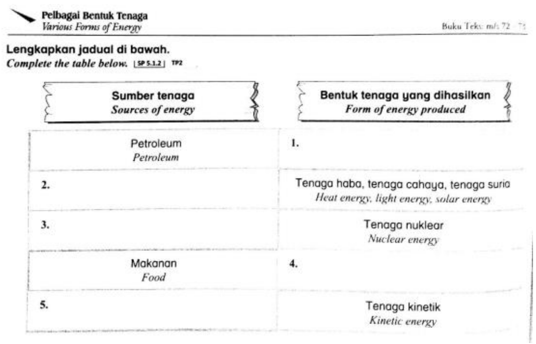
Objectives 2:

Describe the forms of energy produced

Procedure:

Teacher's Activity	Pupil's Activity
A. Preparatory Activities 1. Good morning class. 2. How is the weather today? 3. What does the Sun provide us with? 4. Yes, good. Sun gives us two forms of energy that are heat energy and light energy.	1. Good morning teacher. 2. Sunny. 3. Heat and light 4. Pupils realize that Sun gives us heat and light which are the form of energy.
Motivation 1. Teacher revises the sources of energy with pupils by using a guessing game. 2. Teacher draws a symbol on the board and ask pupils to guess it.	1. Pupils guess the source of energy based on the symbol.  Nuclear
B. Presentation of the lesson (Focus Lesson) 1. Today, we will be describing the 9 forms of energy. 2. Teacher will be explaining the forms of energy by using power point presentation.	1. Pupils listen to the explanation. 2. Pupils answer the questions asked by teacher.

 3. Teacher asked several questions during the explanation.	
C. Modelling (Guided Instruction) 1. You are needed to design your energy robot in a group of 5. Each group needs to discuss and create an energy robot that consists of at least 3 forms of energy. After that, you need to describe your robot. 2. I will show you an example of my energy robot.  My robot's name is Bobo. It produces sound when it greets me. Bobo uses heat energy to make doughnut and hot milo. It can jump because its legs can be stretched and compressed. When Bobo is happy it red light flashes and produces light energy. I think Bobo is the best robot in the world!	* Teacher provides scaffolding with guided examples through modelling for the pupils.

D. <u>Collaborative Work</u> 1. Please get into a group of 5 and create your own energy robot. 2. After you have done, please present your robot in front of the class.	1. Pupils collaborate with their group members to complete the task.
E. <u>Enrichment Activity (Independent Work)</u> 1. Please complete the worksheet given. 2. Teacher discuss the answers with pupils. 3. Teacher concludes the lesson.	<u>Worksheet</u>  **Pelbagai Bentuk Tenaga** *Various Forms of Energy* Buku Teks: m/s 72 - 73 **Lengkapkan jadual di bawah.** ***Complete the table below.*** SP 5.1.2 TP2 **Sumber tenaga** / ***Sources of energy*** — **Bentuk tenaga yang dihasilkan** / ***Form of energy produced*** Petroleum / *Petroleum* — 1. 2. — Tenaga haba, tenaga cahaya, tenaga suria / *Heat energy, light energy, solar energy* 3. — Tenaga nuklear / *Nuclear energy* Makanan / *Food* — 4. 5. — Tenaga kinetik / *Kinetic energy*

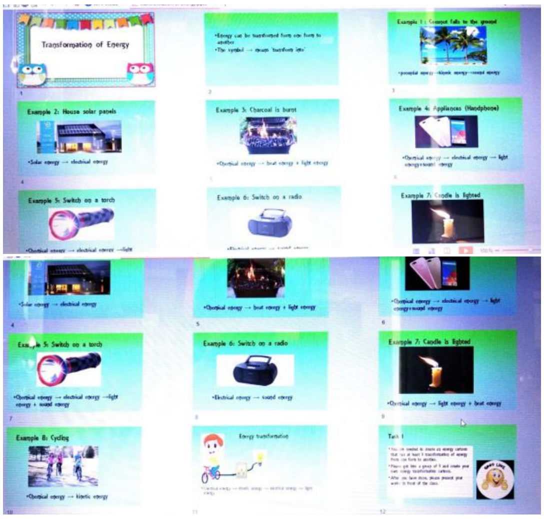
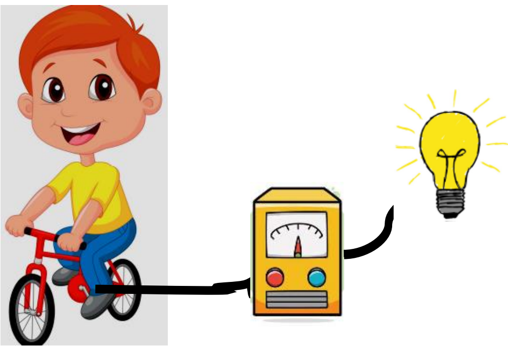
Objectives 3:

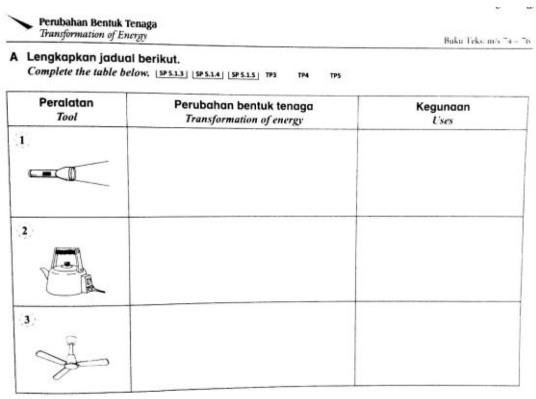
Explain with examples the transformation of energy

Make generalisation that energy can be transformed from one form to another

Procedure:

Teacher's Activity	**Pupil's Activity**
A. <u>Preparatory Activities</u> 1. Good morning class. 2. I have something in my pocket. Can you guess what is it? 3. Yes, it is a smart phone. What is the form of energy that this smart phone has? 4. What is the transformation of energy happen when the phone is ringing?	1. Good morning teacher. 2. Money, handphone…. 3. Light energy, chemical energy, sound energy 4. Chemical energy to light energy and sound energy 5. Pupils realise that energy can be transformed from one form to another.
<u>Motivation</u> 1. Let us watch this video. https://www.youtube.com/watch?v=G6poIEzZUsI 2. Teacher ask several questions about the	1. Pupils watch the video. 2. Pupils answer the questions asked by teacher.

transformation of energy in the video.	
B. <u>Presentation of the lesson (Focus Lesson)</u> 1. Today, we will be learning about the transformation of energy in several appliances and situations. 2. Teacher will be explaining the transformation of energy by using power point presentation.  3. Teacher asked several questions during the explanation.	1. Pupils listen to the explanation. 2. Pupils answer the questions asked by teacher.
C. <u>Modelling (Guided Instruction)</u> 1. You are needed to create an energy cartoon that has at least 3 transformations of energy from one form to another. 2. I will show you an example of my energy transformation cartoon. 	* Teacher provides scaffolding with guided examples through modelling for the pupils.

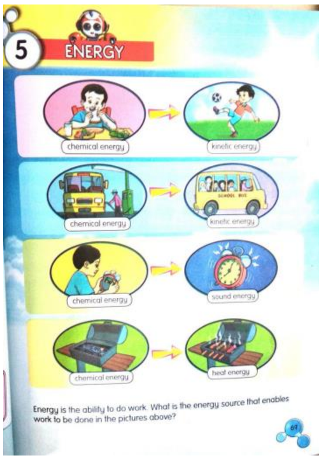
Chemical energy → kinetic energy → electrical energy → light energy	
D. <u>Collaborative Work</u> 1. Please get into a group of 5 and create your own energy transformation cartoon. 2. After you have done, please present your works in front of the class.	1. Pupils work in a group of 5. 2. Pupils are to draw a cartoon that has at least 3 transformations of energy. Label it, then, write out the transformations with arrows below the picture. 3. Pupils present their tasks.
E. <u>Enrichment Activity (Independent Work)</u> 1. Please complete the worksheet given. 2. Teacher discuss the answers with pupils. 3. Teacher concludes the lesson.	<u>Worksheet</u>  **Perubahan Bentuk Tenaga** *Transformation of Energy* Buku Teks: m/s 74 – 76 **A Lengkapkan jadual berikut.** *Complete the table below.* SP 5.1.3 SP 5.1.4 SP 5.1.5 TP3 TP4 TP5 Peralatan *Tool* | Perubahan bentuk tenaga *Transformation of energy* | Kegunaan *Uses* 1 2 3

4B: Conventional Teaching Method

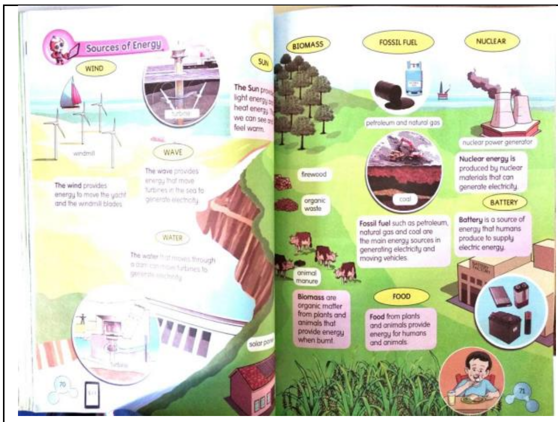
Objectives 1:

State and describe the 9 sources of energy

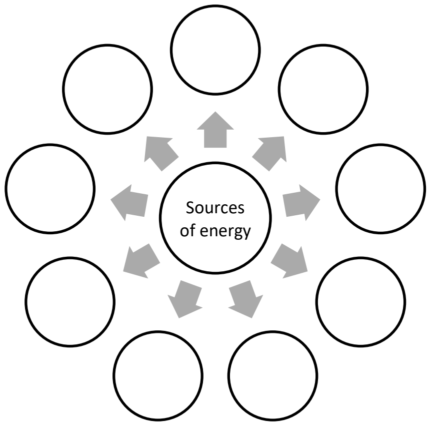
Procedure:

<table>
<tr><th>Teacher’s Activity</th><th>Pupil’s Activity</th></tr>
<tr><td>A. Preparatory Activities
1. Good morning class.
2. What do you have for your breakfast?
3. Why do you need to eat?
4. Yes, good. Today we will learn about energy.</td><td>1. Good morning teacher.
2. Sandwich, fried noodles, fried rice….
3. For energy</td></tr>
<tr><td>B. Opening Activity
1. Pupils are shown several pictures on the textbook (page 69).


2. Pupils are asked several questions about the pictures.
➢ How do we get the energy to do daily work?
➢ What is the energy source that enables work to be done in the picture?
3. Pupils answer based on their prior knowledge.</td><td>1. Sun, water, wave, wind, petroleum….
2. Pupils answer the questions asked by teacher.</td></tr>
<tr><td>C. Lesson Delivery (Focused Instruction)
1. Pupils are taught about the sources of energy (textbook page 70, 71).</td><td>1. Pupils read and listen to the explanation.
2. Pupils answer the questions asked by teacher.</td></tr>
</table>

<table>
<tr>
<td>


2. Pupils read the information given on the textbook and teacher explain the details.
3. Several questions are asked to measure the pupils' understanding.
➢ What are the sources of energy that we have learned?
➢ How can water and wave generate electricity?
➢ What is biomass?
➢ What are the examples of fossil fuel?
</td>
<td></td>
</tr>
<tr>
<td>
D. <u>Enrichment Activity (Independent Work)</u>
1. Pupils are to complete the exercises given to them.
2. Pupils discuss the answers with teacher.
3. Teacher concludes the lesson.
</td>
<td>
<u>Worksheet</u>
State and describe the 9 sources of energy in the bubble map.



</td>
</tr>
</table>

Objectives 2:

Describe the forms of energy produced

Procedure:

<table>
<tr><th>Teacher’s Activity</th><th>Pupil’s Activity</th></tr>
<tr><td>

A. <u>Preparatory Activities</u>
1. Good morning class.
2. How is the weather today?
3. What does the Sun provide us with?
4. Yes, good. Sun gives us two forms of energy that are heat energy and light energy.

</td><td>

1. Good morning teacher.
2. Sunny.
3. Heat and light
4. Pupils realise that Sun gives us heat and light which are the form of energy.

</td></tr>
<tr><td>

B. <u>Opening Activity</u>
1. Pupils are shown a situation (textbook, page 72).
2. Pupils are asked several questions about the situation.
➢ How do the clothes dry?
➢ What forms of energy does the sun produce?
3. Pupils answer based on their prior knowledge.

</td><td>

1. Pupils answer the questions asked by teacher

</td></tr>
<tr><td>

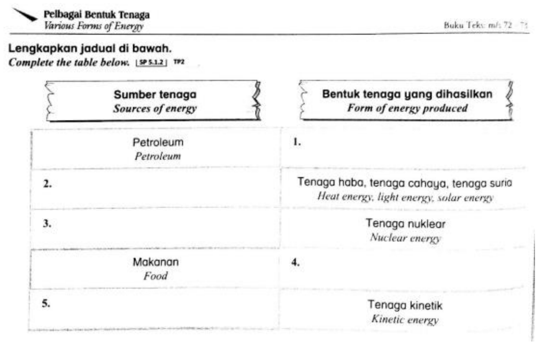
C. <u>Lesson Delivery</u> <u>**(Focused Instruction)**</u>
1. Pupils are taught about the various forms of energy (textbook page 72, 73).

2. Pupils read the information given on the textbook and teacher explain the details.
3. Several questions are asked to measure the pupils’ understanding.
➢ What are the forms of energy that we have learned?
➢ What are the examples of situations that produce potential energy?
➢ When does kinetic energy produce?
➢ What are the examples of objects that have chemical energy?

</td><td>

1. Pupils read and listen to the explanation.
2. Pupils answer the questions asked by teacher.

</td></tr>
</table>

D. Enrichment Activity **(Independent Work)** 1. Pupils are to complete the exercises given to them. 2. Pupils discuss the answers with teacher. 3. Teacher concludes the lesson.	Worksheet 

Pelbagai Bentuk Tenaga
Various Forms of Energy

Lengkapkan jadual di bawah.
Complete the table below. SP 5.1.2 TP2

Sumber tenaga *Sources of energy*	Bentuk tenaga yang dihasilkan *Form of energy produced*
Petroleum *Petroleum*	1.
2.	Tenaga haba, tenaga cahaya, tenaga suria *Heat energy, light energy, solar energy*
3.	Tenaga nuklear *Nuclear energy*
Makanan *Food*	4.
5.	Tenaga kinetik *Kinetic energy*

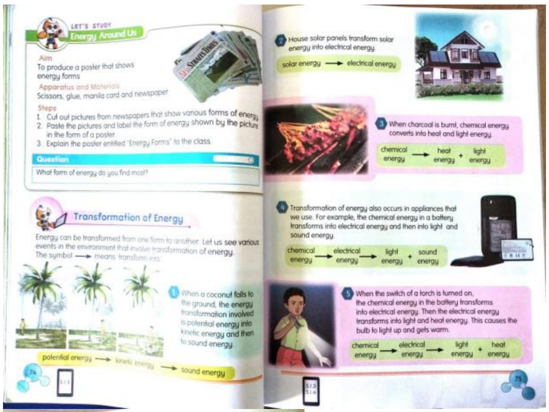
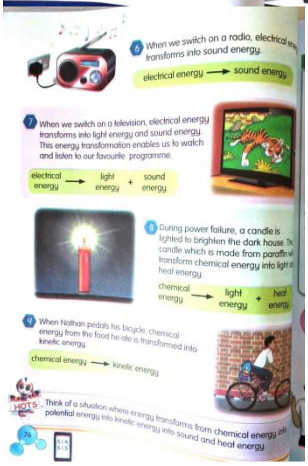
Objectives 3:

Explain with examples the transformation of energy

Make generalisation that energy can be transformed from one form to another

Procedure:

Teacher's Activity	**Pupil's Activity**
A. Preparatory Activities 1. Good morning class. 2. I have something in my pocket. Can you guess what is it? 3. Yes, it is a smart phone. What are the form of energy that this smart phone has? 4. What is the transformation of energy happen when the phone is ringing?	1. Good morning teacher. 2. Money, handphone…. 3. Light energy, chemical energy, sound energy 4. Chemical energy to light energy and sound energy 5. Pupils realise that energy can be transformed from one form to another.
B. Opening Activity 1. Pupils are shown a moving ceiling fan. 2. Pupils are asked several questions about the transformation of energy by the ceiling fan. ➢ What is the source of energy of the ceiling fan? ➢ What is the transformation of energy involve when the ceiling fan is moving? 3. Pupils answer based on their prior knowledge.	1. Pupils answer the questions asked by teacher. Electrical energy Electrical energy → kinetic energy → sound energy

C. <u>Lesson Delivery</u> **<u>(Focused Instruction)</u>** 1. Pupils are taught about the transformation of energy (textbook page 74, 75, 76).   2. Pupils read the information given on the textbook and teacher explain the details. 3. Several questions are asked to measure the pupils' understanding. ➢ What is the transformation of energy involve when a coconut falls to the ground? ➢ What is the transformation of energy when charcoal is burnt?	1. Pupils read and listen to the explanation. 2. Pupils answer the questions asked by teacher. Potential energy→ kinetic energy →sound energy Chemical energy →Light energy+ heat energy
D. <u>Enrichment Activity</u> **<u>(Independent Work)</u>** 1. Pupils are to complete the exercises given to them. 2. Pupils discuss the answers with teacher. 3. Teacher concludes the lesson.	<u>Worksheet</u>

Perubahan Bentuk Tenaga
Transformation of Energy

Buku Teks: m/s 74 – 76

A Lengkapkan jadual berikut.
Complete the table below. SP 5.1.3 SP 5.1.4 SP 5.1.5 TP3 TP4 TP5

Peralatan *Tool*	**Perubahan bentuk tenaga** *Transformation of energy*	**Kegunaan** *Uses*
1 		
2 		
3