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# Science, Technology, Engineering and Mathematics Initiatives at Rural Schools and Its Impact on Learning Motivation

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**Abstract.** The number of students enrolled in Science, Technology, Engineering and Mathematics (STEM) related programs at tertiary level of education and those in science stream at high schools show a declining trend in recent years. This phenomenon is happening globally since at least the past two decades. The nation is moving closer to its Vision 2020 deadline to be a developed country; however, the downward trend in numbers is alarming. Therefore, it becomes critical to aggressively implement more initiatives to increase the number of graduates, workforce and professionals with technical and science related background. Based on past researches, there are differences in STEM achievement between students in urban and rural areas in Malaysia. Two rural schools were selected for the project that aims to assess students' awareness about the importance of STEM related knowledge, and to motivate them in learning STEM. Experiments and hands-on activities were carried out with the students at two Orang Asli primary schools in rural areas in Perak, Malaysia. Data was collected through observations and document analysis on students' achievement. Analysis shows that students are not aware of the importance of STEM in their everyday life, and they have increased motivation in learning, not only on STEM courses.

## 1. Introduction

The number of students enrolled in Science, Technology, Engineering and Mathematics (STEM) related programs at tertiary level of education and those in science stream at high schools show a declining trend in recent years. This phenomenon is happening globally since at least the past two decades. The nation is moving closer to its Vision 2020 deadline to be a developed country, however, the downward trend in numbers is alarming. To fulfill the requirement, government has set a policy that the ratio of students' enrollment in science / technical field to arts / literature stream is 60:40 [1]. Even though the target has been set, the enrollment of students in science / technical field does not achieve its target. For example, in 2005, the total enrollment in science stream at school was only 31.22% [2]. Realizing the decline in students' interest and enrollment in STEM education not only in Malaysia but globally, there are research done to investigate the critical factors that can motivate students to pursue their studies in STEM. Among the findings were learning strategies and styles, attitudes, talent, support from family, interaction with others, and education motivation. Additionally, other factors include experience in instruction and education environments [3]. Of these factors, it was found that the most significant for



high school students are interpersonal interaction between teacher and student, the relevance and authenticity of the topics being studied, and the diversity of the teaching methods [4].

It becomes critical to aggressively implement more initiatives to increase the number of graduates, workforce and professionals with technical and science related background. Issues surrounding Orang Asli community, specifically on education, include various perspectives contributed by both internal and external factors. Needless to say that the problems experienced do not exclusively rise from student factors but also from the delivery system, involving teachers and others responsible for the education and welfare of these children [5]. Students lagging in academic performance with high dropout rate compared to the overall academic performance throughout the nation is a common problem [6]. Especially for Orang Asli students in rural areas, additional challenges they have to face include the lack of basic necessity such as electricity to do their revision at night, and other luxuries such as educational toys, revision and reading materials, and educational programs on television [6], complete school facilities and committed teachers. Additional hurdles include the non-conducive environment, such as the lack of internet connection, phone line, infrastructure and educated parents who could have direct influence in their academic performance [7].

The government of Malaysia has taken the responsibility to ensure that Orang Asli in Malaysia are not left behind in education. Among the initiatives and projects planned by the government is for the human capital development of Orang Asli, as stated in the Aboriginal Peoples Developments Strategic Plan 2011 – 2015 [8]. However, a study by Abdullah et al. [9] on primary and secondary schools students of Temiar tribe in Gua Musang Kelantan in 2011, found that the Orang Asli students have low self-esteem, lack of interest in school, not doing their revision, introvert, and having difficulty mixing with other races in the school. As reported in Haron et al. [10], results from the questionnaire analysis showed that students at Royal Belum Forest perceived themselves as having positive self-belief, goals and awareness of the importance of education. However, from observations, they need help to translate their beliefs to actual academic performance. Meanwhile, Ahmad et al. [11] and Abdullah et al. [12] stated some of the Orang Asli students have a positive viewpoint and high interest on education. They have the opinion that education is important in their lives and realize that they and their families can have a better future through education [11] and aim to get a good career through education Abdullah et al. [12]. However, the study shows that there is no significant relation between academic achievement with Temiar students' attitudes and interest. In a study on Orang Asli Temiar, Abdullah et al. [9] relate students' performance in education to teaching and learning (pedagogy) used by teachers.

Having identified those issues, it is far more critical for the Orang Asli children living in the reserved forest, such as the Royal Belum, to overcome. This paper focuses on Orang Asli children who are attending primary 6 at two schools in and within the Royal Belum Reserved Forest. The study aims to assess Orang Asli students' awareness about the importance of STEM related knowledge, and to motivate them in learning STEM.

## 2. Methodology

Two Orang Asli rural schools in Perak, Malaysia were selected for the study using experiments and hands-on STEM activities. The activities were carried out with primary 6 students at two Orang Asli primary schools. The first school, SK Sg. Tiang is only accessible by speedboat and is located about 45 minutes from the Pulau Banding Jetty. Eleven of Orang Asli students from year six were selected to participate in the classroom activities. All of the students are from the Jahai ethnic group. Meanwhile, the second school, SK RPS Air Banun has better access; via a small village road, about 3 km from the KM-48 exit of the main East-West highway. Unlike the first school, the students here are mainly from the Temiar ethnic group. This school has a higher number of primary 6 students. All 28 students were involved in this experimental activities.

This study adopted a qualitative research design. Data collection methods include behaviour observations and focus group discussions with the Orang Asli school children. In order to capture the essence of Orang Asli students' learning, an observation was carried out during class activities conducted by the researchers. The activities designed are to encourage students to participate actively in

teams, completing the mini projects that involved STEM knowledge. The activities come with a 'questions and answers' session. Two conducted classroom activities consisted of one core activity and one elective. Fixed 'rotor-copter' experiment was run at both schools as the core activity. Meanwhile, the elective activities between School 1 and School 2 were different from each other; set according to real time students' responses and performance during the core activity. The elective activities for School 1 and School 2 were called 'bottle runner' and 'mentos explosion' respectively. Rotor-copter and bottle runner experiments involve students' direct involvement in making the products and testing them. These are done in a team of at least two students. Mentos explosion requires less skills because it was more of an experimental work.

One same instructor with the help of two facilitators conducted the instructional activities at the two schools. Two observers per student group of two to three were assigned to evaluate the students during STEM activities at both schools. An observation form was filled in by observers for each student participant. The observation forms contain observed behaviour items in the checklist as shown in Table 1. The observed behaviour items are scales to the 15 measurement criteria that represent four categories as the following:

- (1) Cognitive Development (Language skills, impulsivity, organization and ability to solve problems)
- (2) Psychomotor (Motor skills, measuring skills, activity level and peer interaction)
- (3) Affective (on-task behaviour, response to authority, social maturity and response to environment)
- (4) Motivation (Attention, follow directions and motivation)

Meanwhile, the focus group discussions conducted with the students were to identify their awareness about the importance of STEM related knowledge and identifying the impact of the activities to their motivation in learning STEM.

**Table 1.** Classroom behaviour observation checklist.

Categories	Measurement Criteria	Observed Behaviour
Cognitive	Language Skills	Adequate, low, fluent
	Impulsive	High, low, normal
	Organization	Good, poor, adequate
Psychomotor	Language Skills	Adequate, low, fluent
	Activity Level	Underactive, normal, overactive
	Peer Interaction	Withdrawn, over involved, aggressive, appropriate
	Motor Skills	Well developed, adequate, limited, clumsy
Affective	Measuring Skills	Well developed, adequate, limited ability
	On-Task Behaviours	Normal, talkative, daydreaming, disruptive
	Response to Authority	Annoying, rebellious, appropriate, seek attention, friendly, controlling, ignoring, limited interaction
	Social Maturity	Immature, needs reinforcement, average, mature
Motivation	Response to Environment	Curious, limited, adequate, exploratory
	Attention	Short attention, distractible, poor concentration, adequate
	Following Directions	Good, needs repetition, poor, average
	Motivation	Good effort, takes initiative, procrastinates, not easily giving up

### 3. Results and Analysis

A total of 39 Orang Asli year 6 students from two schools in Royal Belum, Grik, Perak participated in the STEM activities. The participating schools are Sekolah Kebangsaan Sungai Tiang (SK Sg Tiang), which was only accessible by water and SK RPS Air Banun (SK Air Banun), accessible by road. Table 2 shows the sample sizes of the two schools; whereby only a total of 38% are female students. The observation-report outcome shows the measure of students' observed behaviour level for cognitive, psychomotor, affective and motivation with regards to the STEM activities that were carried out. Figures 1 to 4 depict the scores for each category according to the measured observed behaviour, comparing between the two schools.

**Table 2.** Demographic data.

School	Gender	No. of Students	Total No. of Students
Sg Tiang	Male	6	11
	Female	5	
SK Air Banun	Male	18	28
	Female	10	

Cognitive language skill criteria in Figure 1 shows SK Air Banun students are more fluent, while almost all students from SK Sg. Tiang are at the adequate level. The ability to solve problems were observed to be over 30% better for the students at SK Air Banun compared to SK Sg. Tiang. The other two cognitive criterion also show that those students from SK Air Banun score better than their counterpart from SK Sg. Tiang. Referring to Figure 2, students from SK Air Banun score better for all criterions (peer interaction, motor skills and measuring skills) except for activity level, which is slightly below those students from SK Sg. Tiang. Figure 3 shows, four criterions under affective category measures on-task behaviour, social maturity, students' response to the environment and their response to the authority. From the observation, SK Sg Tiang students are 12% more normal for the on-task behaviours; but students from SK Air Banun are more mature socially. Although most students at SK Sg Tiang response to environment are adequate, the graph shows they are 18% more curious than the students from SK Air Banun. However, in terms of responsive to authority, SK Air Banun are 2% friendlier than the students are from SK Sg Tiang. Figure 4 shows three criterion for motivation category. Generally, students from both schools are motivated, observed from their participation in the activities. SK Air Banun students exceed by 37% for motivation criteria when compared to those in SK Sg Tiang. However, 23% more SK Sg Tiang students have adequate attention. In contra, SK Air Banun students are 25% more in numbers who are good at following directions. The graph shows 55% of students at SK Sg Tiang needs repetition when they were given directions.

Figures 5 to 7 show the activities at SK Sg Tiang. Two activities were carried out at the school: rotor-copter and bottle runner. The students were guided step by step by the instructors on making the products, which involved the activities requiring the students' skills and knowledge; from measuring items, cutting, fixing to experimenting their workability. Observers are also seen in the pictures, assessing each student according to the observation criterions throughout the process. Figures 8 to 10 show the school attendance and activities at SK Air Banun. Two activities were carried out at the school: rotor-copter and mentos-explosive. One was conducted in the classroom and the other outside. The students were guided step by step by the instructors on making the products. The behaviour observed was recorded in the observation behaviour form. The students are more playful and active during the question and answer session.

The impact of the activities and their awareness about the importance of STEM related knowledge were identified during a focus group discussion. The students know how to calculate, measure and some science information but they were not aware of its application in daily life. Through the activities and

explanations during the activities, they admitted to make connections with STEM knowledge. The students of both schools expressed that they had enjoyed learning through the activities that were carried out. The boys were more expressive and more willing to share their opinions, compared to the girls who were more shy. In general, the male students from SK Air Banun are more active than those from SK Sg Tiang.

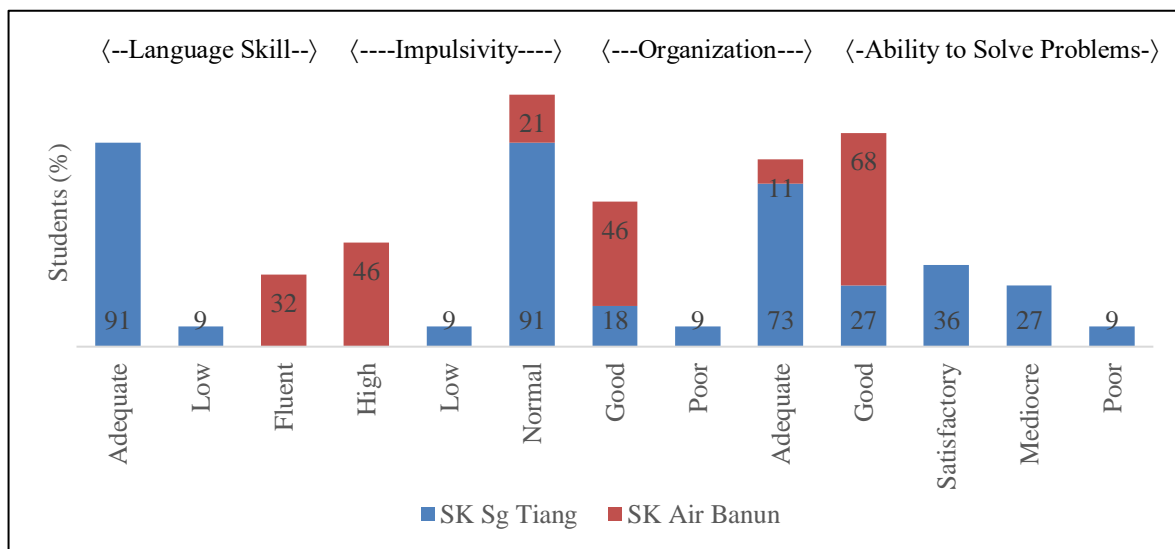


Figure 1. Comparison between schools for cognitive behaviour.

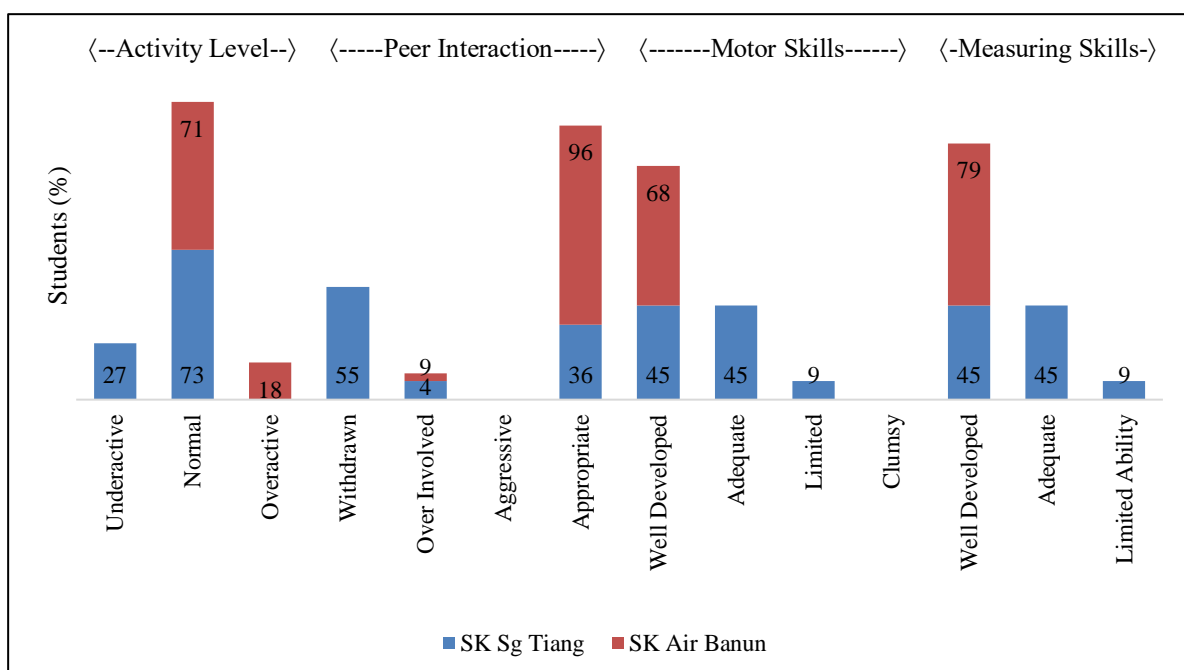


Figure 2. Comparison between schools for psychomotor behaviour.

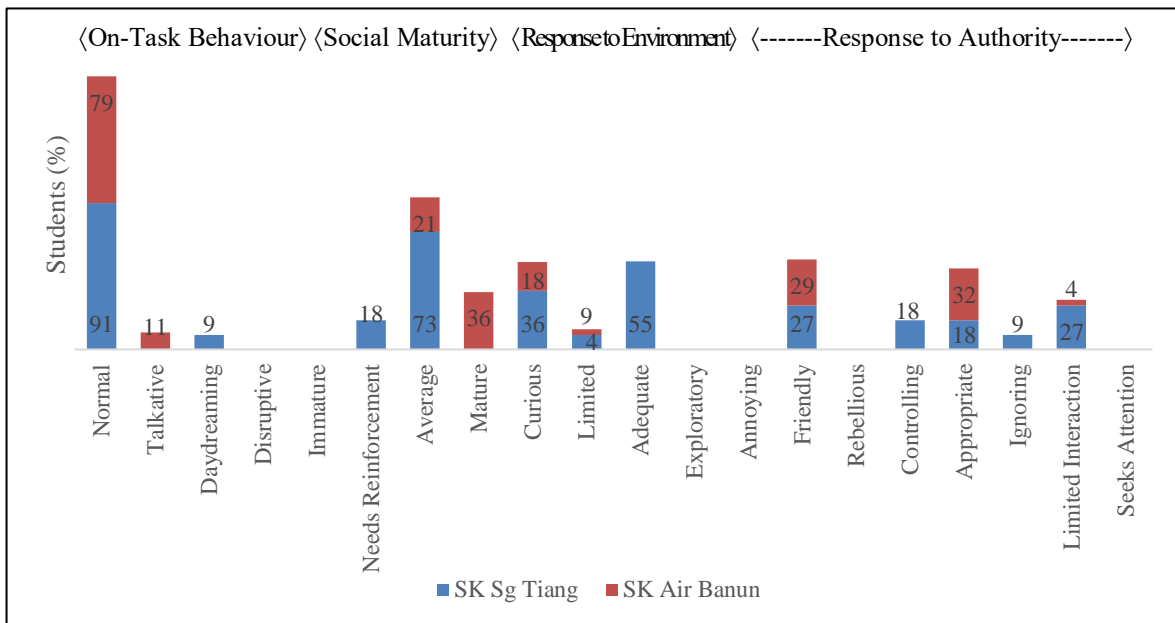


Figure 3. Comparison between schools for affective behaviour.

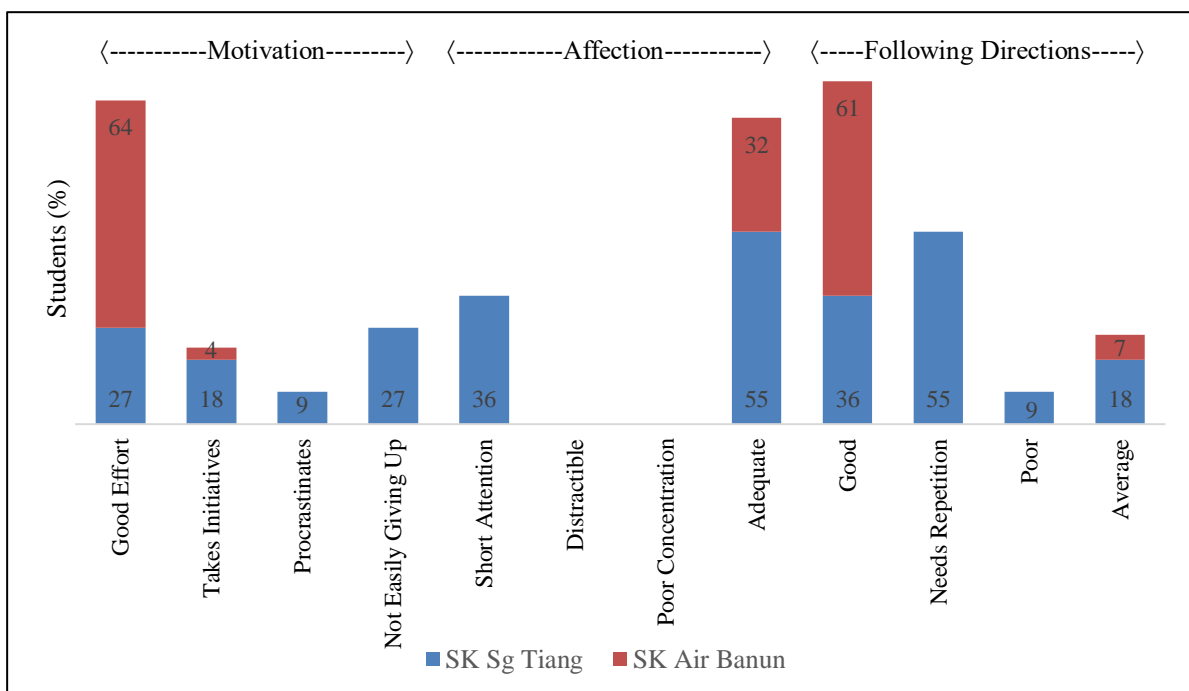


Figure 4. Comparison between schools for motivation behaviour.



**Figure 5.** SK Sg Tiang students preparing their ‘bottle runner’ experiment, following the instructor.



**Figure 6.** SK Sg Tiang students were observed to be discussing in their groups.





**Figure 7.** SK Sg Tiang students experimenting the ‘rotor-copter’ that they had made.

SK RPS BANUN					TAHUN	
TAHUN	LELAKI	PEREMPUAN	JUMLAH	HADIR	LELAKI	LAK
TAHUN 1	5	12	17	17	TING. 1 PERDANA	9
TAHUN 2	8	13	21	16	TING. 1 PAV	10
TAHUN 3			37	34	TING. 2 PERDANA	12
TAHUN 4	20	17	37	31	TING. 2 PAV	9
TAHUN 5	14	15	29	28	TING. 3 PERDANA	
TAHUN 6	21	13	34	28	TING. 3 PAV	

JUMLAH PENCH PELAJAR:	287	PERATUS KEHADIRAN:	87.80
JUMLAH HADIR:	252	MENENGAH:	86.60
		RENDAH:	78.00

BILANGAN MURID MENGIKUT KAMPUNG		
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KG. BANUN	KG. RABA	KG. DESA PERMAI
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KG. SEMELOR	KG. CHUWEH	KG. SG. TIANG
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**Figure 8.** SK Air Banun class attendance for year 6.



**Figure 9.** SK Air Banun students during question and answer session.



**Figure 10.** SK Air Banun students during ‘mentos explosion’ experiment.

#### 4. Discussion and Conclusion

Samples were Orang Asli population from Perak, one school (SK Sg Tiang) was more remote and in the heart of the RB forest reserves while the other (SK Air Banun) were more easily accessible by road and situated at the fringe of the reserves. The study aims to assess students' awareness on the importance of STEM related knowledge and attempt to motivate these students in learning STEM. In general, students from both schools are seen as typically involved in whole-class instruction but not interacting with the instructors unless being asked. Interaction between students are mainly between the male students during the product-making phase. Moreover, students rarely select their own instructional activities and they were usually very passive often just watching or listening to the instructors.

In Table 1, a checklist that categorise students' cognitive, psychomotor, affective and motivation behaviours were used. Each with their own measurement criteria and scoring each students responses during the classroom STEM sessions handled by the investigators. Results were represented as bar graphs in Figures 1 to 4. There were some differences but may not be significant in the four investigated components between children from the two schools. However, the students at SK Sg Tiang demonstrated more spread out scores that skewed towards moderate to lower as seen in all four graphs (see Figures 1 to 4). Students at SK Sg Tiang were lower in the cognitive aspects of language skills, impulsivity, organizations, and ability to solve problems. This trend continues in terms of psychomotor behaviour where Sg Tiang students were observed to be less active, more withdrawn and showed more limited motor and measuring skills than their counterpart. However, the SK Air Banun students demonstrated more disruptive behaviour (Figure 3) and shorter attention span (Figure 4) than the SK Sg Tiang children.

STEM is a living subject, where most of us in the urban area would be more aware of due to the need for commercialization and industrialization. Hence a career choice in STEM as one of the motivating factor. For rural, specifically the Orang Asli who find contentment living in the pristine forest and remote environments, STEM would seem unnecessary in their everyday life. They chose to live where basic necessity or lack of modernization, two terms that may not drastically affect them as it does us urban folks, as their dwellings and home. It seems that as for now these people have different life motivations and may find that science, technology, engineering and mathematics as just another school subjects. Especially children from SK Sg Tiang, daily activities for the children are running off jumping diving and swimming downhill to the lakes as the school bell rang for the last session of class. Every school day, they have already been given breakfast at the to start their days and lunch at the end. They would be in and around the lakes or wondering off with their older siblings to the jungle until dark. When it gets dark the whole village is really dark, these children would have spent enough energy during the day to soundly sleep until the next morning. There is very limited access to electricity and treated tap water, they do get some internet access from the only school that they go to.

The researchers had the opportunity to befriend two successful Orang Asli youths who were the daughter and another, the niece of the Tok Batin during several visits to their village. They hold teaching diplomas but rather than furthering their education or staying in the cities, they chose to return home. They are currently teaching in the village preschools that are funded by the MK Banding foundations. The immediate STEM probably would be the challenge to gather vegetables and fruits, hunt for meat in the jungle and fishes from the lake than the far off invention of a helicopter and so forth. These children learnt skills shared by their elders and may also include some knowledge of economy such as buying and selling for petrol, rice, salt or sugar and from technology perspective - telephone cards.

These scenarios may reflect the overall Orang Asli simple and contented lifestyle. As for the findings from the two schools, only slight differences were observed from students in the more remote school of SK Sg Tiang and SK Air Banun. Nonetheless students from both schools enjoyed and seem motivated in learning STEM by their response during the activities. They may be aware of the subject STEM but may not be able to actually relate its importance in their daily activity of living.

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