Study Note

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Factors Limiting High Achievement Level in Grade 6 Science Subjects in Fiji: External Examination Items and Results from 2017, 2018 and 2019

Wiliame Tabuaniika TAWAKE, Masao ISHIMURA

Global Education Course, Graduate School, Naruto University of Education

Abstract

Over the years, the Fiji Education portfolio has undergone many reforms in terms of curriculum and assessment. The Ministry of Education has localized the curriculum, and with the pressure of having external exams, teachers are still comfortable with the rote memorization style of teaching. According to Doochin. D, 2019 English is regarded as a universal language, there are still some significant concerns regarding the Fijian students' lack of comprehension skills. It is evident from the current information acquired from the National Examiners report (2015-2019) concerning the decline in the science achievement level. Students seem to excel and achieve above the benchmark in the knowledge, understanding, and cognitive application domain. However, students struggle to grasp abstract scientific terminologies, which have disallowed them to think critically or solve complex problems on some of the toughest exams, such as the Fiji Year 6 Intermediate Examination. There are a lot of factors surrounding low achievement levels. The purpose of this article is to analyze and highlight some of the significant factors limiting achievement levels in science subjects. The suggested pedagogy, namely Inquiry-Based Learning, can be strengthened to improve teaching competencies and address the need to prioritize the constructive philosophy of teaching and learning. A pre-requisite of high order thinking skills is to first obtain and familiarize with low order thinking skills; these need to be enhanced in children as per the prescribed curriculum for the elementary level in Fiji.

Keywords: Active learning, Metacognition, Language, Cognitive, Inquiry-Based Learning.

1. Introduction

1.1. Background

The education system in Fiji constitutes the traditional teaching approaches using chalk and blackboard and is usually teacher-centered. The Ministry of education is continuously pressing on the need to incorporate innovation in the teaching pedagogies and shifting from a teacher-centered to student-centered (Kaur, 2017). Education for the future will have to change. With the rapid change that we are experiencing in the 21st century, the mindsets of the children we educate inside the classroom have drastically changed. Grade 6 science assessment descriptions over the years constantly highlight the need to help boost students' ability to read and understand the questions well before taking the tests. National Examiners tremendously emphasized the necessity to re-teach the science concepts by teachers. The need to cultivate high-order thinking skills inside the classrooms and, most importantly, grasp basic scientific terminologies during an exam. In almost every subject in Fiji, especially elementary science, NER remarks highlight teachers' and student social

interactions during teaching and learning (National Examiners Report 2015, 2016, 2017, 2018, 2019).

It has hindered the promotion of critical or problem-solving skills. Shared ideas, interactive learning/collaborations, creativity, experiential learning, real-world problem solving (Dale & Newman, 2005), or participative learning occur inside the classroom, which could help improve science achievement levels.

1.2. Overview of the Low Comprehension Skills in Primary School Science

The heavy reliance on textbooks, chalk, blackboard, and rote memorization teaching from teachers to disseminate information to children in science has allowed most children in grade 6 to accomplish only up to primary knowledge level type of questions during external examination. All the skills like participative, active, experiential learning, and discovery learning are supposed to develop. It is a different case in elementary science as replicated from the examiner's statement. Fiji has another issue due to the limitation in the language barrier and inadequate innovation of teachers' competencies on the shift in the new teaching pedagogies. Furthermore, the reform in the reorientation of education in the 21st century has made many Fiji teachers unaware of the global change or transformation in the education system. While in the past until the present day, we are still involved in strict adherence to a fixed curriculum, and the teacher's role is always directive, rooted in authority (WNET, 2004). Perceptions towards the linguistic ecology of Fiji have always been by the interaction of the i'Taukei, Hindi, Urdu, Rotuman, and English languages (Chand, 2015). Although i'Taukei and Hindi are dominant vernacular languages in Fiji, learning each other's vernacular languages was not compulsory for either group until recently (Chand, 2015).

The limitations in using local language and familiarizing themselves with their identity could revitalize and strengthen the regional terminology, which would help solve the problems of low comprehension skills at the elementary level in science subjects. According to Chand (2015), Fijians must interact freely for better integration and vibrant society.

Understanding science education at the grassroots level with the Constructivism learning orientations seeks to understand how people create their knowledge constructs and understanding influences thought processes (Gogus, 2012). To curb the issue, it is vital to solving the problem by analyzing the grade 6 science achievement level. NER examined in detail the commentary submitted by the examiner's report in 2019.

1.3. Overview of Science Curriculum in Fiji

Ministry of Education has already incorporated science topics into the curriculum standards. It is in the form of multidisciplinary. Suppose an Inquiry-Based Learning Approach promotes Education for Sustainable Development (ESD) in science subjects in all schools (Small. T, 2018). In that case, **Inquiry-based Learning will help students** make connections about what they **learn**. Their curiosity **helps** them engage and gain a deeper understanding of topics and content instead of primarily memorizing and recalling rules, ideas, or formulas (Pappas, 2014).

While the traditional methods approach works on some students, we cannot say that it is not good. However, we can only suggest ways to improve teachers' competencies increase students' interest and motivation in learning.

If we have to improve our students' teaching delivery, we might need to re-focused on an Inquiry-based approach. Inquiry learning is compatible with the Itakura method (Kasetsu Jikken Jugyo) and constructivist approach, emphasizing that students but co-created by the student. It encompasses a broad spectrum of techniques, ranging from teacher-directed structured and guided inquiry to student-directed open questions (National Research Council [NRC], 2000)

Table 1. Inquiry-Based Instruction vs. Traditional Teaching Approaches

	Inquiry-Based	Traditional
Principle Learning Theory	Constructivism	Behaviorism
Student Participation	Active	Passive
Student Involvement in Outcome	Increased responsibility	Decreased responsibility
Student Role	Problem solver	Direction follower
Curriculum Goals	Process-oriented	Product-oriented
Teachers Role	Guide/facilitator	Director/ transmitter

Source: Silber (2021)

Table 2 reveals some of the common characteristics surrounding Fiji primary school's science education concerns. While the Ministry of Education, Heritage, and Arts is currently undergoing a transitional period of changes and reforms to achieve the government's vision of improving the quality of education in Fiji and making Fiji a knowledge-based society. Some elements or barriers remain stagnant, limiting the achievement level of our Fijian students inside the classrooms.

Due to the language barrier, science terminologies become too abstract and irrelevant for some children to grasp the learning outcome. The mindsets of valuing (vs) under-valuing formal education in Fijian society depend entirely on each family. There is a contradiction between school culture and home culture. There is a mismatch between Western teaching styles and Fijian student learning styles. It requires a more emphasis on the ethnic Fijian concept of collectivism/collaboration, which is fulfilling one's role within a group (White. C.M, 2007). Japan is successfully executing these skills. It can also be rejuvenated in Fiji to match learning styles from home and schools, reducing the emphasis on individual achievement heavy stress on rote- learning. In reality, in schools, children are prohibited from using their native language; however, to use English as the official language of instruction, linguistic also plays a vital role in reducing abstract science concepts. If preserved and translated, these could also improve achievement levels to match learning styles from home to school.

2. Overview of the 2019 Year 5 and 6 Fiji Primary School Science Curriculum

Table 2 displays the three science subjects covered in Year 5 and 6. All three science subjects combined are known as 'General Subjects.' Ministry of Education examined students are in grade 6.

2.1. 2019 Fiji Intermediate Examination Blueprint

Table 3 explicitly indicates the 2019 detail test blueprint used to guide and target question items used to formulate the tests to achieve the three cognitive levels in Blooms' Taxonomy (Bloom et al., 1956). This test blueprint improves consistency across test forms and helps ensure that the goals and plans for the test match with curriculum content in each prepared test. It precisely shows and justifies that the concepts and skills prescribed in the curriculum are well taught in class and covered in the exam transcripts. It is tested during exams to indicate the student's attainment level by the end. It helps teachers layout curricular aims and thinking skills expected of students.

In the General Subjects, Safety concepts in Health Science subjects dominate the most significant number of question items distributed to each cognitive level with 17 questions while Living Things and Environment concepts in Elementary Science subject had a total of 15 questions only subsequently. Place & Environment, Resources & Economic Activity in Social Science have 6- 5 questions items distributed to them. In comparison, Human Growth & Development in Health Science has six questions allocated to these concepts. Concepts such as Time Continuity &

Table 2. Typical Characteristics of Science Education in Fiji.

Key Area	Common Diagnostic Features
Rationale	In 2014, no child was to be left behind. The Ministry of Education policy guarantee quality education, inclusive and equitable for Fiji to become a knowledgeable society by investing in the communities. However, students to be equipped with thinking skills to examine the information and make logical decisions are slow deliberately in General subject (science) NER.
Mediums of Instruction	English is the second language, subsequently Fijis` official language of instruction, while local language is the mother- tongue.
	Even teaching at an elementary level, teachers must teach all subjects. Primary school teachers are not Science specialists.
	Internal professional development arrangements focus on literacy, numeracy teaching, and learning. The lack of science apparatus and inadequate science laboratory resources at the elementary level in Fiji limits the student's achievement level in conducting a worthy science lesson.

Source: Ministry of Education (2015)

Table 3. science Curriculum Topics covered in Grade 5- 6 External Exams (2019)

No.	Subjects	Strand	Sub-strand
1	**Social Science**	Social organization & Processes	Personal, Social Groups and Processes, Cultural Identity, Diversity, and Cohesion
		Time Continuity & Change	Understanding the Past, Continuity, and Change
		Place & Environment	Features of Places, People, and Care of Places
		Resources & Economic Activity	Use and Management of Resources, People, and Work
2	**Health Science**	Safety	Safety procedures, safety skills, raising emergency alarms, developing refusal strategies when offered harmful substances, developing skills handling natural disasters.
		Human Growth & Development	Topics such as hormones, puberty, relationships, lifestyles, peer pressure, nervous systems, heart, minds, and development of humans children learned under these strands in the textbooks.
		Building Healthy Relationships	Managing healthy relationships, resolving conflicts, positive and negative effects of peer pressure, distinguishing and recognizing aggressive behavior
3	**Elementary Science**	Living Things & Environment	Students learned about life cycles, human activities, plants, reproductions, animals, conservations, the environment, and human activities
under these strands.		Matter	laboratory, three states of matter, natural, recycled or reused, investigate changes.
		Energy	Electric circuit, electromagnet, electrical energy, forms of energy, levers, pulleys, and wheels. Care and safety of working with machines.
		Earth & Beyond	Children learned weather patterns, environment, human life, weathering process, and living organisms.

Source: Fiji National Curriculum Framework (2013)

Table 4. Year 6 Blueprint External Examinations (2019)

Subjects	Concepts		QUESTION TYPES						SKILLS			MARKS	WEIGHT
		NO. OF QUESTIONS	M/C	T/F	M	F/B	I/L	LA	Knowledge	Skills	Application/ Attitude		
Social Science	Social Organization & Processes	5	1 1x2m		1 1x1m	2 2x1m		1 1x1m	(2)(1) 1x2m 1x1m	(2) 2x1m	(1) 1x1m	**6**	5/80x100= 6.25
	Time Continuity & Change	5	1 1x2m	2 2x1m	1 1x1m			1 1x1m	(2)(3) 1x2m 3x1m		(1) 1x1m	**6**	5/80x100= 6.25
	Place & Environment	9	2 2x2m	1 2x1m	1 1x1m	2 2x1m	3 3x1m		(4)(3) 2x2m 3x1m	(5) 5x1m		**12**	9/80x100= 11.25
	Resources & Economic Activity	6	2 2x2m			2 2x1m		2 2x1m	(4) 2x2m	(2) 2x1m	(2) 2x1m	**8**	6/80x100= 7.5
Health Science	Safety	17	5 5x2m	2 2x1m	1 1x1m	2 2x1m	3 3x1m	4 4x1m	(10)(3) 5x2m 3x1m	(5) 5x1m	(4) 4x1m	**22**	17/80x100= 21.25
	Human Growth & Development	6	2 2x2m		2 2x1m	2 2x1m			(4)(2) 2x2m 2x1m	(2) 2x1m		**8**	6/80x100= 7.5
	Building Healthy Relationships	3		1 1x1m				2 2x1m	(1) 1x1m		(2) 2x1m	**3**	3/80x100= 3.75
Elementary Science	Living Things & Environment	15	2 2x2m		3 3x1m	4 4x1m	4 4x1m	2 2x1m	(4)(3) 2x2m 3x1m	(8) 8x1	(2) 2x1m	**17**	15/80x100= 18.75
	Matter	5	2 2x2m	1 1x1m	1 1x1m			1 1x1m	(4)(2) 2x2m 2x1m		(1) 1x1m	**7**	5/80x100= 6.25
	Energy	4	1 1x2m	2 2x1m				1 1x1m	(2)(2) 1x2m 2x1m		(1) 1x1m	**5**	4/80x100= 5
	Earth & Beyond	5	2 2x2m	1 1x1m		1 1x1m		1 1x1m	(4)(1) 2x2m 1x1m	(1) 1x1m	(1) 1x1m	**7**	5/80x100= 6.25
Total		80	20	10	10	15	10	15	60	25	15	**100**	**100**

Source: Ministry of Education (2019)

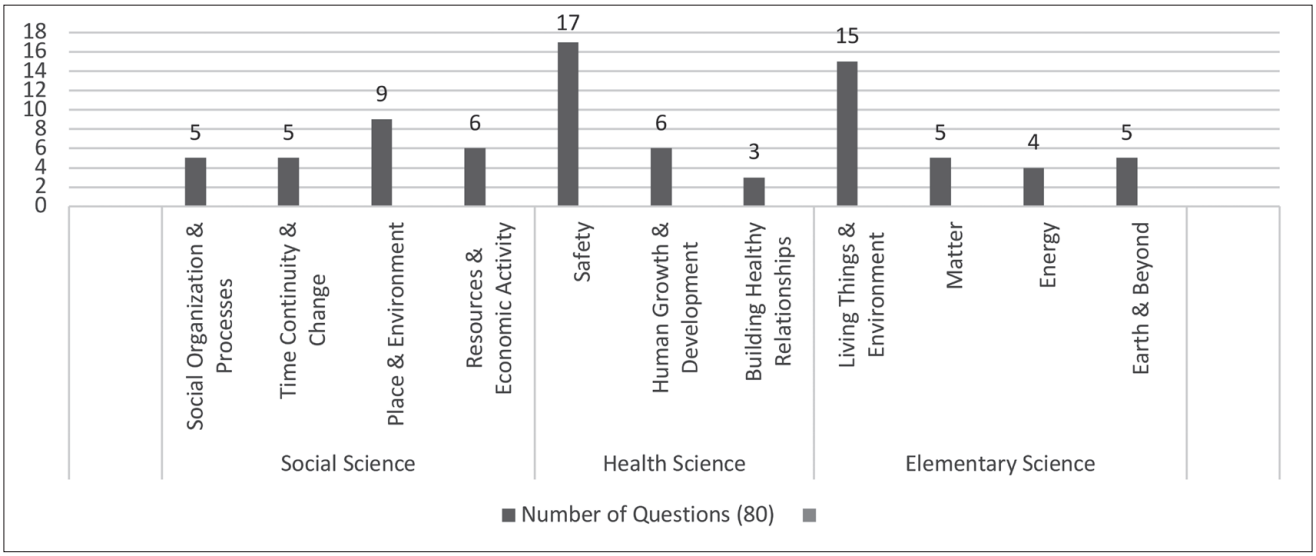

Figure 1. Year 6 Exams- Total No. of Question Allocated in each Concept. Source: Ministry of Education (2019)

Change, Matter, Earth and Beyond, Social organization, and Building a Healthy Relationships have the least number of questions distributed to them consist or ranges from 3-4 questions only.

According to Figure 1, a total number of 11 concepts were devised into questions, tested altogether, and distributed to the three-level of skills from Bloom's taxonomy. They were knowledge-based questions, comprehension skills questions, and application skills-based type of questions. Statistically, there is an inconsistency in the distribution of questions. Based on Figure 1, safety concepts in Health Science subjects with Living Things and Environment topics have the most significant number of questions allocated under these categories. In contrast, other topics' number of questions varies.

When setting any standard exam papers in school or externally, teachers must ensure that the matrix or chart representing the number and the type of test questions described across the topic in all content areas are consistent and equally distributed. Eighty questions were still not equally distributed to the 11 concepts from the three science subjects. A total of 7 questions is supposed to be the average number of questions that were supposed to be allocated to each idea to make it consistent and balanced likewise well distributed to each relevant skill accordingly. According to Figure 1, two concepts (Safety:17, Living Things & Environment 15) have exceeded the average number of questions needed allocating in the assessment in particular strands. There is an imbalance reflected in the blueprint. It has a side effect on the students' cognitive level with the results—considerations on an equal number of questions allocated for all concepts. Otherwise, teachers resort to rote memorizing teaching methods and delivering information focusing more on the exam-oriented learning style rather than process-oriented.

Concepts on Place & Environment had nine questions allocated under its category, Resources & Economic Activity had six. In comparison, Human Growth & Development had six questions relatively at least they were all within the average range score. On the other hand, six concepts in science subjects were just below the average allocated score. This table indicated the level and the order of importance from what we are testing in our curriculum. It also reflects in the order of importance.

The questions allocated for the topic Matter varies from other concepts; therefore, encouraging students to cultivate critical thinking skills, participative, active, collaborative, is rarely emphasized. These skills could be enhanced using Inquiry-based Learning. Strengthening basic science skills like observing, measuring, predicting, and inferring could be improved. Active learning and keeping students engaged are priorities using the 5E model of instructions.

2.2. Science Comparative Analysis of the Percentage Pass and Percentage Fail from 2017-2019

According to these results in Figure 2, Examiners

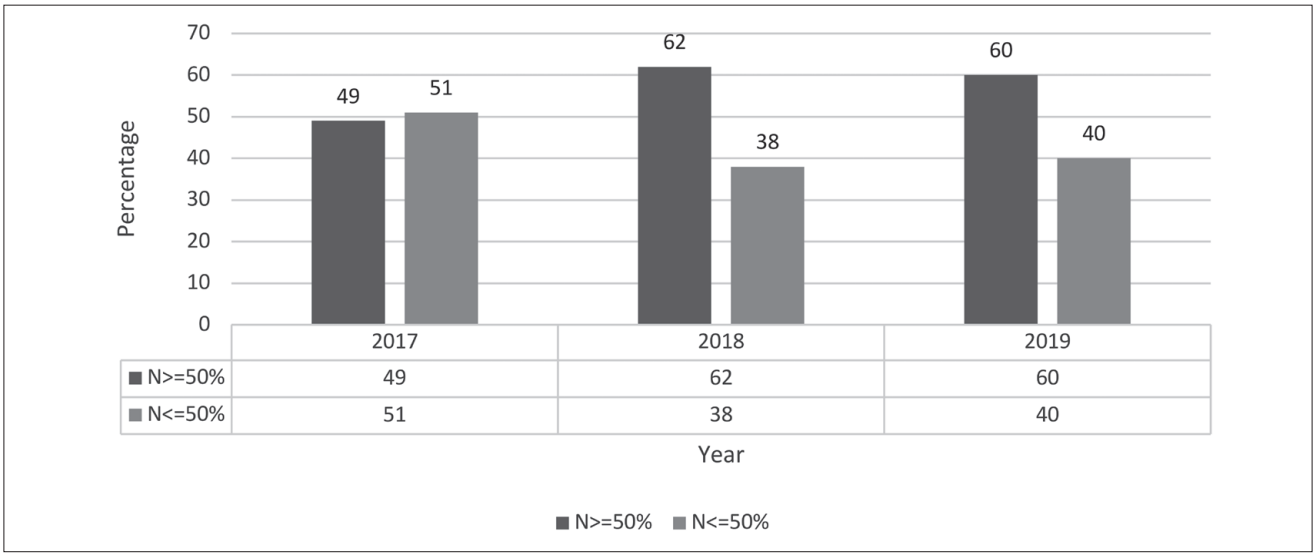

Figure 2. Percentage of passed and failed students. Source: Ministry of Education (2017, 2018, 2019)

Report 2015-2019 reiterated that the teacher focuses more on teacher-centered instruction. Students are less likely to engage in inquiry learning or critical analyses (Au, 2009). Standardized test measures determine how well students will perform on achievement measures rather than focusing on whose knowledge, language, and points of view are most worth learning (Sleeter & Stillman, 2013). A classroom or place of learning that confines the curriculum to quality teaching to the assessment assists in undermining the opportunity for students to be curious in engaging and challenging ideas. When students are engaged and challenged, thinking is likewise **metacognition** are attained (Eisner, 2013). Metacognition awareness, thus, tend to make students more systematic in idea thinking and helps them identify errors before they proceed too far in the wrong direction of the inquiry process (Keselman, 2003). The more accurately students can describe their thinking, the more effective they can self-regulate their learning during the inquiry learning process and become expert inquiry performers (Loh, B., Reiser, B. J., Radinsky, J., Edelson, D. C., Gomez, L. M., & Marshall, S., 2001).

2.3. Analysis of the Number of Questions Allocated in Each Concept from 2018-2019

Cognitive Achievement Level.

The low order thinking skills in the cognitive level consist of Multiple-choice sections, and below

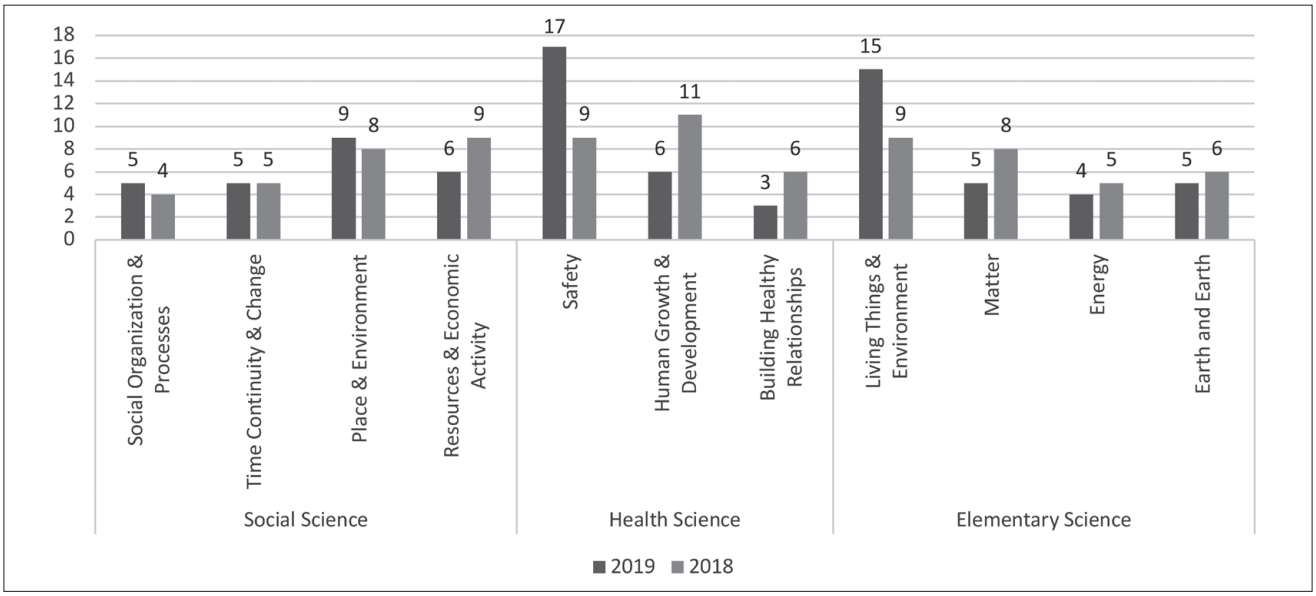

Figure 3. Year 6 external exam number of questions allocated in each concept in 2018 and 2019

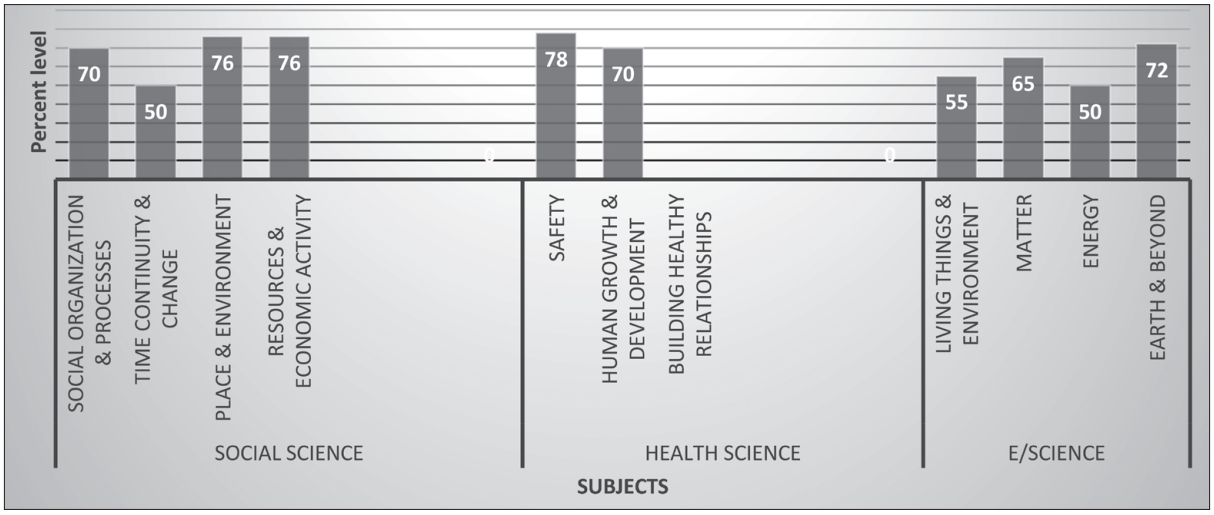

Figure 4. Concept of basic knowledge achievement level. Source: Ministry of Education (2019)

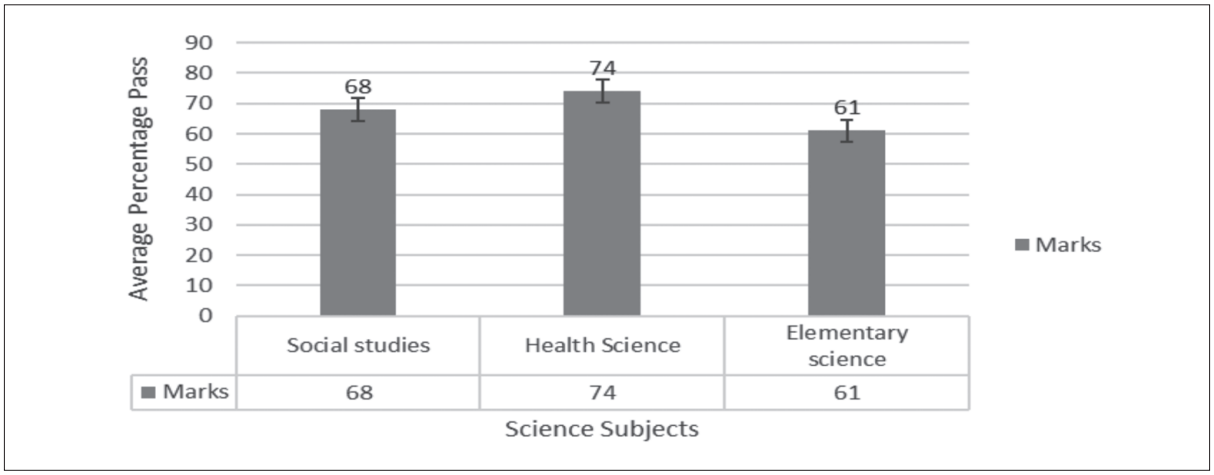

Figure 5. The total average percentage pass in the knowledge skills sections.

shows the percentage level achieved from different topics covered from the three other subjects. To encourage students to comprehend well, they must be engaged **in hands-on investigations** in the process of developing their **strategy of science** and **inquiry skills**, such as **making observations,** raising **hypotheses**, collecting and **organizing data**, drawing **conclusions**, making **inferences**, and finding a **solution** (Zion, 2012)

There is a need to prioritize and improve the science literacy level of students with more interactive strategies and intervention methods at the school level. The students' science concepts did not attempt well-included topics like Matter, Energy, Living Things & Environment and Time, Continuity, and Change.

2.4. Total Average % Pass in Multiple Choice Sections (Knowledge-Based Skills)

The students well attempted the knowledge-based level. Health Science has 26 questions allocated derived from topics such as Safety, Human Growth, and Development. Students understood the concepts well taught inside the classrooms, with an acceptable score of 74%. Students sitting for external exams did well in two topics covered in health science strands. Students deal with food daily; hence, they understand the essentials needed in every home.

The majority of students did well in Health Science. However, a few of them misinterpreted the concepts tested. Social Science subjects have 25 questions distributed in these focus areas, whereby the nationwide average was 64%. The students pretty attempted it, and they identified the correct answer. Students tried the four concepts tested under these strands; moreover, they did well. Elementary science

has four ideas tested, which come to the total number of 26 questions under the knowledge-based skills on which satisfactorily attempted energy topic. At the same time, 50% of the students got the correct answer in Living Things & Environment. The students well understood the Matter and Earth and Beyond topic.

3. Factors that needed improvements.

3.1. Teacher-student ratio

The teacher teaches as many as fifty students or more in some classrooms, compromising quality teaching and one-to-one support. On the same note, shared workload, cooperative Learning, integrating activities and programs to lighten the task at hand are vital. To receive more government grants in some primary and secondary schools, the head of schools are getting as much enrolment as possible (Chand,2013).

3.2. Curriculum and Teaching pedagogies

The fast-changing pace from the past decade till the 21st century has transformed how we interact with people. The way we think, encounter problems, and think critically has been the center of attention for all primary levels of education in almost every country.

The science achievement level in assessment is evident that students struggle to comprehend; nonetheless, teaching pedagogies remain stagnant from teachers responsible for improving the science achievement level. Our curriculum has remained stagnant for decades (Chand, 2013); thus, education stakeholders continuously invite innovative ideas and pedagogies to improve classroom lessons.

4. General Conclusion

We can only suggest ways to improve pedagogies to help teachers cultivate Critical thinking/Problem-Solving skills about science achievement levels in school, which is why the researcher is proposing another innovative way to introduce a new pedagogy. **Inquiry-Based learning** integrated with (**Kasetsu Jugyosho**) will likely help teachers. It will help students be more engaged in science lessons fostering critical and problem-solving skills well-structured proven to have also helped increase achievement rate for students in assessments. The Itakura method is a Japanese teaching technique that places students at the forefront of the lessons, allowing/empowering them to express their opinions to one another. It will strengthen Structured Inquiry-Based Learning or IBL. Both have similar connotations that value **metacognition**. Both are compatible with Constructivist learning theory, which requires students to think at a higher level, assess information, make hypotheses, and conduct experiments.

Inquiry-based learning is grounded in the **constructivist** learning approach. It focuses on the importance of the learner constructing their knowledge rather than memorization of information (Pappas, 2014). The meaning is the process of discovering to (Itakura method-Kasetsu) developing these fundamental skills with the learner **formulating hypotheses and testing them by conducting experiments** or making observations (Pedaste et al., 2012); otherwise, students will have shallow knowledge of the concepts taught. There are four forms of inquiry known in inquiry-based instruction. They are **confirmation inquiry, structured inquiry, guided inquiry, and open inquiry** (Pappas, 2014). The first level of inquiry is confirmation inquiry, in which students assist with the question and method. Results should be in advance with this type of inquiry (Tafoya, Sunal, & Knecht, 1980). The second level of inquiry learning is structured learning, where the students are made aware of the experience of conducting investigations or practicing specific inquiry skills like those of collecting and analyzing data (Banchi & Bell, 2008). The third level of inquiry is guided inquiry and is the level of inquiry instruction used as the treatment for this action research study. Guided inquiry is the inquiry level where the teacher provides the question and procedure; however, the students arrive at an explanation supported by research they have collected (Tafoya, E., Sunal, D. W., & Knecht, P., 1980). The final level of inquiry learning is free inquiry. In free inquiry, students form their questions, design their methods of investigation, and carry out the inquiry process without guidance from the teacher (Pappas, 2014).

The **5-E model** consists of five phases: engagement, explanation, exploration, elaboration, and evaluation (Warner & Myers, 2008). The **5-E model** is relevant and allows children to find problems to solutions. The model places heavy emphasis on collaborative learning and activity. Students are cognitively **engaged** in

sense-making, developing evidence-based explanations, and communicating their ideas. The teacher plays a crucial role in facilitating the learning process and may provide content knowledge just-in-time (Hmelo-Silver, C.E., Duncan, R.G. & Chinn, C.A., 2007). In guided inquiry, the teacher acts as a facilitator and scaffolds the content whenever needed to ensure the correct flow of knowledge for students in the inquiry process. Scaffolding makes learning more attainable for students by changing complex and challenging tasks in ways that make these tasks accessible, manageable, and within the student's zone of proximal development (Rogoff, 1990; Vygotsky, 1978). With the teacher scaffolding the inquiry process, the students can engage in sense-making, managing their investigations and problem-solving strategies, and articulate their thinking and reflect on their Learning (Quintana, C., Reiser, B.J., Davis, E.A., Krajcik, J., Fretz, E. & Duncan, R.G. 2004). While rote memorization is an essential skill to master, an inquiry is a skill that will take you into the 21st century, and exploration allows students to seek answers and find resolutions (Cox, 2009).

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