Chapter 4

Teaching and Learning Primary Science for Marginalised Children

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Additional information is available at the end of the chapter

http://dx.doi.org/10.5772/intechopen.68577

Abstract

In the twenty-first century, the demand for large scale human capital workforce based on scientific knowledge is rising especially in Science, Technology, Engineering and Mathematics (STEM)-related carriers. Innovative societies need people who are equipped with scientific knowledge and competencies. But, science education has tended to be perceived as irrelevant and not interested by marginalised children. Therefore, this study aimed to determine the impact of the learning outside the classroom (LOC) module on academic achievement and intrinsic motivation of marginalised learners in learning science. For that, quasi-experimental design with pre-test post-test, non-equivalent control group research design was implemented. The treatment group (n = 38) used LOC module, while the control group (n = 35) used conventional module in teaching science. Academic achievement evaluates using Science Achievement Test (SAT), whereas intrinsic motivation evaluates using Intrinsic Motivation Questionnaire (IMQ). Data obtained from AT and IMQ were analysed using independent-sample T-test and MANOVA repeated measures. The results showed non-significant increase in SAT mean scores in the treatment group. The findings also indicate that there is no significant main effect and interaction effect between group and time towards intrinsic motivation. As a result, the two teaching methods do not have significant and positive impact on intrinsic motivation among marginalised learners.

Keywords: academic achievement, intrinsic motivation, learning outside the classroom (LOC), marginalised children, primary science module

1. Introduction

In the twenty-first century, the demand for large scale human capital workforce based on scientific knowledge is rising especially in Science, Technology, Engineering and Mathematics

(STEM)-related carriers. Innovative societies need people who are equipped with scientific knowledge and competencies. Therefore, STEM education has become extremely important in today's world in order to produce STEM literate students who are capable of identifying, applying and integrating STEM concept in understanding complex problems and able to generate innovation to solve the problems [1].

All societies in the world have ways to educate their people because education has always played a very important role in the development of a society, in which it can affect self-development, can improve living standards, shape the future and also develop human capital. Moreover, the importance of educational qualifications increases drastically as the number of low-skilled jobs in the employment market nowadays decreases. Malaysia, a developing country in the twenty-first century, is constantly working to improve the level of STEM education among its people including marginalised students. Efforts to raise the level of education among marginalised children in Malaysia have always been given serious consideration. This is to ensure they become full participants that are capable of utilising the knowledge and skills that can contribute to the society. Through education, individual's gap can be reduced and the level of competence among students can also be increased [2].

The rapid development taking place in Malaysia has opened up opportunities to the process of modernization and also access to education, especially for marginalised groups that are still considered backward. Therefore, marginalised children should move forward and adapt themselves in this new era through STEM education so that they will not be left behind when compared with other communities. In addition, it also provides marginalised children for a future that requires knowledge and application skills in a highly competitive job [3] in STEM-related carriers. Hence, factors that affect and contribute to learning process among marginalised children especially in science learning should be identified and studied so that a nation of high competence and high achievers in the field of STEM can be realised.

In recent years, studies have conducted on the affective domain in learning such as motivation as well as cognitive domain that focuses on knowledge learned in school [4]. Motivation is a pre-requisite and co-requisite for effective learning [5] and is said to have influence and impact on children learning outcomes [6]. Furthermore, the importance of motivation in learning has been studied extensively in education [4, 6–12] and has been widely recognised. This research focuses on intrinsic motivation because it was found to be very relevant and also one of the main factors affecting the academic achievement of learners [13–15] and regularly reviewed in academic achievement [16, 17]. According to Ref. [18], intrinsic motivation arises from the individual needs to achieve a certain level of competence. In addition, it involves fun in the learning process at school [13].

In addition to intrinsic motivation, conducive learning environment is also a very important factor in ensuring effective learning process among marginalised children. According to Ref. [19], marginalised children love learning activities that involve environment as they have deep feeling for the environment. Conducive and comfortable learning environment in school will lead to the enactment of meaningful learning among them. Therefore, the authors

http://dx.doi.org/10.5772/intechopen.68577

have initiated an innovation instructional strategy with the application and implementation of activities based on the environment in the process of the teaching and learning (T&L) science. Intervention that can enhance the level of science achievement and intrinsic motivation of marginalised children in primary schools in needed. With this, Learning Outside Classroom (LOC) primary science module has been developed as a mechanism to accomplish the desired goals. The purpose of this research is to determine the impact of LOC primary science module in enhancing science academic achievement and intrinsic motivation of marginalised children.

2. Education achievement and intrinsic motivation of marginalised children

Despite the importance of science nowadays in STEM education, science education has tended to be perceived as irrelevant and not interested by marginalised children. As Brianzoni and Cardellini [20] stated, many learners are often not interested in school science. Although various efforts and programmes has been taken by the Ministry of Education (MOE), marginalised children in Malaysia still showed low and unsatisfactory level in science performance [21, 22]. The level of science education among marginalised children still lags behind as compared to mainstream children. This is because marginalised children often associated with lower academic achievement when compared with children in the mainstream flow This situation not only happen in Malaysia but also faced by other countries such as Canada, Taiwan and New Zealand [23–28]. This is consistent with [29] which states that there are differences exist globally between the education level of native learners and non-native learners in their respective countries.

Overall, the motivation level to learn in school among marginalised children in Malaysia still consider low and has been reported to be at unsatisfactory level [30, 31]. This is further strengthened by Refs. [9, 32] which showed that Malaysian learners have low motivation in learning science. According to Mohammad and Abdul [33], the lack of motivation in learning has contributed to the occurrence of dropout and truancy from school that directly affects their academic achievement. Therefore, it is very important to raise the level of intrinsic motivation among marginalised children in Malaysia. With the increasing level of intrinsic motivation, hopefully, it can have a positive impact on the academic achievement of marginalised children.

Many studies conducted show there is a significant positive relationship between intrinsic motivation and academic achievement [6, 8, 11, 12, 34]. This relationship leads to the conclusion that the motivation can be used to predict the academic achievement of learners [35]. Therefore, we as educators are obliged to increase efforts to ensure that marginalised children have access not only to appropriate education but also to a scientific culture.

Hence, a form of science education that is holistic needs to be created to produce marginalised children who are science literate capable of applying science and technology to overcome the challenges of life now and in the future. Implementing new instructional strategies

and pedagogies in science education for marginalised children is extremely important to drastically improve the scientific literacy by giving value and enjoyment in learning science. New strategies needed to create opportunities for marginalised children to be motivated and actively involved in learning science, not only in the classroom, but also outside of traditional classroom. LOC primary science module requires teachers take children out of the classroom during the science T&L process. Hence, the learning process will occur in locations that are close to the environment. Marginalised children need to see its relevance in a societal sense to have the opportunity to be engaged in meaningful learning. This is because forest and the environment are important elements in their daily life. This fun and enjoyable situation will have positive impact and effect on their learning process and intrinsic motivation. Furthermore, Ref. [36] mentioned that LOC approach will be able to build dynamic knowledge and subsequently can explore the skills and abilities of the children. This is to prepare them to face the future when pursuing STEM careers that are highly competitive in the twenty-first century.

3. Conceptual framework of LOC primary science module

This LOC primary science module applied several theories of learning, namely behaviourist learning theory, cognitivist learning theory and constructivist learning theory. Behaviourist learning theory emphasises behavioural changes that can be observed and measured. The principles in Thorndike Theory [37] such as Law of Readiness (pupils readiness to learn), Law of Exercise (the importance of practice and repetition) and Law of Effect (the impact or effect which is obtained by pupils when doing an action) are taken into consideration. Additionally, the principle of reinforcement in Skinner's Operant Conditioning Theory [38] also applied together. Meanwhile, the cognitivist learning theory based on Ref. [39] which emphasises information processing in the mind also included in this module. Ausubel [39] emphasises meaningful learning and the use of advance organiser in the T&L process.

In addition, contextual approach based on constructivist theory that stimulates a person's mind to find meaning in context by making meaningful and relevant relationship to their environment also applied. The learning materials used are readily available from the environment in which these marginalised children are already familiar with these materials. This can make it easier for the children and enhance further the process of understanding the learning that takes place where the children can process new knowledge in a way that is meaningful to them. The sequence of information presentation during the science T&L process is based on Needham's Five Phase Constructivist Learning Theory [40] that is able to create learning environment that stimulates and motivates marginalised pupils. Needham's Five Phase Constructivist Model [40] involves the orientation phase, eliciting ideas, restructuring of ideas, application of ideas and reflection as shown in **Table 1**.

Apart from the learning theories above, the construction of the LOC module will also take into account the Cognitive Load Theory (CLT), which aims to reduce the learning load experienced

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Phase	Purpose	Examples of activities
Orientation	To attract students attention and interest	Experiment, video and film show, demonstration, problem-solving, song
Eliciting ideas	To be aware of the student's prior knowledge	Experiment, small group discussion, concept mapping and presentation
Restructuring of ideas • Explanation and exchanging ideas • Exposure to conflict ideas • Development of new ideas • Evaluation	To realise the existence of alternative ideas, ideas need to be improved, to be developed or to be replaced with scientific ideas To determine the alternative ideas and critically assess the present ideas To test the validity of the present ideas To improvise, develop or to replace with new ideas To test the validity of new ideas	Small group discussion and presentation Discussion, reading and teacher's input Experiment, project and demonstration
Application of ideas	To apply the new ideas to a different situation	Writing of individual's report on the project work
Reflection	To accommodate ones idea to the scientific ideas	Writing of individual's report on the project work, group discussion, personal notes

Table 1. Needham's five phase constructivist model.

by the students so that the learning process can occur easily, simply, and smoothly. CLT emphasises on the role played by short-term memory and long-term memory in a learning process. The load in short-term memory should be considered and given attention so that it does not exceed the capacity or limitations that can be processed. Hence, all three effects in this theory, namely the Split-Attention Effect, Modality Effect and Redundancy Effect taken into account and considered during the development of the module.

The instructional design model used is based on the Morrison, Ross, Kalman, and Kemp Model (MRKK) [41]. This model is the basis for the development of the module that will be prepared by the researcher in this study. It has nine major elements arranged in an oval-shaped cycle and is not linear. This means that the instruction can start anywhere that is considered appropriate. The cycle has no starting point or ending point. The process of review and evaluation will take place on an on-going basis to improve instruction. The MRKK Model is shown in **Figure 1**.

Motivation is said to have a significant positive relationship with academic achievement [7, 12–14]. Such relationship leads to the conclusion that motivation can be used as a predictor of academic performance. When marginalised children go through the T&L process based on this module, it is believed that positive changes in the aspect of intrinsic motivation can be demonstrated. This will also simultaneously influence and have positive impact on academic achievement in science. The conceptual framework discussed can be visualised in **Figure 2**.

Figure 1. MRKK model.

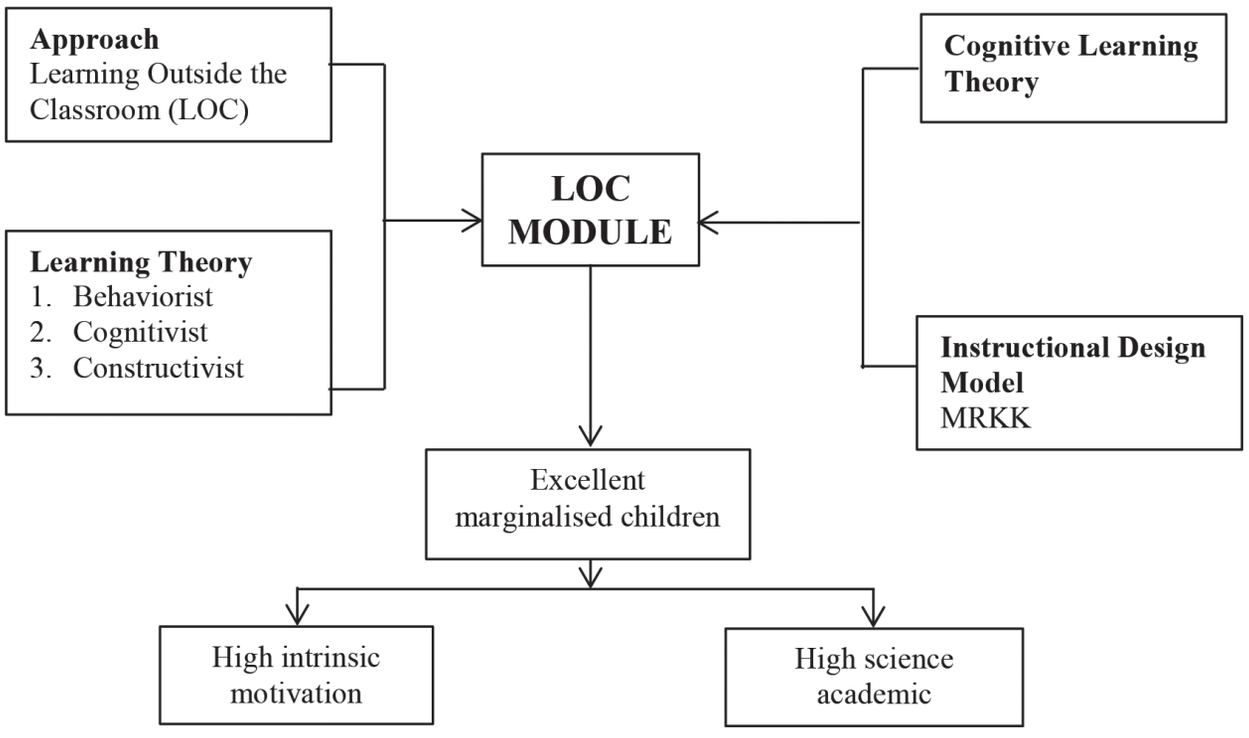

Figure 2. Conceptual framework.

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4. Application of theories in LOC primary science module

The sequence of information presentation during the T&L process is according to Needham's Five Phase Constructivist Theory (1987) [40] which involves the phases such as orientation, eliciting ideas, restructuring of ideas, application of ideas and reflection as shown in **Table 1**. The application of these learning theories is implemented in phases deemed appropriate during the science T&L process. In the orientation phase, the Law of Readiness in Thorndike's theory will be implemented. The learning objectives and the teacher's expectations of learners will be communicated to the learners at the beginning of the T&L session. In addition, the contents in the form of a mind map will also be presented to the learners. This is also appropriate with Ausubel's theory of learning [39] which emphasises advance organiser in which the conceptual relationship in the form of a mind map will be applied. The purpose is for the learners to prepare themselves to cope with and receive information that will be presented by the teacher.

During the eliciting ideas phase, learners are stimulated to review and be aware of their original idea of the concepts relevant to the topic to be presented. The discussion and questioning strategy can be used to trigger or elicit learners' original idea. Motivation in the form of encouragement and guidance can be used by teachers so that the learners feel comfortable in giving their answers or their views. This is as described by the Law of Effect in Thorndike's theory and also in Skinner's theory of conditioning that emphasise positive reinforcement and negative reinforcement.

The next phase is the restructuring of idea phase, where learners are aware of the existence of alternative ideas in the form of scientific ideas. In this phase, the pupils realise that the existing ideas that they have before this need to be modified or expanded to ideas that are more scientific. The outside of the classroom contextual approach that is implemented will be more meaningful to the learners. Meaningful learning is emphasised by Ausubel in his theory. Appropriate strategies and teaching techniques can be applied to allow an increase in learners' knowledge.

In the application of ideas phase, the process of consolidation of scientific ideas that was newly developed and established during the restructuring phase will be applied in other circumstances and situations. Repetition process in the form of exercises and drills can be carried out so that the newly acquired knowledge can be reinforced and applied in daily life. This coincides with the Law of Exercise in Thorndike's theory which emphasises on practice and repetition. Exercises will be given to the learners after the completion of each learning session in each subtopic taught by the teacher. This allows learners to master topics taught before proceeding to another subtopic.

The last phase is the phase of reflection. In this phase, learners are aware of the changes of the original idea to new ideas developed during the process of T&L. Comparison of original ideas with the new ideas is done by the learners and the learners will also reflect on the learning process that has resulted in the changes to the ideas to occur.

The contextual-based LOC approach that is implemented in this research is expected to increase the enthusiasm and interests of the learners to learn. The process of learning outside the classroom (LOC) brings learners out from the traditional classroom to the natural

environment where they would feel comfortable and familiar as their daily lives are surrounded by flora and fauna. The activities undertaken and the examples given will use materials that are familiar and enjoyable to the pupils. This is to encourage more meaningful learning so that they can associate it with the phenomenon around them or their daily life. Parts of lesson plan in LOC module are shown in **Figure 3**.

Application of ideas (25 minutes)	**Activity 2.3** ***Hands-on activity*: Plants need air to live.** Teacher tells students that they are going to conduct an investigation about the basic needs of plants that will involve air. Teacher elicits students' prior knowledge about control breathing: *T: Who can show teacher how to stop humans and animals from breathing?* *S: Cover your nose* *T: What will happen if you stop breathing or there is no air for you to breathe?* *S: Die / Fainted / Fainting* *T: Then, how to stop plant from breathing?* *S: Close the hole / Don't know* Teacher explains to students that if they cover the leaves with nail varnish, the holes on the leaves will be filled and this prevents leaves from getting air. *T: What will happen if the plant does not get air?* *S: Die* *T: You will carry out an investigation to see what will happen if the plant does not get enough air.* *S: Yes, teacher.* Teacher divides students into groups of 2-3 or at the discretion of the teacher. Each group appoints a team leader. Teacher shows students the materials / equipment needed to carry out the investigation for each group. Students start the investigation activity.	Contextual Early preparation: • Germinate the seeds into seedlings (1-2 weeks before the activity). • Place soil in a container.

Figure 3. Parts of lesson plan in LOC primary science module.

http://dx.doi.org/10.5772/intechopen.68577

5. Objectives

This research aimed to develop and determine the impact of learning outside the classroom (LOC) primary science module in enhancing science academic achievement and intrinsic motivation of marginalised children in remote area of Malaysia. With this, alternative T&L approach will be introduced beside the conventional teaching strategies practiced in rural schools in Malaysia.

6. Methodology

6.1. Research design

This research employed quasi-experimental of the type pre-test, post-test and non-equivalent control group design. Both the treatment and control group were tested with pre-test and post-test before and after the intervention implemented as shown in **Table 2**.

This research was conducted in four out of six marginalised primary schools in a remote area of Malaysia. Control group and treatment group comprised of two schools each in order to make sure that the number of respondents are more than 30 for each group. Control group used conventional module, while treatment group used LOC primary science module during T&L of science. The independent variable in this research is the study group, namely control and treatment group, while two dependent variables are science academic achievement and intrinsic motivation.

6.2. Respondent

Year 2 learners from four primary schools in interior part of Malaysia served as respondent in this research. A total of 73 respondents involved in this research in which the treatment group consisted of 38 Year 2 learners and the control group consisted of 35 Year 2 learners.

6.3. Instrument

Two instruments were used in this research which is Science Achievement Test (SAT) and Intrinsic Motivation Questionnaire (IMQ). Authors created two sets of SAT, namely pre-test and post-test which are equivalent in the aspect of number of items, level of difficulty,

Group	Test	Intervention	Test
Control	Pre-test	Conventional	Post-test
Treatment	Pre-test	LOC primary science module	Post-test

Table 2. Pre-test, post-test, non-equivalent control group design.

the format and the scope to test learners' knowledge in the topic "Plant", while IMQ was taken from Ref. [42], adapted from the Youth Children's Academic Intrinsic Motivation Inventory (Y-CAIMI) instrument in Ref. [14]. However, only two categories in IMQ were selected for this research, namely general construct and science construct. After the verification process by experts and pilot test was conducted, SAT contains 10 items, whereas IMQ contains 18 items which consists of 11 items from general constructs and 7 items from science constructs in the form of a 3-point Likert scale of "1 = Not True", "2 = Not Sure", and "3 = True". The reliability for SAT in this study showed a value of 0.711 using the Kuder Richardson approach and IMQ showed value more than 0.70 with Cronbach alpha coefficient.

6.4. Procedure

After pilot test, correction and improvements was done to the module and instruments before administered them in the actual research. SAT and IMQ were administered to respondents in both groups before the T&L on plants as pre-test to determine the homogeneity level of academic achievement and intrinsic motivation between the control and treatment groups. Control group used conventional module, while treatment group used LOC module during T&L session. At the end of the T&L session, SAT and IMQ administered again to the same respondents in both groups as post-test. Both SAT and IMQ administered by the provisions of the same time taken before and after the T&L session on "Plants" topic in both control and treatment groups.

6.5. Analysis

Quantitative data obtained through SAT and IMQ before and after the T&L session in both the control and treatment groups were analysed using descriptive statistics and inferential statistics. Independent samples T-test was conducted on the data collected during the pre-test to determine the level of homogeneity of the academic achievement and intrinsic motivation between the two groups involved. Independent samples T-test also performed on post-test to determine the effect of LOC primary science module in enhancing marginalised learners' academic achievement in science. In addition, MANOVA 2 × 2 × 2 repeated measures analysis was used to determine the effect of LOC primary science module in enhancing intrinsic motivation. Repeated measures involves two study groups (control and treatment), two time (pre-test and post-test) and two constructs of intrinsic motivation (general and science).

7. Research findings

7.1. Homogeneity of academic achievement and intrinsic motivation

Homogeneity analysis using T-test independent samples at 0.05 significant levels found that there were no significant difference between control and treatment groups in term of academic achievement and intrinsic motivation. **Table 3** shows pre-test mean score of academic

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Dependent variable	t	df	p	Mean difference
Pre-test academic achievement	−0.085	63.95	−0.932	−0.293
Pre-test intrinsic motivation	1.617	71	0.110	0.086

Table 3. Independent T-test pre-test mean score of academic achievement and intrinsic motivation according to groups.

achievement, $t = -0.085$ and $df = 63.95$, $p > 0.05$, and pre-test mean score of intrinsic motivation, $t = 1.617$ and $df = 71$, $p > 0.05$. The findings show that before the intervention, both the academic achievement and intrinsic motivation in the control and treatment groups were homogeneous. This allows comparison to be performed on the impact of LOC primary science module in the learning of "Plants" topic among marginalised children.

7.2. Science Achievement Test (SAT)

Before intervention, descriptive analysis found the pre-test mean score of SAT in control group, M = 46.29 (SD = 11:40), while pre-test mean score of SAT in treatment group, M = 46.58 (SD = 17.60). After intervention, descriptive analysis found the post-test mean scores of SAT in control group, M = 73.14 (SD = 21.11), while post-test mean scores of SAT in treatment group, M = 76.84 (SD = 14.91). Control group showed an increase mean score of 26.85, and treatment group showed an increase mean score of 30.26. Post-test mean scores of treatment group exceeds the control group by 3.70. **Table 4** shows the descriptive statistic of pre-test and post-test mean scores of AT according to groups.

Table 5 shows the analysis of the independent samples T-test of post-test mean score for academic achievement according to group. Results in **Table 5** showed that there is no significant differences in the post-test mean score of SAT between the control and the treatment groups, $t = -0.870$ and $df = 71$, $p > 0.05$.

7.3. Intrinsic motivation

MANOVA repeated measures 2 × 2 × 2 analysis was used to determine the impact of LOC primary science module in enhancing intrinsic motivation among marginalised children

Group	N	Test	Mean (M)	Standard deviation (SD)
Control	35	Pre	46.29	11.40
		Post	73.14	21.11
Treatment	38	Pre	46.58	17.60
		Post	76.84	14.90

Table 4. Descriptive statistics pre-test and post-test mean score of achievement test according to groups.

in this research. The findings in **Table 6** showed that there is no significant main effect of group on intrinsic motivation [F (2, 70) = 0.273, p > 0.05]. Data also showed that there is no significant main effect of time on intrinsic motivation [F (2, 70) = 2.574, p > 0.05]. The effect of the interaction between time with the group is also not significant to the intrinsic motivation [F (2, 70) = 3.039, p < 0.05].

However, further analyses as shown in **Table 7** found that there is a significant main effect of the time on the general construct of intrinsic motivation [F (1, 71) = 5.054, p < 0.05]. Further descriptive analysis found that the pre-test mean score of general construct (M = 2.633, SD = 0.282) exceeds the post-test mean score of general construct (M = 2.526, SD = 0.369). This means that the level of intrinsic motivation among marginalised children generally has not been increased, but it decreased significantly across time.

The results in **Table 7** also found that there is a significant interaction effect between time and group on general construct of intrinsic motivation [F (1, 71) = 4,423, p < 0.05]. Further analysis using a paired T-test for control group general construct of intrinsic motivation was significant (t = 2.600, df = 34, p < 0.05), while the paired T-test results for the treatment group general construct of intrinsic motivation were not significant (t = 0.127, df = 37, p > 0.05). **Table 8** shows the results of paired t-test.

Dependent variable	t	df	p	Mean difference
Post-test academic achievement	−0.870	71	0.387	3.699

Table 5. Independent T-test post-test mean score of academic achievement according to groups.

Effect	Pillai's trace value	F	df1	df2	p	Partial eta squared
Group	0.008	0.273	2	70	0.762	0.008
Time	0.069	2.574	2	70	0.083	0.069
Group × time	0.080	3.039	2	70	0.054	0.080

Table 6. Multivariate test.

Effect	Construct	Squared total	df	Mean squared	F	p	Partial eta squared
Time	General	0.452	1	0.452	5.054	0.028	0.066
	Science	0.129	1	0.129	0.911	0.343	0.013
Time × group	General	0.396	1	0.396	4.423	0.039	0.059
	Science	0.457	1	0.457	3.239	0.076	0.044

Table 7. Effect within subjects test.

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Construct	Group	Test	Mean (M)	Standard deviation (SD)	t	df	p
General	Control	Pre	0.214	0.491	2.600	34	0.014
		Post					
	Treatment	Pre	0.007	0.349	0.127	37	0.900
		Post					

Table 8. Results of paired T-test for general construct of intrinsic motivation according to time and group.

8. Discussion

The findings in this research showed that both LOC primary science module used in treatment group and conventional module used in control group give equal or similar impact in improving the academic achievement of marginalised children. This result directly indicated that the LOC module is not very effective as compare to conventional module in improving the academic achievement of Year 2 marginalised children in Malaysia. In this research, information still effectively conveys to marginalised children although conventional module was used. This may be due to the fact that marginalised children live in surroundings full of wide variety of flora and fauna. According to Ref. [43], knowledge of plants is unique among marginalised people around the world. With the familiarity of plants among marginalised children, it does not make any significant difference between using conventional module or LOC module during T&L science in school.

Nevertheless, there is an increase in the mean score of 3.70, when LOC primary science module was used. In comparison, it can be said that LOC module has more positive impact than the conventional module although it does not show any significant difference. In the LOC module, teacher requires to bring children out from the traditional classroom for the T&L session. This situation led the children near to the environment and close to the natural flora and fauna. This provides an opportunity for children to learn science in a new environment that is conducive and comfortable for them. A conducive learning environment coupled with fun may be a contributor to the slightly higher mean score in the LOC module compare to the conventional module.

The findings also indicated that the LOC primary science module is ineffective in enhancing intrinsic motivation among marginalised children as a whole. Although there are significant main effects of the time and significant interaction effect between time and group on the general construct of intrinsic motivation, but both, respectively, showed a decrease over time. The significant decrease in the mean score on general construct of intrinsic motivation in the control group showed that conventional module has a significant negative impact on intrinsic motivation among marginalised children. For comparison purposes, it can be said that LOC primary science module is better than the conventional module, although both modules did not bring positive impact on the general construct of intrinsic motivation among marginalised children.

Although LOC primary science module did not significantly increase academic achievement and intrinsic motivation among marginalised children, it does not necessary indicate that this module is not good. Such declines can be due to several reasons. One of the reasons may likely due to the change of strategy or approach to T&L used by teachers in the treatment schools that create a negative impact on the achievement and motivation of these marginalised children. From the conventional approach that is more teacher-centred to the implementation of learner-centred activities in LOC primary science module has brought drastic change to the marginalised children. This change causes something unusual to them. As reported by Ayla [4], this drastic change causes negative impact among marginalised children in Turkey.

Another reason of ineffective LOC primary science module may relate to the existing level of marginalised children's achievement and motivation for learning as a whole. Many studies reported that these marginalised children are weak in their studies and show lower cognitive level compared to mainstream learners. Refs. [30, 31] also reported that marginalised children do not show enthusiasm and high motivation in the process of learning. The learning process among marginalised children only occurred when they are in school. They do not study at home because of parents are not interested in education, and moreover, they cannot see the importance of education for their children. This directly affects the academic achievement and intrinsic motivation of marginalised children.

These findings bring us to suggest a few proposals in order to enhance the academic achievement and intrinsic motivation among marginalised children in Malaysia. The curriculum used for this marginalised children should be revised and updated. As reported by Ayla [4], review of science curriculum that is more focused on matters relating to life will directly affect the environment in the classroom and in turn have a positive impact on children's learning in Turkey. In addition, shifting the focus from cognitive aspect to psychomotor and affective aspects of the learning process of the marginalised children in the curriculum can be considered. This is because marginalised children are poor in cognitive aspect and the attention span of these children is limited.

Besides that, integration of local culture and environment in the new curriculum may help to make the curriculum more relevant to the marginalised children. This modification or integration in accordance with the culture and environment of marginalised or indigenous communities have occurred in other countries such as Canada [44, 45] and New Zealand [46]. With this integration, marginalised children can relate what they have learned in science to their daily lives. Marginalised children can see the relevance of education and science in their daily lives and in turn can increase their intrinsic motivation towards learning science. According to Ref. [47], it is not enough to introduce learners to new and updated developments in science, but they need to see its relevance in a societal sense to have the opportunity to be actively involved in the process of learning.

Modification and improvement can be conceived to overcome the weaknesses of the LOC module in order to give more significant and positive impact. The blending of suitable strategies and pedagogies with curriculum that integrates culture and environment of the indigenous community in the new module can and should have more positive effect compared to the module used in this research. All these are in hope that the level of motivation

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among indigenous learners can be raised to a higher point. As stated in Refs. [48, 49], modules that use suitable strategies and pedagogies with curriculum that integrates community's culture and environment can give more positive impact in the process of T&L.

9. Conclusions

Although LOC primary science module in this research did not give favourable effect towards achievement and intrinsic motivation, but it has implications especially to T&L practices and marginalised children. Lesson plan in the module helped teachers to conduct the T&L in a more systematic manner besides enhancing their higher order questioning skills. The group activity created more fun learning and hence contributed towards active participation, which ultimately enlightened the marginalised children about the importance of studying science. This instructional strategy introduced in LOC module also allows children to learn science in a meaningful way. The aim is to produce human capital among marginalised communities in the twenty-first century for a future that requires knowledge and skills in a job application that is highly competitive.

With the limitations in our research, we also encountered questions in need of further research. T&L science module which integrates local culture and environment of indigenous knowledge that are suitable and practical for marginalised children should be carried out. The module created can be a way to guide novice teachers especially in teaching science to marginalised children too. In addition, using indigenous language in the process of T&L science for marginalised can be studied too. This method has been carried out successfully in Canada for First Nation's community and in New Zealand for Maori community. Further research is also needed to effectively blend learning experiences in formal and informal learning in order to significantly enhance the academic achievement and motivation in learning science for marginalised children. In conclusion, several efforts to improve the T&L process need to be taken seriously in the hope of enhancing motivation towards learning science among the indigenous learners. Various teaching issues and challenges in marginalised schools need to be solved so that the T&L process can be implemented effectively towards marginalised children. With this, they too can contribute to achieving a high level of scientific literacy and STEM literate community.

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