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*Research Article*

# Effect of science camp for enhancing STEM skills of gifted young scientists

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**Abstract**

Programs and educational practices that enable gifted students to conduct science activities and develop themselves in engineering fields are rapidly increasing in Malaysia. One of them is the science camp to improve STEM skills. This study investigates the effectiveness of science camp (Junior Science Camp) towards young children's understanding and knowledge about science. One hundred and three children aged four to six years old participated in the three-day camp. Mixed research model was used in this research. Data were collected by Junior Science Camp Scientist Test (JSCST) as pre and post-test, parent evaluation of the camp. Questions in the pre and post-test were on the content in the five camp modules: I am an engineer, I am a scientist, I am a chemist, I am a forensic scientist, and I am a natural scientist. Data from the open-ended question in the survey (parent evaluation) were used to triangulate the quantitative data from the pre and post-test. Findings showed that the camp was effective in enhancing the young children's (preschoolers') understanding about science and increasing their knowledge about science and STEM fields. Implications of this study are related to the design of future science camps and also the methodology and instruments of future research.

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## Introduction

The importance given to science education and raising young scientists is an important feature of developed countries. In high school and university education in science education, Malaysia has ensured that this area is largely (60%) in the curriculum. Nevertheless, the target has yet to be achieved, besides it was determined that there was a decrease in the interest of students in the field of science (Halim & Meerah, 2016). Numerous policie, obstacles, and strategies formulated by Malaysian governments especially the Ministry of Education to deal with this issue. Quality of teaching has been cited as one of the factors that determining of the students' interest holistically in science at early years (Halim & Meerah, 2016). Saleh (2014) study findings showed that most of Malaysian high school students think that Physics activities are not atractive and enjoyful. Exciting and motivating teaching strategies might help in promoting interest in learning science. Responding to this, in year 2019, Pusat GENIUS@Pintar Negara, Universiti Kebangsaan Malaysia in collaboration with National Child Development Research Centre (NCDRC) at Universiti Pendidikan Sultan Idris took the initiative to organise a Science, Technology, Engineering and Mathematics (STEM) camp to young children with high ability. The most authentic way of introducing science to young children is to let them make their own

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discoveries and conduct activities and experiments as real scientists. Thus, science camps might be a great chance for this kind of science learning and discovering. Gagne (2000) in the Differentiated Model of Giftedness and Talent defined giftedness as potential that places an individual in the top 10% of same-age peers in a particular domain. Gagne´ emphasized that a developmental process of formal and informal learning is needed for these abilities to be transformed into talents or systematically trained abilities (achievement). Gagne´ highlighted that both the characteristics of the and the environment are crucial catalysts in the process of talent development. Therefore, the camp is conducted as an effort to provide enrichment activities for young children with high ability. Porter (2005, p. 148) defined enrichment for young gifted children as "the provision of broader, deeper or more varied educational experiences". Early identification of gifted young children, suitable and challenging educational programs are crucial for the attainment of gifted young children's full potential.

Leblebicioglu et al. (2019) define science camps as educational activities which are voluntary and held outside of school settings, and provide planned and structured activities. The participants receive certificates after completion of the camps, and the camps are evaluated to gauge its effectiveness. They empahsise that science camps must provide both formal and informal learning experiences to the participants.

## Literature Review

### Studies on science camp for young children

Studies on science camps provided some insights about the effects on the participants. For example, Gulsen Leblebicioglu, Metin, Yardimci, and Cetin (2011) investigated Turkish children's stereotypical images of scientists in a science camp where a team of scientists interacted formally and informally with twenty-four 6th and 7th grade students. The objective of the camp was to acquint the participants with the nature of science and scientists. Data on the children's images of scientists were from the analysis and discussion of their drawings of a scientist. Their images were challenged through the introduction of three non-stereotypical scientists. Draw a Scientist Test (DAST) as pre- and post-test was used to investigate the change in the children's images of scientists. The participants were also interviewed about their drawings. The findings suggested that the stereotypical images found in the pre-test were scientists were depicted as males and old. However, almost equal numbers of male and female scientists were sketched in the post-test, and they were portrayed as middle aged or young. The researchers concluded that the camp has been effective in making the children to grasp the human nature of scientists that both genders could be scientists, and not necessarily one needs to be old to be a scientist.

Hirça (2014) on the other hand, studied the result of a science camp which emphsised on the Nature of Science (NOS) instruction (explicit-reflective method) with on 30 Turkish gifted students. The open-ended Views of NOS Questionnaire used to assess the changing of students' NOS views. The pretest results determined that half of the gifted students were either at the transitional level or the informed level of the NOS. Findings after the science camp showed that the most of gifted students' NOS views advanced to the transitional view. This study may indicate that science camps for gifted students are very useful in supporting development in an important issue such as the nature of science.

Borgerding and Kaya (2019) conducted a study to investigate preschoolers's view about organisms, their environments, and justifications for linking organisms and their environments during the learning experiences in a week-long summer science camp at a preschool in the United States of America. The focus of the camp was on the concept of biological adaptation where the preschoolers's thinking about organisms, their environments, and the association between organisms and their environments was elicited. 53 preschoolers aged three to six enrolled in two iterations of a week-long summer science camp. Data collection involved 53 preschoolers aged three to six through daily sticker-sorting assessments and interviews with individual preschooler after the camp. Scores from the preschoolers's sticker placements and the reasons for stationing organisms in the selected environments were the data. Findings showed that age, environment, and organism-related trends play a role in the preschoolers' ability to decide the correct environments for the organisms, and influence their justifications for positioning organisms in specific environments. These findings add on to existing literature on preschool evolution education by drawing attention to what preschoolers are able to understand, and the rationalization they provide. Based on the findings, they proposed for developmentally-appropriate science education instruction for preschool children. As this study did not focus on student learning and the effects of instruction in this learning, the researchers suggest that future studies could investigate the influence of instruction in changes in children's ideas. Future studies could also realate these changes to camp experiences.

Metin and Leblebicioglu (2011) reported findings regarding effectiveness of science camp on Turkish children's conception of science. 24 children (11 girls and 13 boys) attended the ten-day science camp. Science teachers took part in the science camp. These educators carried out activities to support the development of students' research skills and collaboration skills throughout the science camp. In the subsequent days, the participants conducted guided-inquiry about the nature in small groups. NOS activities were carried out throughout the camp. The students are divided into groups. Each group prepared a poster and presented it to their families on the last day of the camp. In order to find out the effectiveness of the science camp in introducing science and its specific aspects, Views of Nature of Science Version D (VNOS D) was used as pre- and post-test. The findings showed that science camp program had positive effects on children's conceptions of science where they reported more scientific perspective. The NOS activities gave chances for them to learn more about scientific processes. Some of the participants showed more progress and were able to give more detailed expressions in defining science. In this science camp, students became aware of the details of the process and product parts of science. It has been stated that providing science education through nature and science camps is effective due to its characteristics such as active participation and exploratory thinking.

Results from previous studies on science camps for children and students showed that science camps have been effective in increasing children's understanding of nature of science and scientists, improved students' understandings of NOS, and brought positive effects on children's conceptions of science. Most of the studies in the literature related to science camp for children were from the western contexts and Turkey. Studies in Malaysia on science camp, especially for young children with high ability were scarce. Thus, this study was conducted to investigate the effectiveness of science camp to enhance STEM understanding and knowledge for young children with high ability.

Identification of gifted and talented children and providing appropriate and challenging educational experiences for them is firmly placed on the education agenda in many countries such as the UK and the US (Koshy & Robinson, 2006). However, the needs of the younger gifted children (those whose age is from 4 to 6 years old) have been neglected. In Malaysian context, Phillipson, Kaur, and Phillipson (2003) highlighted that gifted education was not given much priority in the education system, not only within the local community but also at the ministry level. However, recent literature (Ch`ng, 2014; Chan, 2018; Yassin, Ishak, Yunus, & Majid, 2012) on gifted education in Malaysia showed that Malaysian Ministry of Education has been reviving gifted and talented programmes for Malaysian students aged 13 to 17 years old. However, the identification and provision of appropriate educational experiences for younger children are still limited. Thus, Pusat GENIUS@Pintar Negara, the only government gifted school in Malaysia has taken the initiative to carry out the Junior Science Camp for younger gifted children.

### Research Problem

Thus, this study is carried out to investigate the effect of science camp for enhancing stem skills of gifted young scientists. The main research question is 'Does the science camp (Junior Science Camp) has an effect towards the young children's understanding and knowledge about science?' The second reserach question is 'What are the parents' opinion of the camp?'

## Method

### Research Design

This study employed a quantitative method of inquiry to answer the research questions (Creswell & Creswell, 2003; Nardi, 2018). This survey research involved acquiring information from the parents' of the young gifted participants of the science camp.

### Participants

The parents or caregivers were asked to sign a consent form for their children to be involved in the camp. The participants were from various family background. The demographic profile of the participants is shown in Table 3 below.

**Table 1.**

*Demographic Profile of the Participants*

| Age(Years old) | 4 years old | | 5 years old | | 6 years old | | Total |
|---|---|---|---|---|---|---|---|
| Residential area | Urban | Rural | Urban | Rural | Urban | Rural | |
| **Male** | 2 | 0 | 8 | 3 | 24 | 7 | 44 |
| **Female** | 2 | 2 | 16 | 4 | 27 | 8 | 59 |
| **Total** | 4 | 2 | 24 | 7 | 51 | 15 | 103 |
| | 6 | | 31 | | 66 | | |

As can be seen in Table 1, 103 pre-school students living in rural and urban areas were selected for the study according to the stratified and criteria sampling method. Attention has been paid to the fact that the students are 4, 5 and 6 years old and they live in rural and urban areas.

**Research Instruments**

**Junior Science Camp Scientist Test**

The data collection tools included pre and post-test, and the questionnaire on the camp effectiveness. Both data collection tools were developed by the the committee members of the camp. To complement the quantitative data, an open-ended question was added in the questionnaire to determine the opinions' of the parents of the pre-school students who attended the science camp about its effectiveness and also to collect recommendations for future camps. The data obtained through the parents' responses about the science camp were subjected to content analysis. It is presented in the form of themes, with direct quotations.

**Data Analysis**

It was determined that the data collected by data collection tools are applicable to normal distribution. Therefore, the t-test was used in statistical analysis of the pre and post -test marks. Paired sample T test was conducted to investigate the effectiveness of the intervention using the five STEM-based modules in the camp on participants' understanding and knowledge of STEM. Moreover, frequency, percentage, mean and standard deviation scores for each program effectiveness evaluation item of the questionnaire were calculated.

The pre and post tests contain similar questions on the STEM content and activities in the five modules (an example of module content is shown in Figure 1 below).

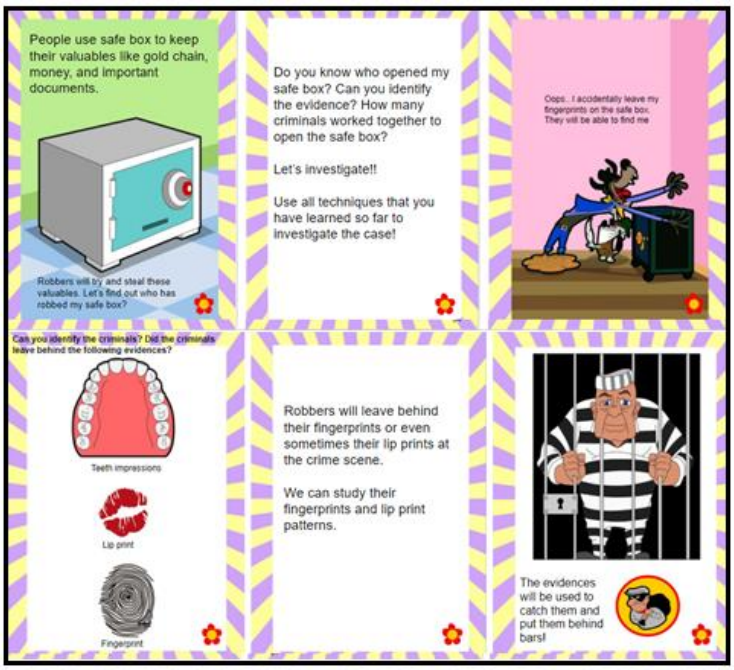


**Figure 1.**

*Module Content : I am a Forensic Scientist*

The five modules are 'I am an engineer', 'I am a scientist', 'I am a chemist', 'I am a forensic scientist', and 'I am a natural scientist'. There are twenty five questions with multiple choice answers. The children were only required to circle the correct answers. The mean and standard deviation were calculated for both pre and post test marks. Figure 2 below shows examples of some questions for the pre and post tests.

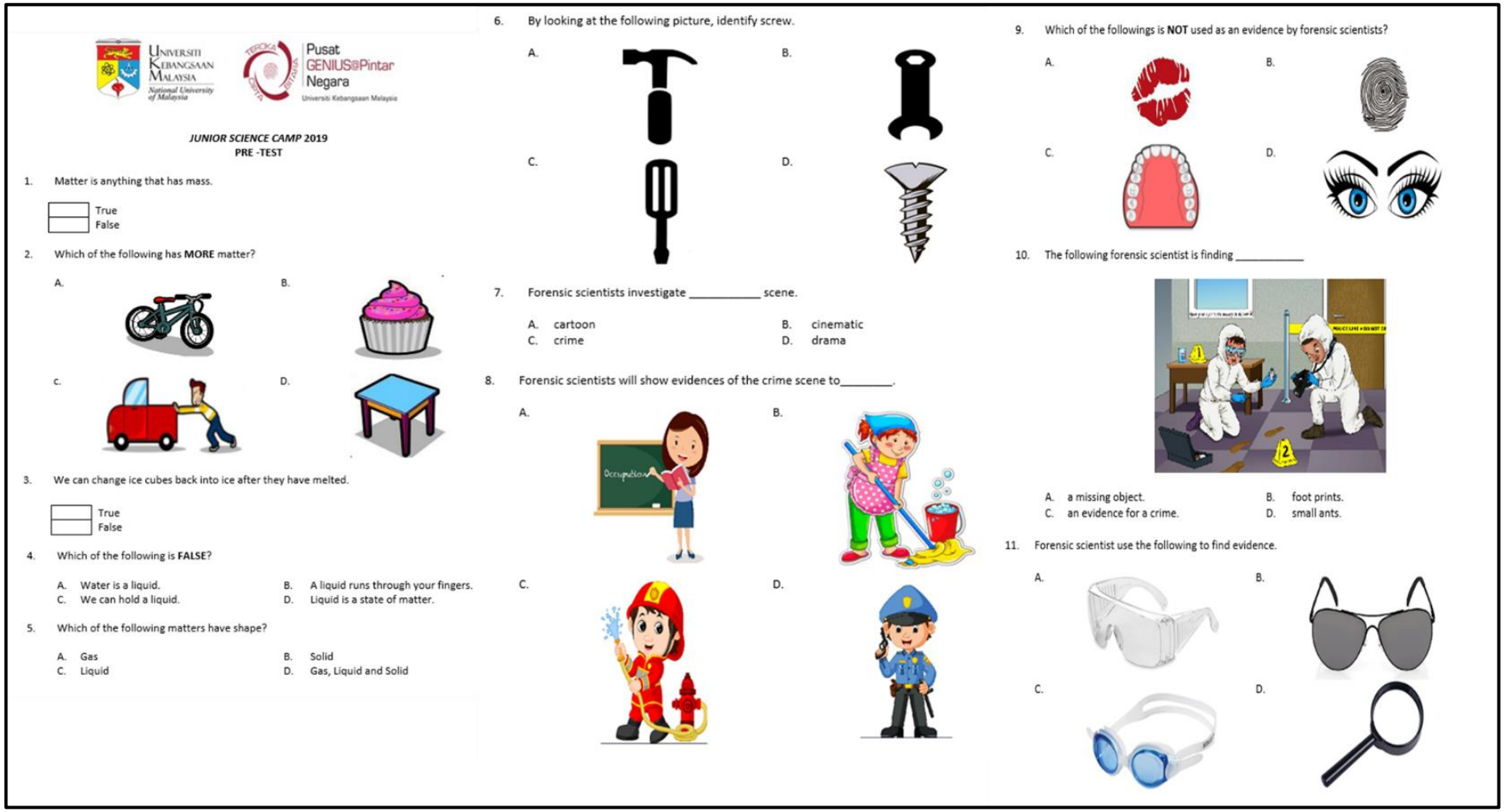


**Figure 2.**

*Questions for the Pre and Post Tests*

As for the questionnaire for parents, only the data from one section of the questionnaire were used to triangulate the data from the pre and post-tests. There were 3 sections in the questionnaire; 1) Implementation of the camp, 2) Administration of the camp, and 3) Effectiveness of the camp. Only the data from the third section, Effectiveness of the camp, were included in the data analysis. The mean of the responses was calculated. The reliability score for the evaluation of implementation of the camp, management, and effectiveness of the camp is between 0.780 to 0.909 (as shown in Table 1 below). While the Cronbach's alpha for the overall JSC 2019 Program Evaluation is 0.921 (16 items). This shows that the instrument used has good reliability.

**Table 2.**

*Instrument (Survey for Parents) Reliability*

| Variables | Cronbach's Alpha | Number of items |
|---|---|---|
| Program implementation evaluation | 0.780 | 4 |
| Program management evaluation | 0.891 | 6 |
| Program effectiveness evaluation | 0.909 | 6 |
| Overall (JSC 2019 Program Evaluation) | 0.921 | 16 |

In the questionnaire on the camp effectiveness, there was an open-ended section on Comments For Camp Improvement. The responses from the open-ended question enriched the data with more depth. The responses provided useful information on the parents' opinions and experiences. The open-ended question complemented the quantataive survey data. Only responses related to effectiveness of the camp in enhancing STEM understanding and knowledge for the young participants were regarded as the qualitative data. The qualitative data from the open-ended section of the questionnaire were analysed qualitatively where first codes were assigned. Then, the codes were categorized to identify the themes.

**PERMATA Children Intelligence Scale (PCIS)**

An online screening test, PERMATA Children Intelligence Scale (PCIS) was used to recruit the participants for the camp. It was developed by both National Child Development Research Centre (*NCDRC*) Universiti Pendidikan Sultan Idris (UPSI) and Pusat GENIUS@pintar, Universiti Kebangsaan Malaysia (UKM).

There are 5 aspects of cognitive ability tested in PCIS, which include i) abstract reasoning; ii) speed of information processing; iii) visual-spatial; iv) verbal comprehension and v) active memory. A pilot test of the PCIS was carried out with a sample size of 137 gifted and talented children from all over Malaysia (n=137). The reliability of the test is 0.918, which indicates that the test has high consistency in measuring young children's IQ. This shows that PICS is a reliable instrument to identify young gifted children because of its high stability. The validity score of the test based on each aspect is shown in Table 2 below. All the scores are above 0.70, and this proves that the items developed in the test are able to measure the desired variables accurately.

**Table 3.**

*Validity Score of Cognitive Ability Aspects in PCIS*

| Aspect | Validity Score |
|---|---|
| Abstract reasoning | 0.872 |
| Speed of information processing | 0.821 |
| Visual spatial | 0.770 |
| Verbal comprehension | 0.845 |
| Active memory | 0.771 |

The screening test was available online from 1 September, 2019 until 19 October, 2019 for children aged four to six years old. The children could do the test at any time convenient to them with the assisance of their parents or caregivers. However, parents or caregivers could only read out the instructions and questions and the children themselves must click or type the answers. If the test is taken at the pre-schools, the teachers must get the consent of the parents first. The evaluation and screening for the participants to be offered places at the camp were done after 19 October, 2019. The parents or caregivers of the selected children were contacted through email and phone calls in November, 2019. One hundred and three participants were selected to attend the camp at two venues, Pusat GENIUS@pintar, UKM and National Child Development Research Centre, UPSI.

**Research Context**

This section describes the research context where the STEM camp, module used for the camp, and research participants are presented.

**STEM Camp (Junior Science Camp)**

The Junior Science Camp was held at Pusat GENIUS@pintar, Universiti Kebangsaan Malaysia (UKM) and National Child Development Research Centre (*NCDRC*) Universiti Pendidikan Sultan Idris (UPSI) for three days from 9 a.m to 4.30 p.m. The camp was handled by five main instructors and teacher assistants (aged 20-24 years old) who were science graduates with Degree and Masters qualifications. The instructors and teacher assistants were given training for four days by the camp organisers who were science lecturers at the gifted centre on the aspects of traits of gifted children, teaching and learning for the gifted children, and how to carry out the activities in the five camp modules and programme. The training was conducted based on the Teacher's Manual prepared by the camp organizer.

There were five modules: I am an engineer, I am a scientist, I am a chemist, I am a forensic scientist, and I am a natural scientist. The modules were published by Pusat PERMATApintar Negara. The focus of the content of the modules was on doing science where the camp participants were expected to be involved in the hands-on STEM activities and experiments.

## Results

The results answer the two research questions; 'Does the science camp (Junior Science Camp) has an effect towards the young children's understanding and knowledge about science?' and 'What are the parents' opinion of the camp?'

**The First Section of the Results Answer the First Research Question**

**Effect of the Camp Towards the Young Children's Understanding and Knowledge About Science**

The results show that there was an increase in the participants' scores in the post-test. The mean and standard deviation are higher in the post-test as shown in Table 4 below.

**Table 4.**

*Paired Sample t-Test*

| Test | No | Min | Standard Dev. | t -value | Correlation | Level of Significance |
|---|---|---|---|---|---|---|
| Pre | 103 | 12.58 | 4.53 | - 3.92 | 0.42 | 0.00 |
| Post | | 14.61 | 5.17 | | | |

Paired sample T test (as shown in Table 4 above) was conducted to see the effectiveness of the intervention using the five STEM-based modules in the camp for participants' understanding and knowledge of STEM. All 103 participants answered the pre-test before the activities started on the first day of the camp and the same questions were given on the last day of the camp after all the modules had been completed by the participants. The full score for the pre and post-test was 25. The average score for the pre-test for all 103 participants was 12. 58 and 14.61 for the post-test. The analysis of t test showed a significant improvement with pre-test ($M = 12.58$, $SD = 4.53$) and post-test ($M = 14.61$, $SD = 5.17$); $t(102) = -3.92$, $p = 0.05$. The pre and post-test scores showed a significant positive correlation ($r = 0.42$). Overall, there was an increase in marks in the post-test, and this proves that the STEM based learning and activities in the module have successfully improved the understanding and mastery of STEM knowledge among the young participants. This shows that this STEM camp has achieved one of its objectives which is to increase children's knowledge related to science through all the modules used.

**Table 5.**
*Program Effectiveness Evaluation*

| No. | Statement | STS | TS | N | S | SS | Mean | SP |
|---|---|---|---|---|---|---|---|---|
| C1 | The objective of the program to cultivate interest in the STEM field is achieved. | 0 (0.0) | 0 (0.0) | 1 (1.0) | 39 (40.2) | 57 (58.8) | 4.58 | .517 |
| C2 | The content of the program is suitable to generate interest towards STEM. | 0 (0.0) | 0 (0.0) | 0 (0.0) | 30 (30.9) | 67 (69.1) | 4.69 | .465 |
| C3 | My understanding of program content increased compared to prior attending the program. | 0 (0.0) | 1 (1.0) | 5 (5.2) | 33 (34.0) | 58 (59.8) | 4.53 | .647 |
| C4 | Participants can increase their knowledge in related STEM fields after attending this program. | 0 (0.0) | 0 (0.0) | 3 (3.1) | 28 (28.9) | 66 (68.0) | 4.65 | .541 |
| C5 | I feel I'm able to use the *Junior Science Camp* module to teach my child about *Science, Technology, Engineering and Mathematics* (STEM). | 0 (0.0) | 0 (0.0) | 5 (5.2) | 33 (34.0) | 59 (60.8) | 4.56 | .595 |
| C6 | Overall, this program is successful and beneficial. | 0 (0.0) | 0 (0.0) | 1 (1.0) | 30 (30.9) | 66 (68.0) | 4.67 | .494 |
| | **Overall** | | | | | | **4.61** | **.453** |

(Level: Low = 1.00 – 2.33, Average = 2.34 – 3.66, High = 3.67 – 5.00)

Table 5 above shows the frequency, percentage, mean and standard deviation scores for each program effectiveness evaluation item measured by 6 items from the third section (Effectiveness of the camp) of the questionnaire. The results show that all six items have a high score with a mean range between 4.53 to 4.69. Based on these results, item C2 which is *"*Program content is suitable to generate interest towards STEM*"* recorded the highest mean (mean = 4.69, SP = 0.465), while item C3 which is *"*My understanding of program content increased compared to prior attending the program*"* recorded the lowest mean (mean = 4.53, SP = 0.647). Overall, the program effectiveness evaluation score (mean = 4.61, SP = 0.453) is at a high level.

**Qualitative Research Results**

**Parents' Opinions of the Camp**

Qualitative analysis of data (responses in the open-ended section of the questionnaire for parents) resulted to themes which emerged during the analysis, Theme 1. Exposure and spark interest in science, Theme 2. Effectiveness of camp module and instructors, Theme 3. Suggestions for improvement of future camp. Parents' opinions that the science camp has been successful in giving exposure and creating the young children's interest in science were evident in the following response.

**Theme 1. Exposure snd Spark Interest in Science**

*Effective in providing exposure as kids have science technology and mathematics in primary 1 to 6.*
*Thanks to the effort, my son is very interested in science now.*
*It could make the children interested in science.*
*Overall, this program is very successful and gives new knowledge to participants and parents. Indirectly it can attract students in the field of STEM*

The responses could imply that the parents felt that their children have received good exposure to science and the children became interested to explore more in relation to science. Moreover, responses also include parents' thoughts that the camp has played a role in achieving Malaysian government's goal in producing more students who are interested in science and pursue further studies in science related fields.

**Theme 2. Effectiveness of Camp Module and Instructors**

The following response from a parent shows that the camp has been effective due to the comprehensive module which contains creative activities and interesting science experiments.

*… complex and creative modules that are rarely found in any institution*
*Well-established module, however, may be activities related to astronomy can be included because there is a planetarium here*

Besides the module, positive responses were also given by parents for the instructors and teaching assistants.

*A great module, dedicated instructor and teaching assistants who deliver wonderful work throughout the programme*
*Instructor and teaching assistants are skillful in handling young children. They are patient and my child likes them*
*My son has fun in this camp. Teachers and facilitators are diligent and wise in serving the needs of the children*

**Theme 3. Suggestions for Improvement of Future Camp**

Responses from parents also indicated their suggestions for similar camps to be conducted for primary school students throughout the country. The following response indicate parents' suggestion for science camp to be made available for primary school children in order to make them interested in science from early age.

*Similar camps at schools could foster students' interest in STEM at an early stage*

A parent suggested for the modules to be made available to other primary schools in the country, and the camp is opened to anyone regardless of background and intelligence score.

*I suggest these modules to be shared with all primary schools across the country. I think learning opportunities like this should be made available so that all students regardless of urban, rural, IQ level should be given the same opportunity*

However, a response indicated that the focus should be on the students from rural areas. This could make them more interested in science.

*This kind of program should be extended to more students (especially those in the rural areas) to enhance interest in STEM among students.*

There were responses that the module, experiments and activities were not thought-provoking enough for the participants. Thus, comments include suggestions for more various and challenging experiments to be included. The responses from parents also include suggestions for improvement of the camp.

*Increase the use of more 'scientific terms' that can increase children's curiosity*

The evidence from this study suggests that generally the parents were satisfied with the science camp, and parents' responses include suggestions for the participants to be invited to participate in future science camps so the children's interests in science can be further nurtured and enhanced. Responses also include suggestions for longer duration of camp as shown below.

*A very interesting camp, can cultivate students' interest in STEM. Maybe lengthen the camp duration to 4 or 5 days.*
*Include more learning by doing activities and also field trips*

## Discussion and Conclusion

This study was conducted to investigate the effectiveness of science camp to enhance STEM understanding and knowledge for young children with high ability. The findings show that the program effectiveness evaluation score is at a high level. The findings of this study make several contributions to the current literature on positive effects of science camp to students. The findings reveal that there was an increase in marks in the post-test, and this has proven that the STEM based module and activities have been effective in enhancing the understanding and mastery of STEM knowledge among the young participants. This indicates that the STEM camp has accomplished one of its objectives which is to increase children's knowledge related to science through all the modules used. An important finding was that the camp has been successful to generate interest towards STEM. This is consistent with the findings in Konur's (2019) study where students' interest increased in the post-test due to the activities carried out in the science camp for the secondary school students, and they could better relate chemistry to their daily life. There are suggestions for the inclusion of more hands-on experiments and field trips in future camps. This corroborates previous findings which showed that learning science by doing enhanced students' positive attitude towards science and nature (Birinci Konura, Şeyihoğlu, Sezen, & Tekbiyik, 2011), had positive impact on students' interests toward biology, their career decision and perception concerning biology and daily life (Sezen Vekli, 2013), and promoted positive behaviour toward animals, empathy, and conservation behaviour (Bexell, Jarrett, & Ping, 2013).

An interesting finding from the qualitative data of this study is the positive response about the teaching instructor and assistants. As they were carefully selected by the camp coordinator and were trained well, they were committed and showed enthusiasm in handling the activities and the young participants' behaviours. This finding is in agreement with Colker's (2008, p. 72) 12 characteristics of effective early childhood teachers: "(1) passion about children and teaching, (2) perseverance, (3) risk taking, (4) pragmatism, (5) patience, (6) flexibility. (7) respect, (8) creativity, (9) authenticity, (10) love of learning, (11) high energy, and (12) sense of humor". The teaching instructor and assistants showed patience, flexibility in carrying out the camp activities, respect for the children and were energetic.

Although this study's findings show that the camp has been successful, there are some comments for improvement given by parents. Following suggestions should be considered while designing future science camps or programs: First, include more first-hand activities, experiments, and field trips which will give exposure and chances for students to be engaged in various STEM related experiences such as astronomy, engineering and others, second, lengthen the camp duration, third, offer science camps to underprivileged students from the rural areas, and fourth, plan camps which have continuation and not just a one-off program. Future camps may also consider to include arts, as STEAM (Science, Technology, Engineering, Arts and Mathematics) education allows for children's engagement in arts activities which may enhance their holistic development not just cognitively, but also physically, social and emotionally. This is because while doing arts activities, children get the chance to practice diverse skills.

## Limitations of Study

Several limitations of this study need to be acknowledged. Future research might include parent interview to evaluate the effectiveness of the camp and observation of the children's carrying out the activities could be carried out to triangulate the data.

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## References

Bexell, S., Jarrett, O., & Ping, X. (2013). The Effects of a Summer Camp Program in China on Children's Knowledge, Attitudes, and Behaviors Toward Animals: A Model for Conservation Education. *Visitor Studies, 16*(1), 59-81. doi:10.1080/10645578.2013.768072

Birinci Konura, K., Şeyihoğlu, A., Sezen, G., & Tekbiyik, A. (2011). Evaluation of a Science Camp: Enjoyable Discovery of Mysterious World. *Educational Sciences: Theory & Practice, 11*(3), 1602-1607.

Borgerding, L. A., & Kaya, F. (2019). Preschool children's ideas about biological adaptation during a science camp. *International Journal of Science Education, 41*(17), 2410-2429. doi:10.1080/09500693.2019.1683911

Ch`ng, B. (2014). Affective Curriculum for Gifted Students in Malaysia: A Recommendation. *Journal for the Education of Gifted Young Scientists, 2*(2), 11-21.

Chan, D. W. (2018). Gifted education in Asia. In *APA handbook of giftedness and talent.* (pp. 71-84). Washington, DC, US: American Psychological Association.

Colker, L. J. (2008). Twelve Characteristics of Effective Early Childhood Teachers. *YC: Young Children, 63*(2), 68-73.

Creswell, J. W., & Creswell, J. (2003). *Research design*: Sage publications Thousand Oaks, CA.

Gagne, F. (2000). A Differentiated Model of Giftedness and Talent. Year 2000 Update. In.

Halim, L., & Meerah, T. S. M. (2016). Science education research and practice in Malaysia. In *Science education research and practice in Asia* (pp. 71-93): Springer.

Hirça, N. (2014). Effect of Summer Science Camp on Turkish Gifted Students' Views of Nature of Science. *Gifted & Talented International, 29*(1/2), 21-31. doi:10.1080/15332276.2014.11678426

Konur, K. B. (2019). The Effect of Chemistry Activities Applied in a Science Camp on Secondary School Students. *International Journal of Progressive Education, 15*(1), 151-166.

Koshy, V., & Robinson, N. M. (2006). Too long neglected: Gifted young children. *European Early Childhood Education Research Journal, 14*(2), 113-126. doi:10.1080/13502930285209951

Leblebicioglu, G., Abik, N. M., Capkinoglu, E., Metin, D., Dogan, E. E., Cetin, P. S., & Schwartz, R. (2019). Science Camps for Introducing Nature of Scientific Inquiry Through Student Inquiries in Nature: Two Applications with Retention Study. *Research in Science Education, 49*(5), 1231-1255. doi:10.1007/s11165-017-9652-0

Leblebicioglu, G., Metin, D., Yardimci, E., & Cetin, P. S. (2011). The effect of informal and formal interaction between scientists and children at a science camp on their images of scientists. *Science Education International, 22*(3), 158-174.

Metin, D., & Leblebicioglu, G. (2011). How did a science camp affect children's conceptions of science? *Asia-Pacific Forum on Science Learning & Teaching, 12*(1), 1-29.

Nardi, P. M. (2018). *Doing survey research: A guide to quantitative methods*: Routledge.

Phillipson, S. N., Kaur, I., & Phillipson, S. (2003). A late developer: Gifted education in Malaysia within a global context. *The Asia-Pacific Education Researcher, 12*(2), 135-175.

Porter, L. (2005). *Gifted young children* (2nd ed.). Sydney, NSW: Allen & Unwin.

Saleh, S. (2014). Malaysian Students' Motivation towards Physics Learning. *European Journal of Science and Mathematics Education, 2*(4), 223-232.

Sezen Vekli, G. (2013). Summer science camp for middle school students: A Turkish experience. *Asia-Pacific Forum on Science Learning & Teaching, 14*(1), 1-26.

Yassin, S. F. M., Ishak, N. M., Yunus, M. M., & Majid, R. A. (2012). The Identification of Gifted and Talented Students. *Procedia - Social and Behavioral Sciences, 55*, 585-593. doi:https://doi.org/10.1016/j.sbspro.2012.09.540