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Measuring Gifted Children in Accelerated Learning: A Pretest and Post-test Study of Knowledge Gain.

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ABSTRACT

This study used a pretest and post-test assessment to measure the accelerated learning approach applied to a group of gifted children. There were 14 samples of gifted children for this study. The pretest and post-test assessment reveals statistically significant differences in positive gains, which indicates that the gifted children involved gained knowledge from accelerated learning. The results reveal that the pretests can establish the gifted children's prior knowledge at the beginning of the class, while the post-test measures the learning that was gained after the classes. Specific hypotheses were formed regarding the knowledge gained to define the relationship and effect in the study after teaching acceleration topics to gifted children. The pretest and post-test knowledge gain were influenced by the content of the class and how it was presented and taught to the gifted children.

Index Terms— gifted children, accelerated learning, pretest, post-test

I. INTRODUCTION

Gifted children tend to demonstrate excellent abilities in various areas, such as intellectual intelligence, creativity, and academic skills, and their success in developing their potential can be obstructed if there is no effort to provide learning approaches that suit the needs of these children[1]. They need less repetition, varied instruction, more freedom to choose, facilitated education, and grouping by levels, as when they do not get this kind of differentiation, they get bored and frustrated [2].

The basis for boredom in gifted children is likely to be related to their characteristics as gifted individuals and their needs of extreme curiosity, the burning hunger for information, high energy levels, intensity, complexity, and drive, while not knowing their own needs, not being challenged, not using their talents, and not having kindred spirits in their lives [3]. Profoundly gifted children are extremely rapid learners with an ability to master content instantaneously and they prosper by working on complexity and seeking challenges, where they can accelerate radically, and can reason abstractly from an early age, reflecting a sophisticated desire to learn [4].

The study applies an approach that teaches gifted children in Chemistry accelerated topics. The 11-12 years old gifted children learned accelerated topics that are meant for 15-16 years old in the Malaysian curriculum syllabus. The teachers teaching the class are trained teachers who have been working with gifted children and have attended courses and seminars on it.

II. ACCELERATION LEARNING

Gifted children often have a strong desire for learning and acceleration can help nurture this passion by allowing them to explore more challenging and advanced topics, fostering a lifelong love of learning. Acceleration, enrichment, or a combination of them is the basis for supporting most gifted children [5]. Academic achievement is positively significant for gifted children who are impacted by acceleration, with accelerated gifted children outperforming their non-accelerated peers [6]. Acceleration does not mean pushing or forcing a gifted child to learn advanced material or socialize with older children, but it is about appropriate educational planning by matching the level and complexity of the curriculum with the readiness and motivation of the gifted child [7].

It is also stated that there is overwhelming research evidence that appropriate acceleration of gifted students

who are socially and emotionally ready usually has highly advantageous outcomes and when a gifted child's academic and social needs are not met, the result is boredom and disengagement from school. A longitudinal study of educational acceleration concluded that acceleration did not negatively affect psychological well-being [8].

In this study, an accelerated learning approach was applied to a group of gifted children. The accelerated topics were designed to attract, and interest gifted children to learn, while the environment is prepared for them to communicate and connect with the teachers. Teachers applying the approach are trained teachers who have encountered and taught gifted children.

The approach combines blended, visualization, and differentiated learning in a face-to-face class. Blended learning is targeted to draw interest towards gifted children, by integrating lessons in the classrooms with colourful presentations and online lessons with videos and songs. Numerous activities are included that allow them to visualize and understand the topic entirely. Gifted children have asynchronous development where uneven intellectual, physical, and emotional development exists with different abilities, and levels of lessons are not at the same level. Differentiated learning assists gifted children either individually or in a group to be on the same level as their other peers in gaining knowledge.

III. IMPLEMENTATION OF ACCELERATION LEARNING APPROACH

In implementing the acceleration learning approach, the teachers and researcher created a supportive environment by arranging the physical and digital learning spaces to encourage collaboration, interaction, and focus that adopts a positive and inclusive classroom culture that supports diverse learning styles and backgrounds. The integration of technology by employing educational technology tools has complemented the chosen learning approach while incorporating digital resources, online platforms, and interactive tools to enhance engagement and accessibility in help the learning process. With the arrival of computers in education, it has become simpler for teachers to impart knowledge and for the students to acquire it as the use of technology has made the process of teaching and learning immediate in class and more enjoyable [9].

To promote active involvement and critical thinking, active learning tactics were incorporated during the design and development process for the approach. These included conversations, group projects, presentations, practical experiments, and problem-solving exercises. Clear instructions and expectations are crucial throughout the implementation phase. This includes outlining the goals of each activity and how they relate to the overall learning aim. It also includes outlining expectations for participation, cooperation, and assessment. Active learning strategies are a form of approach related to the implementation of active learning applied by teachers in the learning process where learners are required to be active in every learning activity, critical, develop themselves, and empower all their potential so that they can learn through various activities such as reading, writing, speaking, listening, and reflecting [10].

In the implementation of the acceleration learning approach, creating a positive and stress-free learning environment is important. Techniques such as mindfulness, relaxation exercises, or stress reduction activities were applied to create a conducive atmosphere for effective learning. Some innovative methods for enchaining learning through stress free education are cooperative learning, use of computer games, use of puzzles, role playing, simulation, experience method and application method, where the learning becomes enjoyable and every student can learn in his/her own style of learning [11].

IV. SAMPLE

A number of 14 gifted children from the ages of 11-12 years old were the samples for this study. They have taken two assessments to determine their giftedness. The gifted children need to take the same exams to provide a consistent measure across the gifted children involved. Ethical considerations, including informed consent and confidentiality, from the gifted children and their parents were agreed upon as the study involves underage children as participants.

V. PRETEST AND POSTTEST

The pretest and posttest questions were adapted from some of the past year's questions of the Standard High School Curriculum (KKSM - Kurikulum Standard Sekolah Menengah) and Cambridge IGCSE (International General Certificate of Secondary Education) O Level syllabus for chemistry. Pretest and post-tests are similar to checklists that may measure a gifted child's needs before a tutorial or learning and then evaluate how well the lessons met the needs [12].

Pretests can be used at the beginning of a class to establish a subject knowledge baseline and be used as a way to determine the depth of understanding of prerequisite material while testing the students before the topics and lessons are covered in the class [13]. While post-test is used to determine what had been learned and understood and review if there are alterations of attitudes and behavior to learn [14]. The pretest was given to all the gifted children in the class before the class started, while the post-test was given after all the learning, activities, and presentations were done by the gifted children.

VI. RESULT

The pretest results showed that the gifted children were not proficient in the chemistry topic to be taught since they scored less than 30%. This was at the beginning of the class before the accelerated learning approach was applied. After the accelerated learning approach was applied to the class, the posttest was taken after the classes finished. Almost all the gifted children showed that they scored more than 40% more than their previous pretest. Only 1 gifted child did not score more than 40% and the gifted child had challenges wanting to learn earlier in class. Eventually, after a few classes, the gifted child who did not want to learn started to join the activities and group work and finally started to learn the accelerated topics in class.

In general, the gifted children's post-test scores exceeded their pretest scores (Fig.1). This indicates that the accelerated learning approach had a positive impact on them and may have motivated them to apply the knowledge and skills they learned in class and activities to their posttest. The accelerated learning approach offered the gifted children new experiences, knowledge, and skills from qualified teachers who recognized them. Their skills improved as a result, and their post-test results increased.

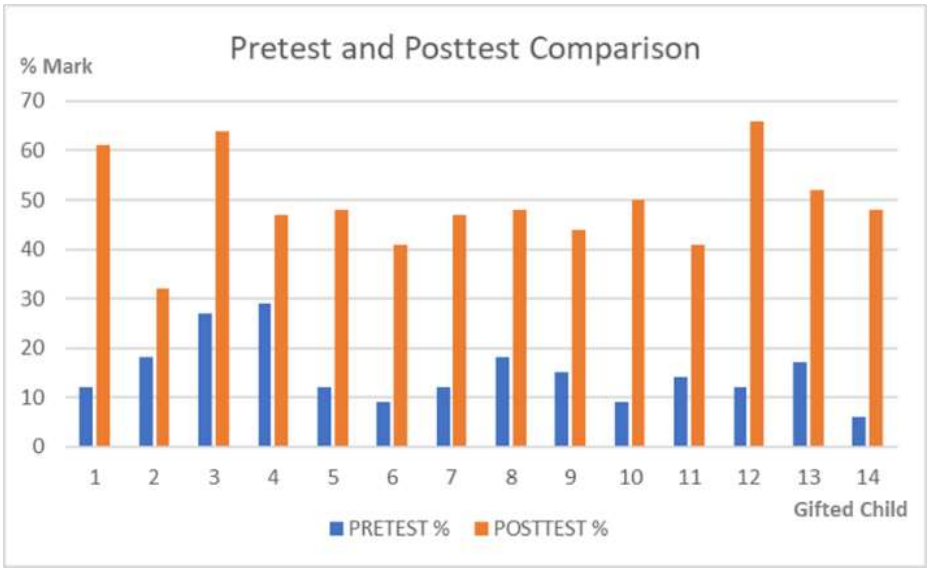

Fig. 1 Pretest and posttest comparison results.

The mean for the post-test score is better than the mean compared to the pretest score (Table 1), which can be concluded that the treatment might be responsible for the improvement [15]. The treatment in this study is the application of accelerated learning topics in chemistry.

TABLE 1 Pretest and posttest mean and standard deviation comparison results.

	Mean	Standard Deviation
Pretest	15.00	6.52
Post-test	49.21	9.28

A. HYPOTHESIS DETERMINATION

Creating a hypothesis for research involves forming a clear, testable statement or prediction based on existing knowledge or theories as it serves as a guiding principle for the study, stating what to expect and what to find or observe [16]. A hypothesis test is a statistical inference technique that provides two opposing hypotheses, a null hypothesis, to conclude the probability distribution of the data [17]. It is also a statement that explains why or how something works, based on evidence or reasonable assumptions, but that has not yet been specifically tested. In this study, the hypotheses created are as below.

H_0: There is no difference in marks for the pretest and post-test.

H_A: There are differences in marks for the pretest and post-test.

B. HYPOTHESIS TEST

The hypothesis test flowchart is used to help in determining the test to be done for the research (Fig. 2) and to analyse if the data follows a normal distribution or not.

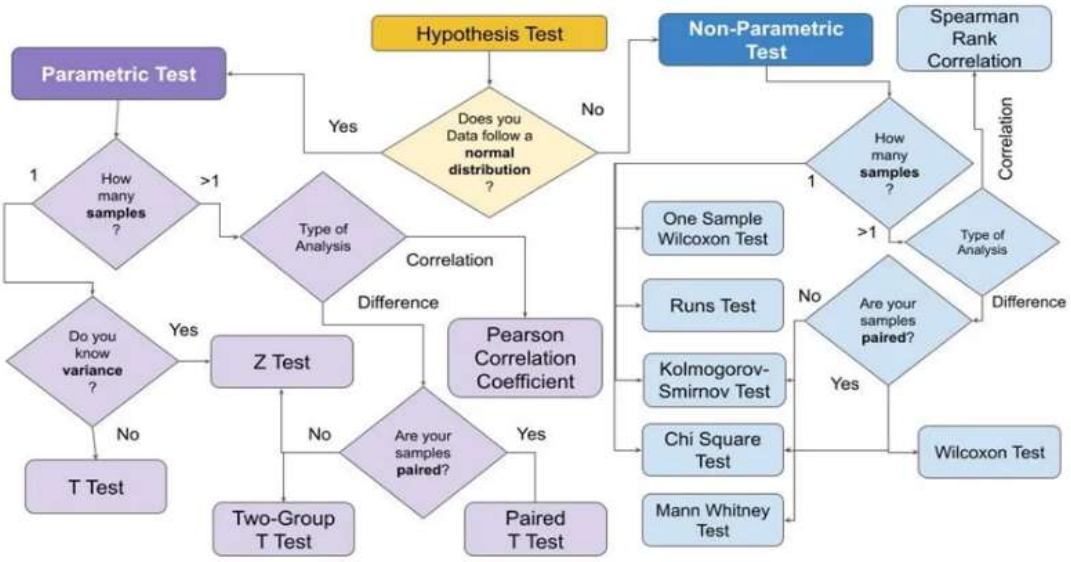

Fig. 2 Hypothesis test flow chart adapted from [18]

Since the sample size is small, determining the distribution of the variable is important, and to determine if the data obtained is normally distributed, the data is tested with the Shapiro- Wilk test. This statistical technique is used to determine if a sample of data is normal. It assesses whether the data originates from a population that is regularly distributed. The test is very helpful in figuring out whether the normal assumption is satisfied, which is frequently necessary for a lot of parametric statistical tests.

The assumption of the null hypothesis (H_0) asserts that the variable is normally distributed, is a statistical procedure used to determine if a continuous variable has a normal distribution, where the null hypothesis (H_0) states that the variable is normally distributed, and the alternative hypothesis (H_A) states that the variable is not normally distributed [19].

The Shapiro-Wilks test was performed with a Shapiro-Wilks calculator [20] and there was no evidence of non-normality for the pretest (W = 0.90, p = 0.10) and post-test (W = 0.31, p = 0.93) as in Table 2. It could be seen that in the pretest data, a skewness value of 0.08 and a kurtosis value of 0.47 suggest that the data distribution is close to a normal distribution. As for the post-test data, a skewness value of 0.54 and a kurtosis value of 0.87 suggest that the data distribution deviates slightly from a normal distribution, but it may still be close to normal.

TABLE 2 Pretest and posttest Shapiro-Wilks test statistics data

	Mean	Standard Deviation	Skew	Kurtosis	W	p
Pretest	15.00	6.52	0.08	0.47	0.90	0.10
Post-test	49.21	9.28	0.54	0.87	0.31	0.93

From the outcome of the Shapiro-Wilks test statistics data and the visual examination of the histogram of the pretest (Fig. 3) and post-test (Fig. 4) with the QQ plot (Fig. 5 and Fig.6), a parametric test is to be used for the data as per the hypothesis flow chart (Fig. 2).

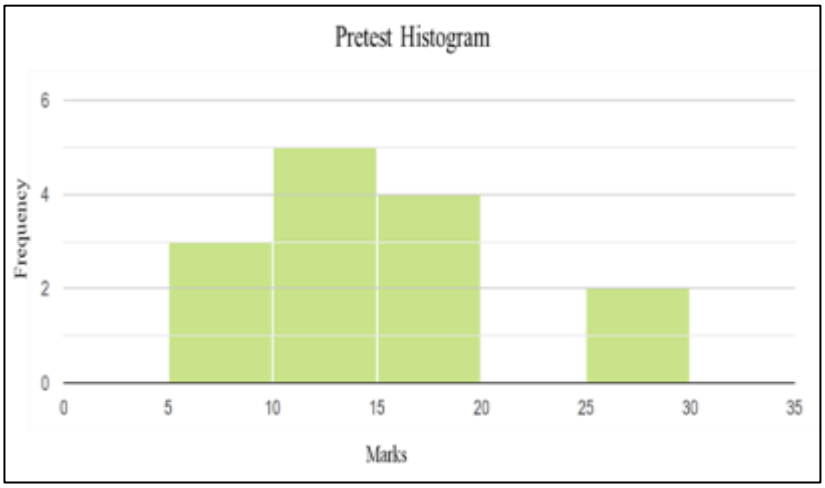

Fig. 3 : Pretest histogram and distribution data

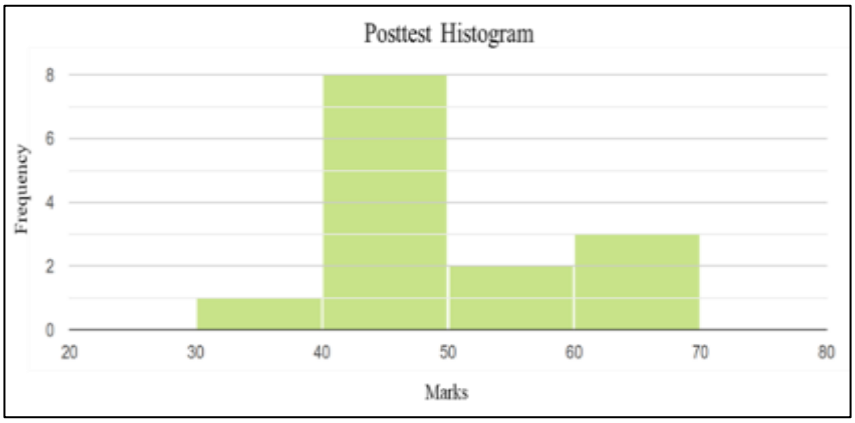

Fig. 4: Post-test histogram and distribution data

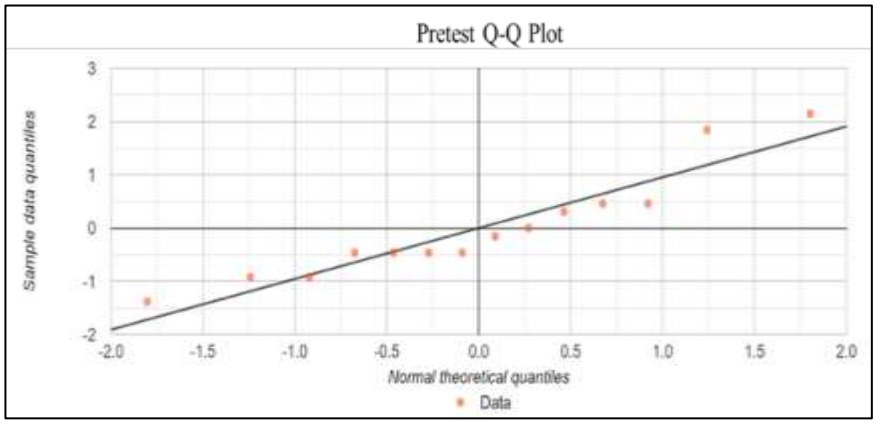

Fig.5 : Pretest Q-Q plot

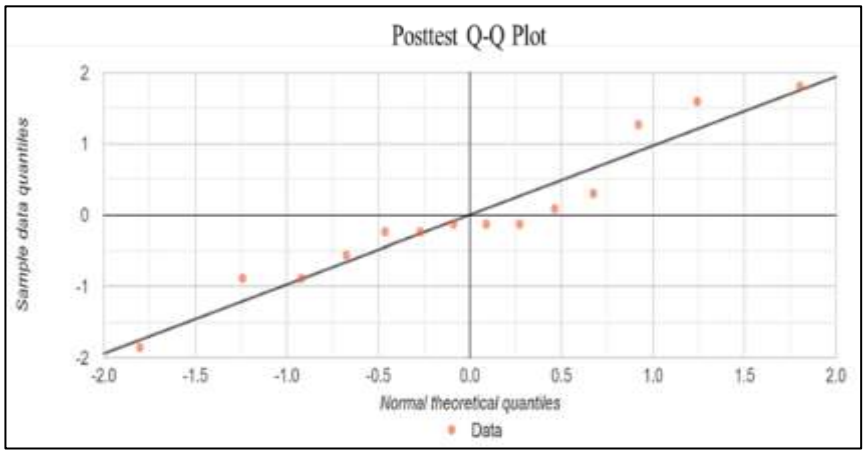

Fig. 6 : Post-test Q-Q plot

The parametric test was chosen after confirming that the data are normally distributed. In this research, the sample is more than 1, and this determines the 'type of analysis', which is a 'difference' type for this study, as we have the difference in pretest and post-test, which are a paired sample. The paired t-test is then confirmed to be used for the obtained data. The paired t-test is analysing the differences or comparisons between two related or paired variables. An example of applying a paired t-test is measuring marks for a group of students before (pretest) and after (post-test) teaching [21] and [22]. A few other studies on education, which have used pretest and post-test as measurements, have also applied the paired t-test [23] and [24].

In testing with the t-test, it could be seen that there was a substantial difference in the percentage of marks obtained by the gifted children in the post-test as compared to the pretest. The mean for the pretest is 15% marks and for the post-test is 49% marks for the gifted children, which shows an increase in the post-test. Mean is the average or the most common value in a collection of numbers [25]. Standard deviation is also calculated, as it is important because it helps in understanding the measurements when the data is distributed, where the more widely the data is distributed, the greater will be the standard deviation of that data [26]. The standard deviation for the pretest is 6.52, which indicates a moderate level of variability in the data set. For the

post-test, the standard deviation is 9.28, which suggests a higher degree of variability in the data set compared to the pretest. These data are listed in Table 3.
The Pearson correlation between pretest and post-test shows a weak positive correlation with the value of 0.1081, where it is implying, that as one variable increases, the other variable tends to increase as well, but the relationship is weak. The t value is -11.9085, which indicates also a weak correlation between the pretest, the post-test, and the variation that exists within the marks obtained. The p value, which is 0.0000, is less than 0.05, which is the significant value [23]; thus, the null hypothesis is rejected, indicating that the gifted children's pretest and post-test results have a significant difference.

TABLE 3 Paired sample t-test statistics results

	Pretest	Post-test
Mean	15.0000	49.2143
Variance	42.4615	86.1813
Standard Deviation	6.5200	9.2800
Observations	14.0000	14.0000
Pearson Correlation	0.1081	
Hypothesized Mean Difference	0.0000	
df	13.0000	
t Stat	-11.9085	
P(T<=t) one-tail	0.0000	
t Critical one-tail	1.7709	
P(T<=t) two-tail	0.0000	
t Critical two-tail	2.1604	

VII. CONCLUSIONS

The findings of this study reveal a compelling and significant difference between the pretest and post-test results, thereby supporting the initial hypothesis. The implementation of the acceleration learning approach towards gifted children has proven to be instrumental in fostering a noteworthy knowledge gain among the participants.
The observed positive outcome not only validates the efficacy of the chosen educational strategy but also highlights the potential of accelerating learning in enhancing educational outcomes. The significant difference in test results suggests that the specific methods and approaches employed within the acceleration learning framework have successfully contributed to a more profound understanding of the subject matter.
These results carry implications for educational practitioners and policymakers for gifted children, indicating that the acceleration learning approach can be a valuable tool in promoting effective learning experiences. By recognizing and capitalizing on the strengths of this approach, educators may be better equipped to engage students, cater to diverse learning styles, and ultimately foster improved academic achievements.
While the current study has shed light on the effectiveness of the acceleration learning approach, it also beckons for further exploration. Future research endeavors could delve deeper into the specific elements within this approach that led to the observed knowledge gain, providing more nuanced insights for educators and curriculum developers.
In summary, the positive outcomes unveiled in this study contribute to the growing body of evidence supporting acceleration learning as a potent educational strategy for gifted children. As we continue to strive for innovative and effective approaches in education, the findings herein encourage broader consideration of acceleration learning as a means to propel gifted children toward heightened academic success.

VIII. ACKNOWLEDGEMENT

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