Study Note

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Developing Hands-on Activities Using the Kasetsu Jikken Jugyou Approach to Generate Interest and Improve Student Achievement in Sciences in the Marshall Islands

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Abstract

This research aimed to investigate and discuss the effectiveness of the recently introduced Japanese conceptual approach (Kasetsu Jikken Jugyou also known as Hypothesis-Experiment Class) through hands-on activities on 10th-grade students' interest and academic achievement in science. The study was conducted at two public high schools in Majuro, the capital of the Marshall Islands. There were 128 students (37 male, 91 female), of which 67 were assigned as experimental groups and instructed by hands-on activities using the Kasetsu Jikken Jugyou approach, while the remaining 61 were assigned as control groups and instructed by the traditional method. For this investigation, the Students' Interest Questionnaire adapted from the Trends in the International Mathematics and Science Study (TIMSS) was used to collect the data. For the students' achievement performance, Pre-test, Post-test, and students' reflection were given.

The data was analyzed using the Independent Sample t-test through SPSS. The results indicated a significant difference between the means of the students' science achievement in favor of the experimental group.

This study's results are significant, especially to the Marshall Islands since the Public School System (PSS) cannot afford to provide expensive science equipment to make the students physically active and engaged in learning science.

Keywords: Kasetsu Jikken Jugyou, Hypothesis-Experimental Class, Hands-on Activity, Traditional Method, and Students' Interest in Science

1. Introduction

Over the years, there has been ongoing work for improvement in the quality of science education in the Republic of the Marshall Islands (RMI) and different countries. Active participation of the students is necessary in order to have quality science instruction.

Science is an essential academic subject for all students to learn at all grade levels because of its relevance to our daily lives and the potential to use these vital life skills in everyday activities. The knowledge, understanding, and the skills that the students grasp in this subject inspires them to use and share their thoughts in the advancement of technology to provide a better future (Jones and Wyse, 2004). Science helps children generate their ideas, make practical judgments through observation, and apply their understanding based on the acquired evidence.

Science is a subject that goes hand-in-hand with hands-on learning activities that fascinate students' senses to become more attentive and participative in class. According to Jones and Wyse (2004) and Wilson (2008), a hands-on experiment is an active learning

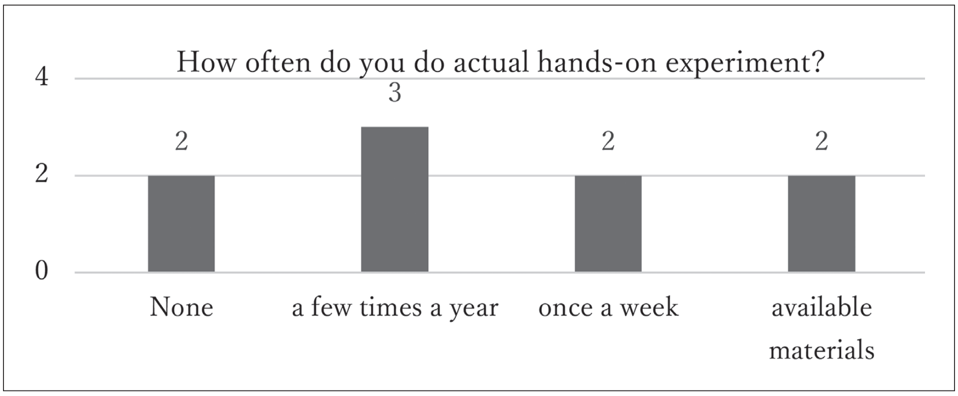

Figure 1. Science teachers' response.
Source: It was summarized by the researcher based on the collected data.

process of learner-centered education whereby it inspires the students to discover and acquire new theories that lead them to be imaginative and critical thinkers. As the students learn to work individually, they develop a sense of ownership of their work that leads to "enhance their desire and ability to be self-motivated" (Blandford Knowles, 2016).

Various researchers have successfully shown that hands-on activity, when used as a teaching method develops students' interest in learning Science (Edmund, 2005). Promote students learning and builds on their attitudes (Hofstein, Mooz & Rishpon, 1990; Ornstein, 2006; Osborne, 2003), also shows improvement in students' academic performance (Taraban, Box, Myers, Pollard, & Bowen, (2007); Bristow, 2000; McCarthy, 2005; Randler & Hulde, 2007).

However, in the actual classroom settings especially in the RMI, very few Science lessons are taught using a hands-on approach. Most lessons are conducted based on a traditional method wherein the only activity for the students is to listen, copy notes, and memorize while the teachers talk and write notes on the blackboard. The graph below clearly explains how often teachers in the RMI conducted their lessons based on teacher-centered approaches. Among the nine science teachers teaching from grade 10 to 12 from 2 public schools (School A and School B), only two teachers answer that they conducted their lesson using a hands-on approach at least once a week.

According to Woolnough (1994), even though the teacher-centered approach used in classes shows a good outcome for students' academic achievement, the students' active participation must not be limited as it is through interaction that the students develop their interest in learning. The enjoyment that the students' experience will also lead to a better commitment to learning.

Since this is the first time for the HEC to be applied in the RMI, the effect on grade 10 secondary students' interest and achievement performance is still under examination and needs more study. Developing a quality science curriculum that fits every learner's needs must involve the relevance of curriculum content, methods, experience, life skills, and values needed for knowledge society (World Education Forum FINAL REPORT, 2015).

2. Participants

The sample size includes two public schools from the Marshall Islands' capital labeled as school A (control class) and school B (experimental class). The researcher chose two sections from each school (section A and section B), and the students were all in 10th grade. The control class has 61 (17 males and 44 females), while the experimental class consists of 67 (20 males and 47 females) having an average age of 15 years for the two schools.

Science as a subject is compulsory, and each lesson's duration is five 50 minutes period per week. The researcher taught both classes from the control and the experimental. The traditional instruction approach was used in the control class, while hands-on activity using the Kasetsu Jikken Jugyou approach in the experimental class.

3. Instruments

3.1. Class Observation

In this study, the researcher was able to observe Science classes for both control and the experimental group from grade 9 (Earth Science), grade 10 (Life Science), grade 11 (Chemistry), and grade 12 (Physics) classes before the traditional teaching method in the control group (School A) was administered. The class observation was done to understand better the teaching approach that the teachers from different grade levels are using.

3.2. Science Achievement Test (SAT)

The researcher developed the science achievement test about cell transport for the post-test to assess the students' achievement learning performance. The test is comprised of fifteen multiple-choice questions and two comprehension questions related to diffusion and osmosis. Moreover, for the pre-test, the content covers the 9th-grade lessons present in the existing science curriculum. The pre-test includes fifteen multiple-choice questions and two application questions. A student's possible scores can range from zero to twenty-five for the pre-test and zero to twenty for the post-test.

The pre-test was conducted to identify the students' abilities by comparing the two sample groups: the control and experimental. Furthermore, the post-test was administered to both groups to evaluate the students' achievement performance about cell transport.

3.3. Student Interest in Science Questionnaire (SISQ)

The Student Interest and Attitude in Science Questionnaire was developed by Trends in International Mathematics and Science Study (2019) and was adopted by the researcher in order to collect data from the students. The questionnaire was divided into five sections: science in school, student preference, teachers' knowledge, student ability, and students' future. Since this study focuses on the students' interest in science, only the students' preferences was recorded and analyzed. The preference question consists of nine items devised to be rated on a 4-point Likert scale (agree a lot, agree a little, disagree a little, and disagree a lot). The SISS was given to the experimental group as a pre-test and post-test. The result of these tests identifies a change in interest before and after the intervention.

3.4. Conceptual Framework

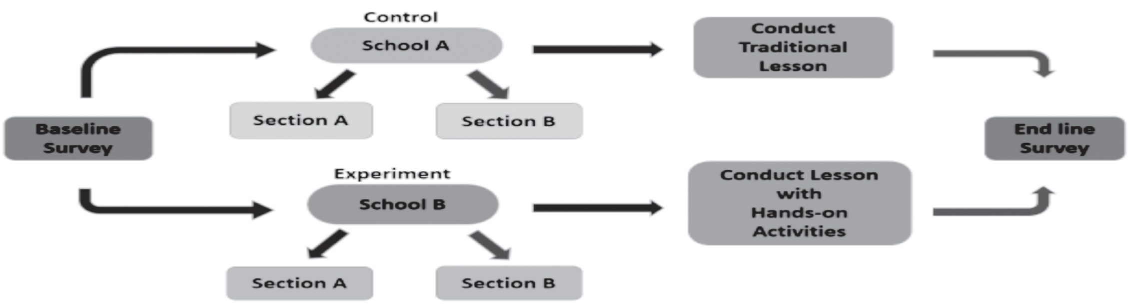

Figure 2. Research Framework.

4. Results of Research

A. Effects of Hands-on Activity Using the Kasetsu Jikken Jugyou Approach on Students Interest in Science

4.1 Results for the first question.

Table 4.2 shows a descriptive view of how often the students experience doing an experiment or hands-on activity during their science classes. Based on the results, it seems that only School A - Sec A (control class) had experience with a hands-on activity once or twice a month, while 74% of the students from School A - Sec B displays otherwise. This vast difference among the control class was that the school administration always chose the best section from each grade level every time the school has a science pilot project. In this case, section A will always have the opportunity to conduct an experiment. However, the results from the experimental class (school B) clearly showed that most of the respondents from sections A and B never experienced hands-on activities.

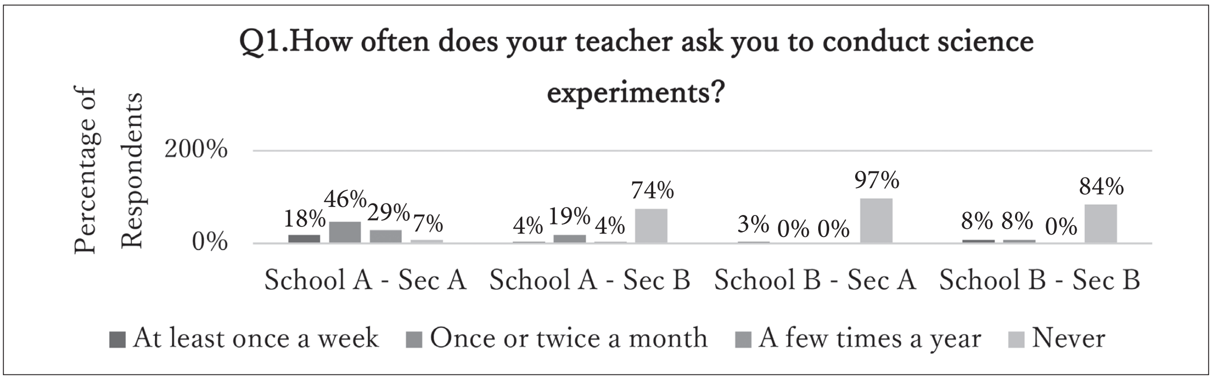

Figure 3. Students' response on question 1.
Source: It was summarized by the researcher based on the data collected.

4.2. Control Class

A survey questionnaire was given to the control class for both sections after implementing the traditional teaching approach's usual way of delivering the lessons. The students' response to a question (a) showed very clearly that only 24% from section A and

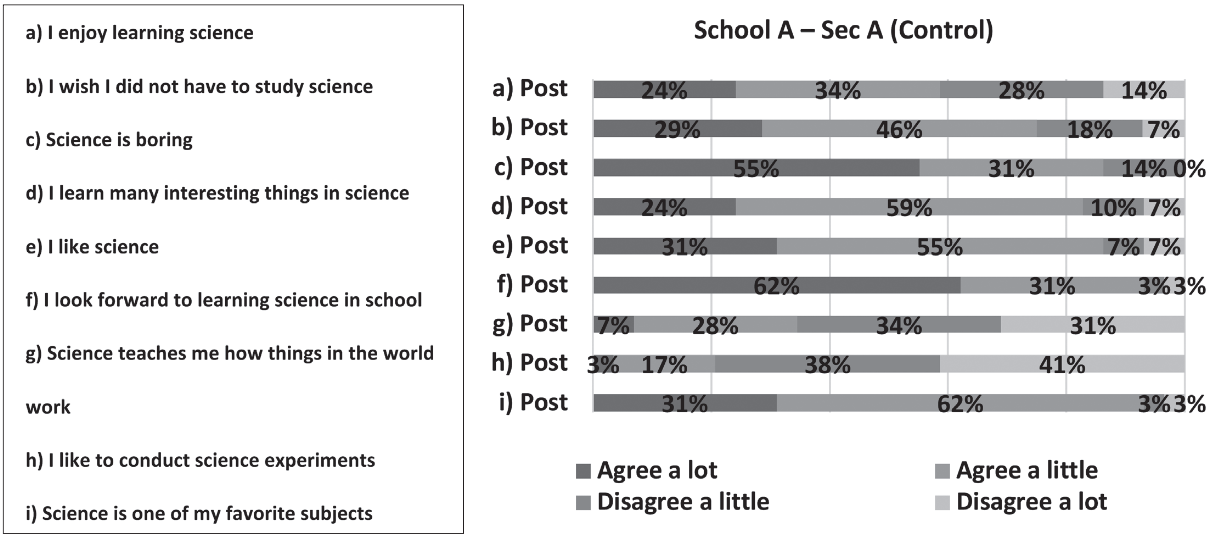

Figure 4. Students' responses to the questionnaire without the intervention.
Source: It was summarized by the researcher based on the data collected.

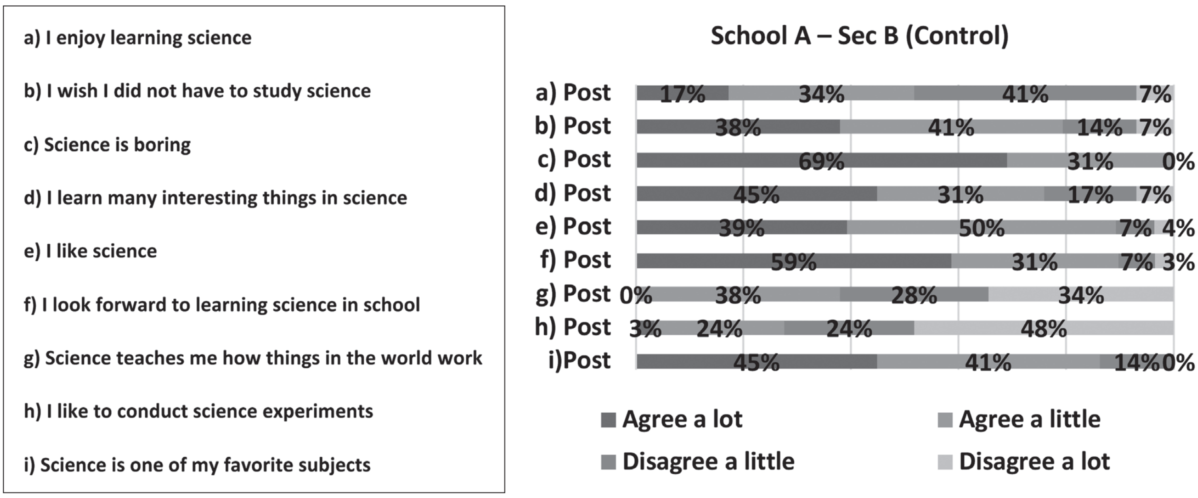

Figure 5. Students' responses to the questionnaire without the intervention.
Source: It was summarized by the researcher based on the data collected.

17% from section B enjoyed the science lesson. Besides students not enjoying their science classes, they also find it a boring class, noticeable in figure 4 and figure 5 responses (c). Section B displays the highest percentage among the sections because they are less likely to experience hands-on activity or experiment. After all, the school administration always chooses the top class whenever there is a pilot project.

4.3. Experimental Class

All the data was compiled from the students before and after the application of hands-on activity using the Kasetsu Jikken Jugyou (KJJ) approach. It was tabulated to examine the students' responses towards science lesson activity with and without the intervention. Figure 6 and Figure 7 showed that after implementing hands-on activity using the KJJ approach, the students' interest in science improved significantly. There was a considerable increase, particularly in students' enjoyment while learning science (seen in question a) from 6% to 56% coming out of section A, while section B dramatically increases from 0% to 77%. Additionally, question (c) displays that before the intervention, 61% of the students from section A said that science is boring while section B poses a 64%. This percentage changes drastically right after the intervention. Both sections were now showing 19% and 12%, respectively. Moreover, both sections pose to like science more and looking forward to learning science in school. Also, after applying the experiments in class using the KJJ approach, most of the students responded that science is now one of their favorite subjects. Mainly to section B class, whose outcome garnered a 45% increase (refer to 6), this affects almost half of the section B class, while section A tallied a 9% increase.

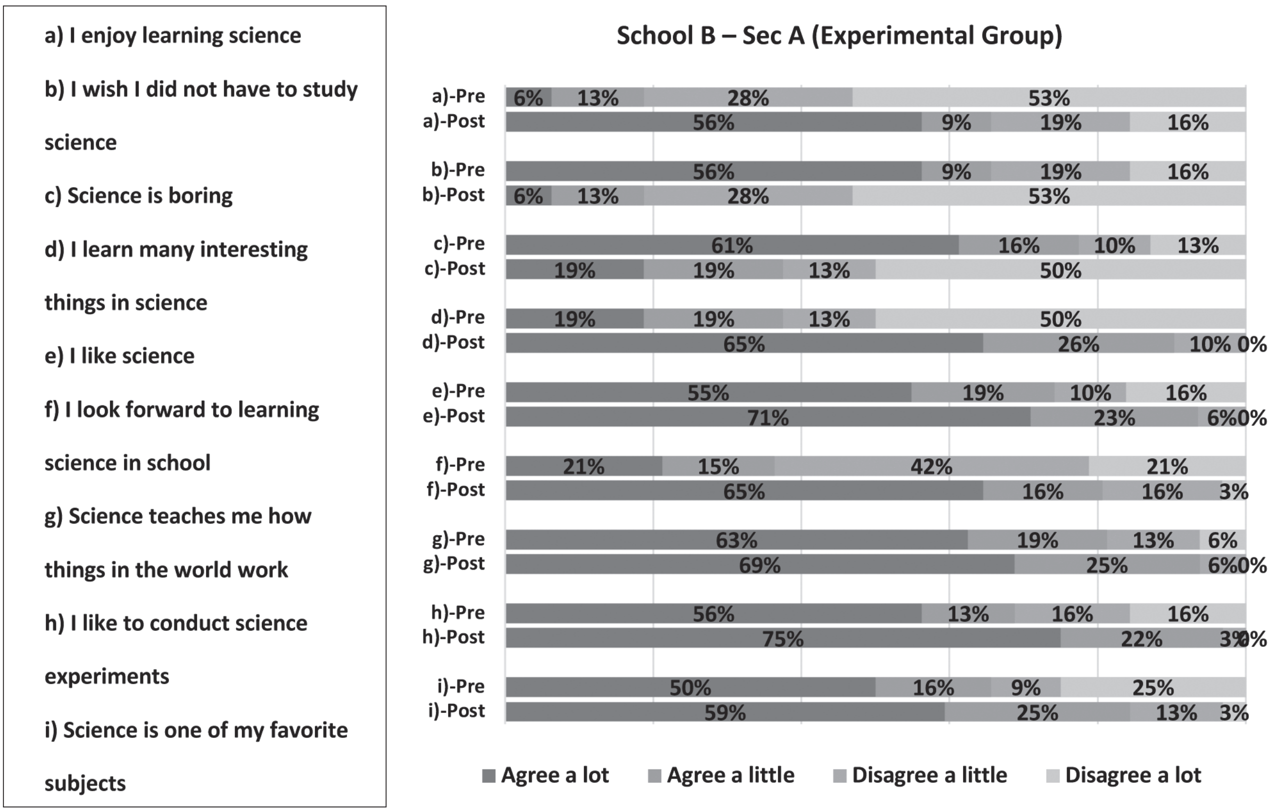

Figure 6. A comparison of students' responses towards science lessons before and after the intervention.
Source: It was summarized by the researcher based on the data collected.

Students participate actively in class when they are not only learning but, at the same time, enjoying what they are doing (Brophy, 2010). Section B class likes and enjoys the science class and learns many exciting things (question d). They have acquired a 68% increase, which was more than half of the class compared to 46% from section A. Hence, it leads the students to be excited and looking forward to learning more about science (question f).

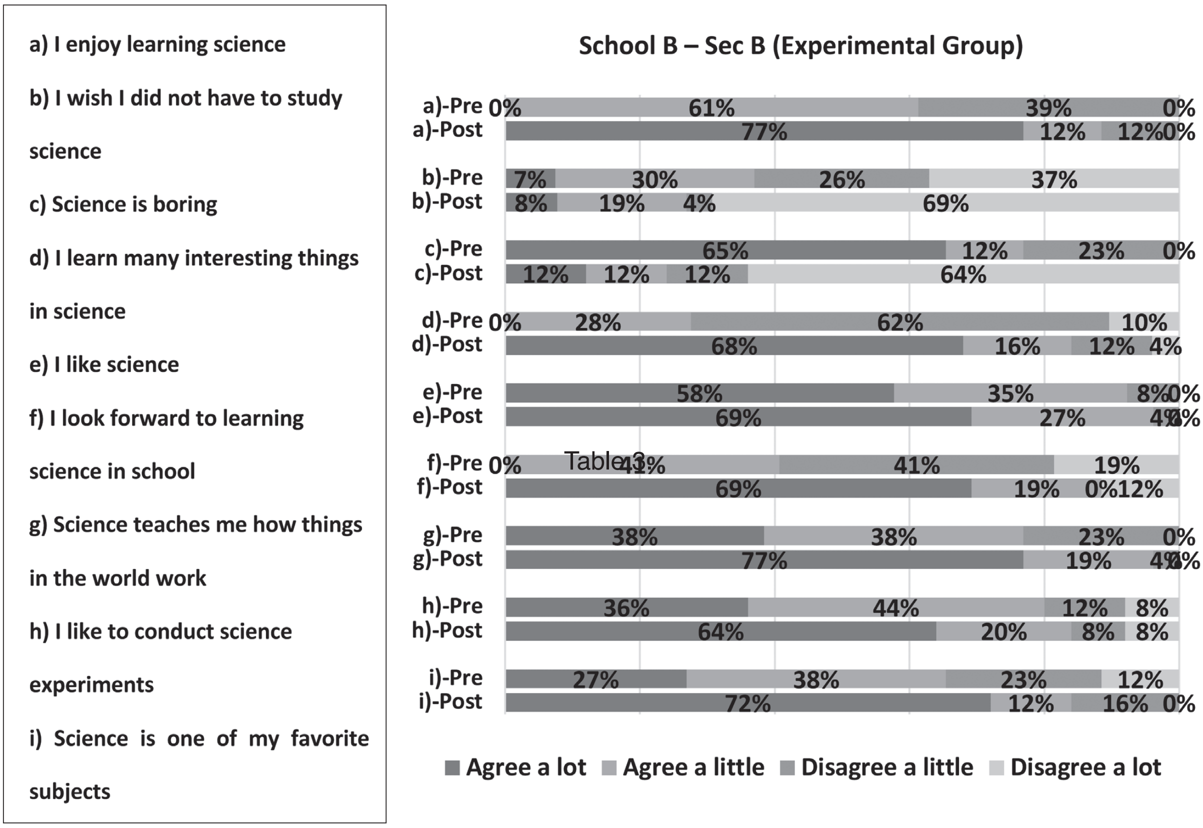

Figure 7. A comparison of students' responses towards science lessons before and after the intervention.
Source: It was summarized by the researcher based on the data collected.

B. Effects of Hands-on Activity Using the Kasetsu Jikken Jugyou Approach on Students Academic Achievement Performance in Science

4.4. Pre-test comparison between School A-Sec A and School B-Sec A

Table 1 shows descriptive information regarding the students' ability between two variables (school A and school B). The researcher gave a pre-test for the sole purpose of finding out whether school A – Sec A is comparable to school B – Sec A. Having a p-value of 0.015, which is equivalent to less than the standard value of the level of significance 0.05, the researcher determines to reject the null hypothesis. Hence, school A-Sec A and school B-Sec A were not on the same level regarding comprehension and application ability.

4.5. Pre-test comparison between School A-Sec B and School B-Sec B

Table 2 showed the pre-test scores based on the students' previous knowledge. The researcher carefully picked topics and created questions that were related to the existing 9th grade Science Curriculum. Data was collected and tabulated to examine whether the two samples were the same or at different levels regarding students' comprehension and application ability. Based on the data collection analysis, the p-value for part 1 was (0.575), and the p-value for the application part was (0.092). The outcome was higher than the significance level of 0.05. Thus, the researcher can say that the null hypothesis was accepted and that school A-sec B and school B-sec B have no difference in terms of comprehension and application ability.

Table 1. A comparison of students' comprehension and application ability based on the pre-test results

Pre-test				
	Part 1 (Knowledge)		Part 2 (Application)	
	School B -Sec A (Exp.)	School A- Sec A (Con.)	School B – Sec A (Exp.)	School A –Sec A (Con.)
Answered	34	28	34	28
Did not answer	0	0	0	0
Total Number of Students	34	28	34	28
Mean	6.6	5.2	4.4	2.6
Variance	4.8	5.3	11.4	4
Standard Deviation	2.2	2.3	3.4	2
P(T<=t) one-tail	0.007605729		0.007358767	
P(T<=t) two-tail	0.015211458		0.014717533	

Table 2. A comparison of students' comprehension and application ability based on the pre-test results

Pre-test				
	Part 1 (Knowledge)		Part 2 (Application)	
	School B – Sec B	School A – SecB	School B – Sec B	School A –Sec B
Answered	25	28	25	28
Did not answer	8	3	8	3
Total Number of Students	33	31	33	31
Mean	4.6	5	1.2	2.2
Variance	5.3	5.7	2.9	5.9
Standard Deviation	2.3	2.4	1.7	2.4
P(T<=t) one-tail	0.287870561		0.046386369	
P(T<=t) two-tail	0.575741121		0.092772738	

4.6. Analysis based on Post-test Results

There were two hands-on activity lessons (Diffusion and Osmosis) conducted in the experimental class. The researcher taught both lessons using the Kasetsu Jikken Jugyou teaching approach. Each class period has fifty minutes long, and it took two days to complete the activity. The anticipation was high for the experimental class to get a better score than the control class.

4.6.1. Post-test comparison between School A-Sec A and School B-Sec A

Tables 3 and 4 shows the record of post-test results, which identifies whether the treatment applied improves the students' academic achievement performance. The researcher used the two-tailed test analysis to identify whether there was a difference between school A (control class) and school B (experimental class). Unfortunately, based on the outcome of the post-test analysis, it was found that there was no improvement in students' academic performance. Because the p-value for part 1 (0.758) and part 2 (0.718) were greater than the significance level or the alpha which is 0.05. Therefore, in this case, we refuse to reject the null hypothesis.

Section B from both the control and experimental class showed the same results as Section A classes. Having both of the p-values for part 1 (0.444) and part 2 (0.878) was higher than the significance level of 0.05. Thus, it was assumed that the experimental class's treatment did not have any influence on the students' academic performance.

Table 3. A comparison of students' comprehension and application ability based on the post-test results.

Post-test				
	Part 1 (Knowledge)		Part 2 (Application)	
	School B – Sec A	School A – Sec A	School B – Sec A	School A – Sec A
Answered	28	28	28	28
Did not answer	6	0	6	0
Total Number of Students	34	28	34	28
Mean	5.4	5.5	1.6	1.9
Variance	3.1	2.9	4.3	5.5
Standard Deviation	1.8	1.7	2.1	2.3
P(T<=t) one-tail	0.379197647		0.359128857	
P(T<=t) two-tail	0.758395295		0.718257714	

Table 4. A comparison of students' comprehension and application ability based on the post-test results.

Post-test				
	Part 1 (Knowledge)		Part 2 (Application)	
	School B – Sec B	School A – Sec B	School B – Sec B	School A – Sec B
Answered	29	30	29	30
Did not answer	4	1	4	1
Total Number of Students	33	31	33	31
Mean	4.6	4.9	0.5	0.6
Variance	3.1	2.9	1.5	1.6
Standard Deviation	1.8	1.7	1.2	1.3
P(T<=t) one-tail	0.222311969		0.439056533	
P(T<=t) two-tail	0.444623938		0.878113066	

5. Discussion and Implication

This study's first question was designed to examine whether hands-on activities using the Kasetsu Jikken Jugyou (KJJ) approach can increase students' interest in sciences. The researcher developed two hands-on activities (Diffusion and Osmosis) to determine possible differences from the students' responses. On principle, we had hypothesized that students with hands-on experience using the KJJ approach were likely to show a positive outcome in gaining students' interest. Based on the questionnaires' results after the intervention, this hypothesis was shown to be acknowledged. Students belonging to section A had a better grade point average than students in section B. Although both sections (A and B) show a positive result after the intervention, among the two classes, section B showed a much higher increase in interest and attitude percentage. Particularly questions coming from (a), (d), and (f) were seen to have a significant impact, especially for below-average students. Moreover, the study's result was anticipated since many researchers have shown that the hands-on activity if implemented regularly as a teaching approach, can improve students' attitudes and learning capabilities (Scharfenberg and Bogner, 2009; Turpin, 2000). Furthermore, this present study has shown that hands-on activity using the KJJ approach has increased students' interest in science compared to the traditional instruction approach.

The second research question aimed at investigating whether hands-on activity enriched instruction using the KJJ approach can improve students academic achievements performance in sciences. Research has shown that hands-on activities help learners remembers things well (Jindrich, 1998). So, in general, we had theorized that hands-on activity could increase students' achievement performance. However, the present results of this research obtained from the Student Achievement Test through pre-test and post-test; it was shown that there was no notable variation in students' academic performance between the control and experimental class. Based on Figure 4, the pre-test results from the control and experimental class does not show any difference. The post-test outcome from Figure 5 could also attest to this. Although there was a slight increase in the experimental class's mean score, the p-value tells otherwise. From the researchers' point of view, most of the students from the control class did well in the first part (Knowledge) of the test, while the experimental class scored higher than the control class in the second part (Application). Thus, when the overall score was combined, it did not show any difference. Also, since this teaching approach was still new to the students, it required them to adjust and cope with the new learning environment. As Fielding (2006) states, some particular circumstances or tasks may need working that individual learners discover are hard to handle. Hence, in this case, the researcher presumes that most of the experimental class students could not adapt to the new learning style promptly.

6. Conclusion

The current research outcome indicates that hands-on activity using the Kasetsu Jikken Jugyou approach enhances the students' learning habits and improves their interest in science dramatically compared to the traditional teaching approach. Students in the experimental class learned cell transportation types, particularly in passive transport (diffusion and osmosis), by experiencing the activity firsthand and increasing their excitement to learn by seeing students participating actively during the experiment. The teacher only acted as a guide throughout the two lesson activity and addressed essential issues at the end of each lesson. However, the control class, which was taught only with the traditional instruction approach, learned only by reading from the textbook, memorizing new terms, listening to the teacher, and taking notes. The majority of the control class does not want to learn science because they find the lessons boring.

This study's results are significant, especially for the Marshall Islands that lacks the budget to buy expensive materials to make students participate actively during laboratory experiments.

The effects on students' academic performance based on hands-on activities cannot be visible now since it takes valuable time and effort for the students to get used to the new instructional method. Hands-on activity only shows that it is not perfect. The researcher suggests that both methods can be successful if applied collectively. However, there were positive outcomes when it comes to the students' interest in science lessons. The results prove that the experimental class (Section-A and Section-B) shows a considerable gap before and after the intervention. Moreover, hands-on activities increase the students' interest in general, but the improvement was also visible in the lower sections or below-average students.

Therefore, even though hands-on activity using the Kasetsu Jikken Jugyou approach does not improve students' test scores right away, it remarkably brings excitement for them to be in school and learn new things again. The students performed all hands-on activities and addressed all essential points of the lesson. On this ground, the researcher was confident that the lessons learnt will be remembered for a long time.

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