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Impact of Adventure-Based Learning on Statistics: A Paradigm Shift towards Holistic Student Development

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Abstract

This research examines the effects of adventure-based learning (ABL) on basic statistics achievement (BSA), critical thinking skills (CTS), and leadership skills (LS) among Year 1 students at a Teacher Education Institute. Conducted through a quasi-experimental design, the study involved 30 students selected by the institute, forming an intact group. MANOVA was used for data analysis by using SPSS version 23. Results revealed significant differences between the ABL and control groups in post test mean scores for BSA and LS, but not for CTS. Analysis of second post test scores also showed significant differences in BSA and CTS, with no significant differences in LS. These findings suggest that ABL positively impacts BSA and CTS compared to conventional methods, though it does not significantly affect LS. The study underscores the potential of ABL to enhance academic performance and critical thinking among students, aligning with the educational objectives of institutes and the Ministry of Education in fostering holistic development. .

Keywords: adventure; leadership skills; quasi-experimental; mathematics; higher education; statistics.

1 Introduction

The new paradigm landscape of education demands a fundamental shift in teaching methodologies, particularly in the domain of mathematics. It's evident that success is no longer solely determined by academic prowess but encompasses a broader spectrum of skills essential for holistic human capital development. This paradigm shift is imperative, as studies emphasize the importance of soft skills, including higher-order thinking skills (HOTS) [14], critical thinking and communication [18]. These skills, alongside academic excellence, are essential for preparing students for career readiness.

Moreover, the urgency for pedagogical transformation is underscored by alarming statistics regarding national students' proficiency in mathematics and science on international assessments. Stuhr et al. [26] highlights the potential of adventure-based learning to improve engagement, while Mahmad et al. [19] emphasizes the widening achievement gap due to ineffective teaching styles. The root of this issue can be traced to the inadequacy of teaching and learning practices among national mathematics and science educators. Mariani and Ismail [20] focusing on creative practices, identifies gaps in instructional methods, while Mahmad et al. [19] underscores the need to improve teaching styles to enhance student outcomes. Traditional methods, including lecture delivery, individual exercises, and blackboard teaching, are still prevalently employed in classrooms [20], often prioritizing syllabus completion and exam preparation over fostering a deeper understanding of concepts [23].

In response to this educational challenge, there is a pressing need to introduce innovative teaching approaches, particularly in the realm of mathematics education [18]. Adventure-based learning (ABL) emerges as a promising pedagogical methodology, leveraging experiential learning to nurture students' physical, emotional, spiritual, and intellectual development. Originating from the establishment of Outward Bound by Kurt Han in 1941, ABL integrates adventure elements into extracurricular activities, thereby fostering confidence, perseverance, and experiential learning among students [26].

The effectiveness of ABL in revolutionizing teaching and learning methodologies from instructor focused to learner-centre approaches is immeasurable. By incorporating outdoor education, camping, and physical activities, ABL creates meaningful learning experiences that transcend traditional classroom boundaries. This transition is imperative as it not only aligns with the diverse learning styles of students but also encourages active participation and collaboration [19]. In the context of mathematics education, ABL provides a unique platform for students to engage in mathematical learning while navigating real-world adventure situations, thereby bridging the gap between theoretical knowledge and practical application.

Central to the success of ABL is the role of educators as facilitators rather than mere instructors. By fostering collaboration between students, teachers, and subject matter experts, ABL creates a conducive environment for idea sharing, critical discussions, and inquiry-based learning. This collaborative approach empowers students to take ownership of their learning journey, thereby enhancing their leadership skills and critical thinking abilities [25]. Moving forward, it is imperative to track the impact of implementing ABL in statistics education on various dimensions of student development, including statistical achievement, leadership skills, and critical thinking abilities. By conducting rigorous research and evaluation, we can gain deeper insights into the efficacy of ABL as a transformative pedagogical approach in mathematics education.

In conclusion, the adoption of adventure-based learning represents a paradigm shift in mathematics education, addressing the evolving needs of students in the 21st century. By fostering experiential learning, collaboration, and real-world application of mathematical concepts, ABL holds immense potential in equipping students with the diverse skill set required for success in an increasingly complex and interconnected world.

Focusing on statistics achievement is relevant for multiple reasons. First, statistics is a vital part of mathematics education with extensive applications in various fields such as science, business, and social sciences. Mastery of statistics equips students with the ability to understand and interpret data, make informed decisions, and engage in quantitative analysis [13]. Second, emphasizing statistics aligns with broader educational goals, preparing students with essential 21st-century skills. In a world increasingly driven by data, the capacity to analyze and interpret statistical information is crucial for informed decision-making and problem solving [1].

Third, integrating statistics education with adventure-based learning provides practical contexts that enhance statistical literacy. Through hands-on experiences involving data collection, analysis, and interpretation, students can better grasp statistical concepts and apply them in real world scenarios [22]. Finally, statistics education supports holistic student development by fostering critical thinking, problem-solving, and analytical skills. Proficiency in statistics also improves communication, collaboration, and evidence-based decision-making abilities, which are essential for success in various personal and professional endeavors [12].

Emphasizing statistics achievement through adventure-based learning (ABL) is crucial because it equips students with the essential skills and competencies to thrive in a data-centric world, enhancing their academic and professional success. Implementing ABL in statistics education has shown promising results in improving students' statistical understanding, leadership abilities, and critical thinking skills. By incorporating adventure elements into learning, ABL offers students experiential opportunities that extend beyond traditional classrooms [22].

In collaborative and educator-facilitated environments, students engage in real-world scenarios that require applying statistical concepts and solving problems. This student-centered approach fosters a deeper comprehension of statistics and nurtures essential soft skills like leadership and critical thinking. Although more research is needed to fully understand the long-term impacts of ABL on student outcomes, current findings suggest that ABL could be a transformative method in mathematics education, providing students with the diverse skill set needed for 21st-century success [1].

2 Research Question

What is the effect of adventure -based learning (ABL) on students' pre-test, post-test and post-post-test outcomes in Basic Statistics achievement, critical thinking skills, and leadership skills compared to traditional classroom instruction?

3 Literature Review

Adventure-Based Learning (ABL) is an experiential educational approach that incorporates adventure activities into the teaching and learning process to facilitate personal and academic growth. Unlike traditional classroom -based instruction, ABL emphasizes hands -on, immersive experiences in outdoor or simulated environments, where participants actively engage in challenges, problem solving tasks, and team -building activities [24]. ABL also is an instructional approach where students actively engage in practical activities related to the concepts being studied. This approach aims to enhance understanding and application of knowledge through hands-on experiences. ABL has shown effectiveness in various educational fields, including statistics, by emphasizing interactive and practical learning experiences.

In the context of statistics education, ABL has several unique aspects that distinguish it from applications in other subjects. First, students engage in collecting real-world data. For example, students might conduct surveys or experiments to gather data for analysis. This gives students a deeper understanding of the data collection and processing processes, as well as improving their skills in performing meaningful statistical analysis [11].

Second, the use of statistical software is a crucial component of ABL for statistics. Students often use software such as SPSS, R, or Excel to analyze the data they collect. Using these tools gives them hands-on experience in applying statistics and prepares them for the use of statistical software in the workplace [7]. Through this experience, students can understand how data is analyzed in a broader context and how to make data-driven decisions.

Third, data-driven projects are a key element in ABL for statistics. Students work on projects that require them to use statistical concepts to solve real-world problems. For example, students might analyze demographic data to understand population trends or sales data to make business forecasts. This approach not only enhances students' understanding of statistics but also develops their problem-solving and decision-making skills.

ABL in statistics differs from applications in other subjects such as mathematics, science, and language. In mathematics, ABL might involve solving abstract problems or using mathematical manipulative. However, in statistics, ABL focuses more on analyzing real-world data and interpreting results [8]. Meanwhile, ABL in science often involves laboratory experiments and observations, but in statistics, data-driven activities and the use of analytical software are more emphasized [17]. In language subjects, ABL might involve activities such as group discussions or creative writing. In contrast, in statistics, the focus is on the collection and analysis of concrete data [2]. Summary for this statement also can illustrate by Table 1.

Table 1: Difference aspect between ABL in statistics, science and language.

Aspect	**Statistics**	**Science**	**Language**
Data collection	Collecting real-world data from actual environments	Laboratory experiments and observations	Collecting materials and information for creative writing
Use of technology	Using statistical software such as SPSS, R or Excel	Laboratory tools and observation technology	Using writing and editing software
Data-driven projects	Analyzing real data to solve real-world problems	Scientific projects based on experiments and studies	Writing projects based on chosen themes and topics
Main focus	Analysis and interpretation of real-world data	Applying scientific theory in experiments	Developing language and writing skils
Assessment	Improving achievement through understanding real data	Assessing practical and theoretical skills	Evaluating creative writing and literary analysis

4 Methodology

This study adopts a quasi-experimental design, which is a research methodology commonly used in educational research when true experimental designs, such as randomized controlled trials, are not feasible or ethical. Quasi-experimental designs allow researchers to investigate cause-and-effect relationships by comparing groups that naturally differ in terms of exposure to the intervention, in this case, ABL. By employing this quasi-experimental design, the study aims to examine the impact of ABL on several key aspects of mathematics education, including BSA, CTS, and LS. This approach involves comparing the outcomes of students who participate in ABL activities with those who do not, while accounting for potential confounding variables. The choice of a quasi-experimental design in this study is driven by practical considerations such as the availability of participants and ethical concerns related to random assignment [8]. Despite not having the same level of control as true experimental designs, quasi-experimental studies can still provide valuable insights into the effectiveness of interventions like ABL in educational settings. Overall, this research design allows for an exploration of the effects of ABL on various dimensions of mathematics education, providing valuable information for educators and policymakers interested in incorporating experiential learning approaches into the curriculum.

4.1 Participant

The study involves 30 undergraduate students enrolled in the Program Persediaan Ijazah Sarjana Muda Perguruan (PPISMP) or degree preparation course at the Teacher Education Institute, divided into two groups: 15 students in experimental group and 15 students in control group. An ABL group receiving instruction through the adventure-based learning approach, and a control group following conventional teaching methods based on the institution's weekly lesson plans. The ABL group engages in experiential activities and problem-solving tasks aimed at promoting personal and interpersonal development, while the control group follows traditional classroom lectures, discussions, and assignments. This quasi-experimental study aims to compare the effectiveness of adventure-based learning against conventional teaching methods in the context of teacher education.

4.2 Procedure

Both groups undergo pre-testing before the intervention begins to establish baseline measures of BSA, CTS and LS. The ABL group then participates in adventure-based learning sessions over a period of 10 weeks, while the control group continues with conventional teaching methods. Throughout the intervention, observations are conducted to monitor student engagement and participation. After the intervention period, both groups undergo post-testing to assess any changes in BSA, CTS and LS. Additionally, a second round of post-testing is conducted eight weeks later to evaluate the long-term effects of the intervention. Thus, the total duration of the study spans 21 weeks.

4.3 Experimental activities

The adventure-based learning intervention consists of three main activities:

4.3.1 Walking/cycling activities

Students engage in problem-solving exercises while cycling on campus, requiring them to plan solution strategies, collect data, and communicate using the Telegram application. Subsequently, they regroup to solve the given problem collaboratively. The implementation of walking/cycling activities is carried out as shown in Figure 1.

Figure 1: Walking/cycling adventure.

4.3.2 Explore race activities

Students receive keywords via Telegram, indicating locations they must explore as a group. Upon reaching each location, they must complete assigned tasks, with successful completion determined by timely and accurate task execution. The activity is carried out as shown in Figure 2.

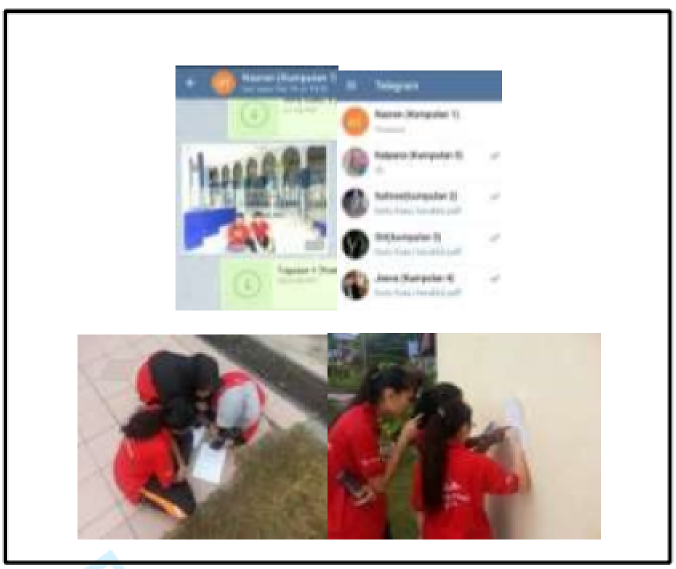

Figure 2: Explore race adventure.

4.3.3 Flying fox activity

Students work in groups to solve correlation-related tasks related to their descent on a flying fox rope. Tasks include planning, data collection, problem-solving, and presentation of results. Figure 3 shows the implementation of the flying fox activity.

Figure 3: Flying fox adventure.

4.4 Conventional group

The conventional group in this study serves as the control group, following traditional teaching methods as outlined in the weekly lesson plans developed by Teachers Education Institute (Mathematics Department). The methodology for the conventional group is designed to mirror standard classroom instruction commonly practiced in educational settings.

This study uses a quasi-experimental design with non-equivalent groups because the sample couldn't be randomly assigned. According to [4, 6], random assignment is often difficult to implement in real-world educational settings due to logistical constraints. Creswell [6] notes that even in these situations, non-equivalent group designs can still yield meaningful insights if confounding variables are carefully controlled. The emphasizes the importance of using precise statistical techniques to minimize bias resulting from the lack of randomization [15]. Internal validity reflects the extent to which the treatment impacts the dependent variable without interference from external factors, while external validity indicates how broadly the study's findings can be generalized. The key disruptive factors such as history, maturation, and testing, which can compromise internal validity [8]. Jackson [15] addresses issues with instrumentation and mortality, while Creswell [6] emphasizes the importance of minimizing selection bias and controlling for sample behavior to ensure more accurate results.

To address the effects of history and maturation, the experiment was conducted within a suitable period with a control group as a comparison [4]. To minimize testing effects, we adjusted the layout of the questions and spaced out the assessments appropriately. Mahmad et al. [19] highlights the role of diverse question formats in enhancing assessment reliability, while Creswell [6] points out that timing can significantly impact test outcomes. Additionally, Juriza et al. [16] supports this approach, noting that these strategies contribute to more accurate evaluations. To address instrumentation effects, we used precise measurement tools and ensured that the instruments were both valid and reliable. Cooley et al. [5] emphasizes the importance of accurate measurement in educational assessments, and Creswell [6] further reinforces the need for valid instruments in the grading and intervention processes.

To prevent mortality effects, we provided participants with explanations and incentives, while also excluding those who had more than 50 percent absences, as pointed out by [6, 16]. Furthermore, to avoid sample behavior effects, we made sure that respondents did not know whether they were in the treatment or control group, and we used the same teaching modules and weekly plans throughout the study, as noted by [9, 11].

To tackle statistical regression effects, we utilized valid and reliable instruments and carried out a pilot study to assess their validity and reliability, as highlighted by [4, 15]. These actions were implemented to maintain the internal and external validity of the study.

In conclusion, this study successfully conducted a quasi-experimental design while considering various factors affecting internal and external validity. Measures taken to control disruptions such as history, maturation, testing, instrumentation, mortality, selection, and sample behaviour have ensured that the study's results are valid and reliable. Therefore, this research makes a significant contribution to understanding the effects of Adventure-Based Learning (ABL) on basic statistics achievement and lays a solid foundation for future studies in this field.

4.5 Instruments

Three instruments are utilized to measure outcomes:

1. **Basic statistical achievement test:**
   The test covers topics such as data management, quantitative measurement, and correlation assessment. It consists of two parts, each contributing to a total score of 100. Topics within these parts likely include but are not limited to: data collection methods, descriptive statistics, measures of central tendency and dispersion, graphical representation of data, probability distributions, hypothesis testing, and techniques for analyzing the relationship between variables, such as correlation coefficients. Participants' performance on these topics will be evaluated to assess their proficiency in data analysis and numerical measurement skills.

2. **Critical thinking skills test:**
   The test assesses interpretation and evaluation skills related to statistical concepts. It is designed to measure students' ability to analyze information, evaluate arguments, and draw reasoned conclusions within the context of statistics. This assessment likely includes questions that require students to interpret statistical data, identify trends or patterns, evaluate the validity of statistical arguments or claims, assess the reliability of data sources, and draw logical conclusions based on statistical findings. By evaluating these skills, the test aims to gauge students' proficiency in applying statistical concepts to real -world scenarios and making informed decisions based on statistical evidence.

3. **Leadership skills questionnaire:**
The questionnaire consists of 25 items specifically targeting communication skills and group work abilities. It aims to evaluate students' perceived leadership capabilities, focusing on their effectiveness in communication, task delegation, and fostering collaboration within a group setting. The items likely cover various aspects of leadership, such as oral and non-verbal interaction, attentive listening, conflict mediation, decision -making, motivating team members, and providing constructive feedback. By assessing these dimensions, the questionnaire aims to provide insights into students' perceived strengths and areas for improvement in leadership and teamwork skills.

5 Data Analysis

In the analysis phase, inferential statistics are utilized with the support of SPSS version 23 software. Before proceeding with the analysis, the data undergo a thorough examination to ensure data normality, data linearity, similarity of variance, and identify potential outliers, employing relevant statistical tests such as the Shapiro-Wilk test for normality, Levene test for variance homogeneity, and box plot tests for identifying outliers. To assess the impact of the ABL approach in enhancing BSA, CTS, and LS among students, the MANOVA Test is employed, allowing for the simultaneous examination of multiple dependent variables while controlling for potential confounding variables.

5.1 Finding

The study employed MANOVA (Multivariate Analysis of Variance) to analyze how independent variables (group membership, representing ABL versus control) affected multiple dependent variables (BSA, CTS, and LS). Before conducting MANOVA, Box's Test was used to assess the equality of covariance matrices, yielding a non-significant p-value $(p > 0.05, p = 0.60)$, indicating that the assumption of equal covariance matrices across groups was satisfied. The analysis of Box's Test of Equality of Covariance Matrices revealed a Box's M value of 5.145, an F value of 0.757 with degrees of freedom of 6 and 5680.302 for df1 and df2 respectively, and a significance level (Sig.) of 0.604, indicating no significant difference between covariance matrices (*Significant level p 0.05].

Following the Box's Test, the significance of group effects on the dependent variables at the outset of the study was assessed using the Pillai's Trace statistical test. Pillai's Trace was chosen for its appropriateness in measuring effects when sample size is small compared to other tests. Another reason for using Pillai's Trace in statistical analysis is its robustness against violations of assumptions such as normality and homogeneity of variances, which are often required by other multivariate tests like Wilks' Lambda and Hotelling's Trace. Pillai's Trace is also known for providing more accurate Type I error rates when these assumptions are not met [15]. The findings revealed no notable group impact on the attainment of BSA, CTS, and LS. Additionally, a MANOVA was conducted to examine the average disparities in pre-achievement of the three dependent variables between the ABL and control groups. The MANOVA results indicated insignificant differences in the mean pre-test scores between the groups for each dependent variable: BSA, CTS, and LS. Specifically, the F-tests for BSA [F $(1, 28) = 3.88$, $p > 0.05$], CTS [F $(1, 28) = 1.49$, $p > 0.05$], and LS [F $(1, 28) = 2.89$, $p > 0.05$] all generated p-values exceeding 0.05 $(p > 0.05)$, signifying no significant differences between the ABL and control groups concerning these variables prior to any intervention. In summary, based on the outcomes of Box's Test, Pillai's Trace test, and MANOVA analysis (Table 2), it can be deduced that there were no substantial variances between the ABL and control groups regarding the pre-attainment of BSA, CTS, and LS, demonstrating comparability between the groups at the study's inception.

Table 2: MANOVA test for mean pre-test scores.

Source	DV	DS	df	MS	F	Sig
Model Corrected	PreTest BSA	128.133a	1	128.133	3.88	0.059
	PreTest LS	126.485b	1	126.485	2.89	0.100
	PreTest CTS	99.615c	1	99.615	1.49	0.233

*Significant level $p < 0.05$, DS - Degree of square,
MS - Mean square, DV - Dependent variable

The results imply that the ABL intervention significantly influenced post-test scores for Basic Statistics achievement and leadership skills, as evidenced by notable differences in mean scores between the ABL and control groups (BSA: F $(1, 28) = 4.61, p < 0.05$; LS: F $(1, 28) = 10.46$, $p < 0.05$). However, there was no significant difference in mean post-test scores for CTS (F $(1, 28) = 0.41, p > 0.05$), indicating that the ABL did not noticeably affect this aspect. Moreover, the findings highlight the importance of considering the underlying covariance structures, as demonstrated by the non-significant results of Box's Test ($p > 0.05$, p-value $= 0.54$), suggesting consistent covariance matrices across groups and strengthening the validity of subsequent MANOVA analysis. The summary of the data findings can be seen in Table 3.

The substantial contribution of the ABL to changes in Basic Statistics achievement and leadership skills, as reflected in the R square values (Basic Statistics: 14.1 percentage; leadership skills: 27.2 Percentage), highlights the potential significance of this intervention in enhancing these key competencies among participants. Moreover, the notable difference in mean scores between the experimental and control groups further supports the efficacy of the ABL, particularly in improving leadership skills and Basic Statistics achievement. Overall, these findings not only provide valuable insights into the effectiveness of the ABL intervention but also underscore the need for further research to explore its potential implications and refine its implementation for optimal outcomes.

Table 3: MANOVA test for mean post-test scores.

Source	DV	DS	df	MS	F	Sig
Model Corrected	Posttest BSA	132.300a	1	132.300	4.607	0.041
	Posttest LS	346.800b	1	346.800	10.456	0.003
	Posttest CTS	36.300c	1	36.300	0.414	0.525

*Significant level $p < 0.05$, DS - Degree of square,
MS - Mean square, DV - Dependent variable

In summary, the results of the Pillai's Trace multivariate statistical test highlight a significant group effect across BSA, CTS, and LS ($\text{F}(3, 26) = 4.05$, $p < 0.05$), rejecting the null hypothesis and confirming the measurable impact of the ABL across all dimensions. Further examination through MANOVA analysis (refer to Table 4) reveals notable differences in mean second post-test scores between groups for BSA ($\text{F}(1, 28) = 5.57, p < 0.05$) and CTS ($\text{F}(1, 28) = 5.30, p < 0.05$), but not for LS ($\text{F}(1, 28) = 1.08, p > 0.05$). This suggests a nuanced interplay of factors, with the time interval between tests emerging as a determinant influencing critical thinking and leadership skills.

Table 4: MANOVA test for mean post-posttest scores.

Source	DV	DS	df	MS	F	Sig
Model Corrected	Post-posttest BSA	546.133a	1	546.133	5.569	0.025
	Post-posttest LS	26.133b	1	26.133	1.077	0.308
	Post-posttest CTS	244.626c	1	244.626	5.302	0.029

*Significant level $p < 0.05$, DS - Degree of square,
MS - Mean Square, DV - Dependent variable

Analyzing mean values across ABL and control groups shows superior performance in BSA (ABL $= 52.42$; control $= 43.89$), CTS (ABL $= 72.60$; control $= 66.89$), and LS (ABL $= 87.67$; control $= 85.80$) in the ABL group. This highlights the need for further investigation into the effects of the ABL, considering unaccounted changes in dependent variables. The R square value indicates the proportion of variance explained by independent variables, with the time interval accounting for a 16.6 percent change in Basic Statistics achievement and a 15.9 percent change in critical thinking skills. Prioritizing future studies to delve into these effects aligns with institutional missions and student aspirations.

6 Discussion

The study explores the effectiveness of Adventure-Based Learning (ABL) in enhancing academic achievement, critical thinking skills (CTS), and leadership skills (LS) within the educational context. This discussion will prioritize presenting the main findings regarding the impact of ABL on these areas before discussing their alignment with previous research and providing contextual justifications beyond existing literature.

The study findings indicate significant improvements in both critical thinking skills (CTS) and leadership skills (LS) among participants engaged in ABL compared to those in the control group. Specifically, participants in the ABL group demonstrated higher mean scores on the second post-tests for both CTS (ABL $= 72.60$; control $= 66.89$) and LS (ABL $= 87.67$; control $= 85.80$), indicating a pronounced effect of ABL in fostering these skills [3].

However, the study found no statistically significant difference in mean scores for basic statistical achievement (BSA) between the ABL and control groups. Despite this, the ABL group consistently showed higher mean scores across all aspects compared to the control group (BSA: ABL $= 52.42$; control $= 43.89$), suggesting a potential trend towards improved academic achievement with ABL [24].

The findings of this study align with prior research emphasizing the efficacy of ABL in educational settings. [21] similarly reported positive impacts of ABL on academic performance and leadership development. These studies collectively support the notion that ABL integrates elements of inquiry-based and experiential learning, which are conducive to enhancing student outcomes in various educational domains.

Beyond existing literature, the study provides contextual justification by highlighting the methodological rigor employed, including a second post test after eight weeks to assess long-term retention of skills. This approach is consistent with established research practices aimed at evaluating the sustainability and effectiveness of interventions over time [3, 10]. Furthermore, the study's focus on meaningful learning experiences aligns with [25] framework, emphasizing the retention of knowledge and skills through engaging and experiential activities inherent in Adventure Based Learning. This approach not only supports academic achievement but also nurtures critical thinking and leadership abilities essential for holistic student development [24, 25].

In conclusion, the study contributes valuable insights into the benefits of Adventure Based Learning in enhancing critical thinking, leadership, and potentially academic achievement among students. By integrating ABL into educational practices, educators can effectively foster comprehensive human capital development aligned with national educational goals. Continued research and implementation of Adventure Based Learning are crucial to meeting the evolving educational needs of students and advancing educational objectives on both local and global scales.

7 Conclusions

The ABL approach, while relatively uncommon in mathematics education, emerges as an alternative method that holds promise for educators seeking innovative approaches in teaching and learning. The successful implementation of ABL in this study underscores its potential impact on various facets of education, including BSA, CTS and LS. This unconventional approach challenges traditional perceptions of mathematics education by integrating activities of adventure such as walking, cycling, explore races, and flying fox into teaching and learning sessions. By incorporating these adventurous elements, the approach aims to engage students in a dynamic and hands-on manner, fostering a deeper understanding of mathematical concepts while promoting physical activity and experiential learning. This innovative approach not only breaks away from conventional teaching methods but also enriches the learning experience by offering students unique opportunities to apply mathematical principles in real-world scenarios. Educators also can create dynamic and engaging learning experiences that transcend the confines of the classroom, nurturing holistic development across physical, emotional, spiritual, intellectual, and personality dimensions. The findings of this study not only highlight the efficacy of ABL in enhancing academic outcomes but also demonstrate its capacity to reshape educators' perspectives on mathematics instruction.

Furthermore, the implications of this research extend beyond the realm of mathematics education, offering valuable insights into the broader landscape of teaching and learning. By emphasizing the importance of experiential and adventurous learning, this study contributes to the ongoing discourse on educational innovation and pedagogical approaches that promote well-rounded human development. In light of these findings, it is envisaged that this research will yield meaningful contributions to the Ministry of Education (MOE), particularly in its efforts to foster the development of balanced individuals. By recognizing the value of alternative teaching methods such as ABL, educational institutions can better align with the mission and aspirations of the country, striving to cultivate a cadre of outstanding and distinguished human capital.

In conclusion, this study underscores the transformative potential of ABL in mathematics education and beyond, advocating for the adoption of innovative and holistic teaching methods that nurture not only academic achievement but also essential skills and competencies. By embracing adventurous learning experiences, educators can inspire students to excel and contribute meaningfully to society, aligning with the broader goals of educational excellence and human capital.

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