# Effect of Hands-On Learning Strategies on Senior Secondary School Students' Academic Achievement in Topographical Map Studies in Ganye Educational Zone, Adamawa State, Nigeria

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*Abstracts:* The study investigated the Effect of Hands-On Learning Strategies on Senior Secondary School Students' Academic Achievement in Topographical Map Studies in Ganye Educational Zone, Adamawa State. Four null hypotheses were raised to guide the study. The research design employed was the quasi-experimental non-equivalent pre-test, post-test control group design. The sample size for the study was 263 senior secondary school (SS II) geography students from six intact classes in public senior secondary schools in three Local Government Areas of Ganye Educational Zone. A 40-item Topographic Map Achievement Test (TMAT) constructed by the researcher but structured in line with WAEC/NECO standardized test items in practical geography was used to obtain data. The instrument was validated by two experts from Geography Education and Test and Measurement. A reliability index of 0.80 was obtained using Guttmann's Split half statistic. One Way Analysis of Variance (ANOVA) was used to test hypotheses one and two; and Tukey's Honestly Significant Difference (HSD) Post Hoc Mean Comparisons Test was used to establish the effect size. The independent samples t-Test statistic was used to test hypotheses three and four. The findings from this study revealed that: there was a statistically significant difference in the mean scores of students taught topographical maps using hands-on learning strategy alone, conventional method alone and hands-on learning strategy combined with conventional method in senior secondary schools of Ganye Educational Zone, Adamawa State (F (2, 260) = 52.105, p < 0.05). There was a significant difference in the retention scores of students taught topographical maps using hands-on learning strategy alone, conventional method alone and hands-on learning strategy combined with conventional method (F (2, 260) = 48.477, p < 0.05). There was no statistically significant difference in the mean scores of male and female students taught topographic maps using hands-on learning strategy (t = 0.880, df = 95, p > 0.05). There was no significant difference in the mean scores of male and female students taught topographic maps using hands-on learning strategy combined with conventional method (t = 0.544, df = 83, p > 0.05). Based on the findings of this study, it was recommended that geography teachers should endeavour to use hands-on learning strategy as an alternative strategy or incorporate this instructional technique with other teaching methods in order to improve the teaching and learning of topographical maps in senior secondary schools.

*Keywords:* Academic Achievement; Hands-On learning Strategies; Topographical Map Studies; Topographical Map Achievement Test.

# 1.  INTRODUCTION

Techniques for improving students' interest in learning form major topics of debate among educators. Conventional strategies, typified by lecture-based learning (LBL) are believed to have done little due to their passive, teacher-centred nature. In the recent years, educators are advocating a paradigm shift from passive sitting and listening to a more active and dynamic learning experience. Hands-on learning strategy is a student-centred instructional strategy in which students interact, solve problems and reflect on their experiences.

Hands-on learning or experiential learning has become a common phrase in science education. Hands-on learning is learning by doing. It combines active learning with concrete experiences, abstract concepts and reflection in an effort to engage all learning styles. Hands-on learning involves the learner in total learning experiences which enhances the learner ability to think critically. The learner must plan process to test a hypothesis, put the process into motion using various hands-on materials, see the process into completion, and be able to explain the attained results. Hands-on learning enables students to become critical thinkers, able to apply not only what they have learned, but more importantly, the process of learning to various life situations.

Hands-on learning is a philosophy of education that explains what occurs between a teacher and student that incorporates direct experience with the learning environment and content. Hands-on learning means different thing to different people. While some people see it simply as learning by doing, materials-centred learning, learning through experience or minds-on learning, others see it as engaging in in-depth investigations with objects, materials, phenomena, and ideas and drawing meaning and understanding from those experiences. Whatever ones interpretation may be, hands-on learning strategy effectively engages learners by giving them room to interact with one another thereby contributing to their own learning.  Studies have shown that students with a kinaesthetic learning style require this hands-on type of learning in order to attain higher goals. Verbal and visual learners can adapt to reach higher levels of understanding using learning styles other than their own. Kinaesthetic learners often cannot. Accordingly, it is important for geography teachers to incorporate hands-on learning into their daily instruction. There exist a likely gap between the use of this instructional technique in teaching topographical maps and students' performance in practical geography in schools Ganye Educational Zone that this study explored; however, this is not to categorically state that traditional lecture method is entirely unproductive.

Map work, an essential branch of geography has been identified as one of the most difficult aspect of geography. The importance of map reading in the study of geography has been highlighted by several studies. Maps are indispensable tools used by the geographers at different levels and for various purposes. Meanwhile, geographers make use of different types of maps. Topographical map is one of such map which is an integral tool in map reading at the secondary school level in Ganye Educational Zone. This map exhibits details of the physical and cultural landscapes of the area mapped with the aid of contour lines. The reading and interpretation of topographical maps demand certain skills in the part of the students and teachers. These skills include identification of relief features on topographical maps, ability to perceive three-dimensional features depicted as two-dimensional on the flat map and the ability to give a description of human activities of the area mapped in a simple form. However, several factors are known to have negatively impacted on the effective teaching and learning of topographical maps in Secondary Schools of Ganye Educational Zone. One of the main factors identified which is the focus of this study is the teacher related factor specifically, the instructional strategies adopted by geography teachers to teach topographical maps. A teacher is as good as what he can offer.  Therefore, the instructional strategy he adopts is very crucial in promoting or distorting effective teaching and learning outcomes.

This study centred on practical geography; particularly map reading using topographical maps because secondary school students in Ganye Educational Zone often have difficulty in it. Reference [1] reported that 50% of the Geography topics indicated by students as problematic fall in the area of map work, particularly, the use of the topographical maps. Geography students in schools of Ganye Educational Zone may be susceptible to finding of this study. Also, reports of students' performance in this aspect of practical geography in Senior Secondary School Certificate Examinations conducted by both West African Examinations Council (WAEC) and National Examinations Council (NECO) have not being encouraging. For instance, WAEC Chief Examiners' reports have highlighted poor candidates' performance in SSSCE geography map reading persistently [2]. Some of the likely reasons identified for the poor performance of students in SSSCE geography map reading in Ganye Educational Zone include: shortage of well qualified and experienced geography teachers, lack of well-organized fieldwork, paucity or complete lack of teaching aids and suitable textbooks

and poor teaching methodology. WAEC chief examiners' reports identified poor preparation for the examination, poor coverage of the syllabus, unavailability of appropriate equipment for practical surveys in the school setting, among others as the causes of students' poor performance. On the other hand, students' perceived problems on why they presumed geography to be a difficult subject hence run away from it include: poor background of students in mathematical and some major geographical concepts; lack of appropriate instructional materials to illustrate and demonstrate the aspects being taught; geography not given sufficient time on the school time-table to cover the wide topics etc. Thus, it could be realised that many secondary school students in Ganye Educational Zone regard geography as a difficult subject because of the abstract manner the subject is being taught; with students and teachers heavily dependent on textbooks. Reference [3] opined that prevailing poor performance by students in geography is as a result of misconception they hold about some topics in geography and instructional mode. Often times, due to dearth of appropriate geographical instructional materials, many of the topics treated in map reading in secondary schools of Ganye Educational Zone could not be illustrated with topographical maps. This ongoing trend if left unchecked may spell doom on students' performance in practical geography in no distant future.

Several studies have indicated that continuous use of conventional method to teach students some abstract concepts in map reading with no exposure to topographical maps through hands-on approach has plagued students' performance in practical geography SSCE and fails to inculcate conceptual understanding in learners [4]. On the other hand, researches, though limited, have shown that learners taught by hands-on learning approach achieved remarkable results than learners taught using conventional method [5]. Consequently, [6] advocate for a change in instructional delivery modes. Therefore, could the poor performance of secondary school students in practical geography in Ganye educational Zone be as a result of poor choice of instructional strategy adopted by geography teachers in teaching topographical maps? This study intends to provide an answer to this critical question. Apart from teaching methods, gender is also implicated in students' achievement in geography.

Achievement test results over the years have shown an increasing gap between the performances of male and female secondary school students in science oriented subject. Similarly, studies have shown that invincible rules within the society have provided what is feminine and what is masculine. Hence, science oriented subjects in most cultures are defined as masculine. Based on this gender stereotype, one may likely infer that the male students in secondary schools of Ganye Educational Zone may likely perform better than their female counterpart when taught topographical maps by hands-on learning approach. But this assertion cannot be said to be entirely true until one provides empirical evidence to substantiate this claim. The effect of gender on the academic achievement of students has in recent time been attracting attention from researchers and psychologists. There is however no consensus among scholars on the effect of gender on students' performance in schools. While some studies revealed statistically significant effect of gender on performance, others show no significant difference in the performance of both male and female students. Based on this existing body of literatures, the present study intends to contribute to the on-going debate to determine the influence of gender on academic achievement of senior secondary school students in topographical map studies in Ganye Educational Zone.

Several extant studies have been carried out related to map work. While some of these works centred on the effect of gender on students' academic achievement in map work alone [7], others are descriptive in nature [4]. Besides, in all these studies, no instructional strategies were experimented upon in other to provide empirical evidence as to which instructional strategy would best promote effective teaching learning outcomes in topographical map studies. Even though, [5] carried out a study on the effect of tutorial mode of computer-assisted instruction on students' academic performance in secondary school practical geography in Nigeria, one may still question the applicability of this instructional strategy in topographical map studies considering the poor state of infrastructural facilities in public schools. This study also varied from previous studies in terms of location. No known study was carried out in Ganye Educational Zone related to the effect of Hands-On Learning strategies on secondary school students' academic achievement in topographical map studies. This therefore left us with a wide gap wanting to be filled. The basic assumption underlying this study is that hands-on teaching if used as an instructional strategy to teach topographical maps would enhance learners' conceptual understanding and improve performance. Therefore, the present study was designed to find out the Effect of Hands-On Learning Strategies on Senior Secondary School Students' Academic Achievement in Topographical Map Studies in Ganye Educational Zone with the intention of facilitating learners' conceptual understanding in order to improve performance.

## 1.1. PURPOSE OF THE STUDY:

The need to remediate the difficulties of abstraction encountered by senior secondary school students in topographical map studies in Ganye Educational Zone using hands-on learning strategies (practical and fieldwork) informed this research. The purpose of the study therefore, was to find out the Effect of Hands-On Learning Strategies on Senior Secondary School Students' Academic Achievement in Topographical Map Studies in Ganye Educational Zone, Adamawa State.

## 1.2. RESEARCH HYPOTHESES:

The following research hypotheses were formulated to guide the study:

$H_{O1}$: There is no significant difference in the mean scores of students taught topographic maps using Hands-On Learning Strategy alone, Conventional Method alone and Hands-On Learning Strategy combined with Conventional Method.

$H_{O2}$: There is no significant difference in the retention scores of students taught topographic maps using Hands- On Learning Strategy alone, Conventional Method alone and Hands-On Learning Strategy combined with Conventional Method.

$H_{O3}$: There is no significant difference in the mean scores of Male and Female students taught topographic maps using Hands-On Learning Strategy.

$H_{O4}$: There is no significant difference in the mean scores of male and female students taught topographic maps using Hands-On Learning Strategy combined with Conventional Method.

## 2. MATERIALS AND METHOD

This study adopted the quasi-experimental non-equivalent pre-test, post-test control group design. In quasi-experiments, the researcher uses experimental and control groups but does not randomly assign subjects to groups because they are already in intact classes. The design is used where it may not be permissible to randomly assign subjects to groups. The design is represented as follow:

$O_1$     $X_1$     $O_2$

$O_3$     $X_2$     $O_4$

$O_5$     $X_3$     $O_6$

where:

$O_1, O_3$ and $O_5$ are Pre-test Scores for the three groups

$O_2, O_4$ and $O_6$ are Post Test Scores for the three groups

$X_1 =$    Experimental treatment using Hands-On Learning

$X_2 =$    Experimental treatment using Hands-On Learning and Conventional Method

$X_3 =$    Control treatment using Conventional Method

This schematic representation was structured in line with studies documented in various educational researches [8; 5, 9].

## 2.1 SAMPLE AND SAMPLING TECHNIQUE:

The sample for the study comprised all public Senior Secondary Schools students in Ganye Educational Zone drawn from the population. Multi stage sampling technique was used to select three out of four Local Government Areas in Ganye Educational Zone of Adamawa State. Ganye Educational Zone of Adamawa State is located in the north eastern part of Nigeria comprising of four Local Government Areas namely: Toungo, Ganye, Jada and Mayo-Belwa Local Government Areas. Ganye Educational Zone lies geographically between latitude $8^0 26^0$ N and longitude $12^0 4^0$ E. The simple random sampling technique was used in selecting six Senior Secondary Schools in three Local Government Areas of Ganye Educational Zone namely: Mayo-Belwa LGA, Jada LGA and Ganye LGA, with two schools each from the sampled Local Government Areas. Simple random sampling technique involving the use of balloting without replacement was used to select schools to be assigned what treatment. Intact classes were used in the study. The sample size of the study comprised

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263 SS II geography (147 male and 116 female participants) students from the six intact classes used in the study. Students from four of the intact classes code named class A ($n$ = 97, 51 male and 46 female) and B ($n$ = 85, 48 male and 37 female) served as the Experimental Groups and the students from two of the other intact classes code named class C ($n$ = 81, 48 male and 33 female) served as the Control Group. The SS II geography students were chosen for the study because they have been exposed to geography in their SSS I class. The students were not sitting for any public examination like WAEC or NECO. Hence, they have time to participate in the research. The Experimental Groups were taught concepts in map reading theoretically and exposed to topographic map using hands-on learning strategies and the Control Group was taught concepts in map reading theoretically with no exposure to topographic maps and fieldwork (lecturing and no practical work).

## 2.2 RESEARCH INSTRUMENT:

A 40-item Topographic Map Achievement Test (TMAT) was constructed by researcher but structured in line with WAEC and NECO standardized test items in practical geography. The TMAT comprised two sections (Section A: 33 objective items carrying the total of 33 marks and Section B: 7 compulsory essay items carrying the total of 67 marks) which were administered to students in the three groups (two Experimental and Control groups). Pre-test was administered to the students to determine their entry behaviour. Both the experimental and control groups were exposed to treatments before the administration of TMAT (post-test). The Control Group was exposed to learning of basic concepts in map reading, measurement of distance, direction and bearing, map reduction and enlargement, interpretation of physical and cultural features and settlements as spelt out in Nigeria's Geography Curriculum for Senior Secondary School through the conventional method (here the teacher only directs the teaching learning process). The experimental groups were exposed to the learning of the same concepts through both theoretically and exposure to hands-on learning activities using topographic maps as instructional material. Experimental Group A was exposed to those concepts in map reading using topographical maps and fieldwork with the teacher acting as a facilitator, while Experimental Group B were taught concepts in map reading both theoretically couple with exposure to topographic maps and fieldwork (here the teacher directs and also facilitate the teaching learning process). The researcher administered the treatments to both groups with the aid of research assistants over a period of 8 weeks. The following table (Table I) represents the item specification for the instrument measuring five cognitive domains in the Blooms taxonomy of behavioural objectives namely: knowledge, comprehension, application, analyses and syntheses.

**TABLE I: ITEM SPECIFICATION FOR THE TOPOGRAPHIC MAP ACHIEVEMENT TEST (TMAT)**

| TOPIC | Knowledge (25%) | Cognitive Comprehension (20%) | Objectives Application (25%) | Analyses (15%) | Syntheses (15%) | Total (%) |
|---|---|---|---|---|---|---|
| Basic Concepts in Map Reading (20%) | 2 | 2 | 2 | 1 | 1 | **8** |
| Map Distances, Direction and Bearing (20%) | 2 | 2 | 2 | 1 | 1 | **8** |
| Map Reduction and Enlargement (20%) | 2 | 2 | 2 | 1 | 1 | **8** |
| Interpretation of Physical and Cultural Features (20%) | 2 | 2 | 2 | 1 | 1 | **8** |
| Settlements (20%) | 2 | 2 | 2 | 1 | 1 | **8** |
| **Total (%)** | **10** | **10** | **10** | **5** | **5** | **40** |

## 2.3 VALIDITY OF THE INSTRUMENT:

In order to provide for face and content validity, the instrument for the study (TMAT) was subjected to thorough scrutiny by two experts in Geography and test construction in the Department of Science Education, Adamawa State

University, Mubi. The validators offered suggestions for some items in the instrument to be restructured in line with Blooms taxonomy of behavioural objectives. The validators also suggested that the essay items be reduced from sixteen items to seven items and the objective items be increased from twenty four to thirty three. All necessary corrections were made and incorporated in the final body of the instrument.

**2.4. RELIABILITY OF THE INSTRUMENT:**

In order to ascertain the reliability of the instrument, a pilot study was carried out using 64 geography students in two schools of Mubi North and Mubi South LGA. The students used for the trial-testing did not constitute the targeted population for the study. The total scores of each student obtained after pilot-testing were correlated using Guttmann Split-Half statistic, which yielded a reliability index of 0.80. This reliability coefficient was considered satisfactory for the present study.

**2.5. METHOD OF DATA ANALYSIS:**

The four hypotheses ($H_{O1}$, $H_{O2}$, $H_{O3}$ and $H_{O4}$) in the study were tested using different statistical tools. Hypotheses one and two were tested using Analysis of Variance (ANOVA). Turkey's Honestly Significant Difference (HSD) post hoc test was used to establish the effect sizes between the experimental and control groups' mean score. Hypotheses three and four were tested using independent samples t-test statistic. All tests were done at 0.05 level of significance. The tests determined whether there was significant difference between the means of the variables under consideration.

# 3.   RESULTS

The pre-test scores of students in the experimental and control groups were analyzed. This was done in order to ascertain the entry behaviour of students in the experimental and control groups before the treatment. Therefore, students' pre-test scores in the two experimental (hands-on learning and hands-on learning combined with conventional method) and control groups were obtained prior to treatment and analyzed using Analysis of Variance (ANOVA). The ANOVA results are presented in Table 2.

**TABLE II:  SUMMARY OF ONE WAY ANALYSIS OF VARIANCE (ANOVA) OF STUDENTS' PRE-TEST SCORES IN THE EXPERIMENTAL AND CONTROL GROUPS**

| Sources of Variation | Sum of Squares | df | Mean Square | F | Sig. (2-tailed) |
|---|---|---|---|---|---|
| **Between Groups** | 390.709 | 2 | 195.354 | 1.145 | .320 |
| **Within Groups** | 44347.451 | 260 | 170.567 | | |
| **Total** | 44738.160 | 262 | | | |

Not Significant; $p > 0.05$.

Table II shows comparison of mean achievement scores of students in the experimental and control groups at the commencement of the study. The table reveals that there is no statistically significant difference in the academic achievement of students in topographical map achievement test at the pre-test level (F (2, 260) = 1.145, p > 0.05). This implies that the students in the experimental and control groups had equivalent entry behaviour prior to treatment.

**Hypothesis One:**

There is no significant difference in the mean scores of students taught topographic maps using Hands-On Learning Strategy alone, Conventional Method alone and Hands-On Learning Strategy combined with Conventional Method.

To test hypothesis one, the experimental and control groups students' mean scores were analysed using one way Analysis of Variance (ANOVA). The result of one way Analysis of Variance (ANOVA) is presented in Table III. In order to know which groups specifically differ significantly from the other, the post test scores of the students were further subjected to Tukey's HSD post hoc test which displays a table of multiple comparisons. The result is presented in Table IV.

**TABLE III: SUMMARY OF ONE WAY ANALYSIS OF VARIANCE (ANOVA) OF STUDENTS' POST TEST SCORES IN THE EXPERIMENTAL AND CONTROL GROUPS**

| Sources of Variation | Sum of Squares | df | Mean Square | F | Sig. (2-tailed) |
|---|---|---|---|---|---|
| Between Groups | 35822.231 | 2 | 17911.115 | 52.105 | .000* |
| Within Groups | 89374.309 | 260 | 343.747 | | |
| Total | 125196.540 | 262 | | | |

*Significant; $p < 0.05$.

Table III shows the ANOVA analysis of students' means scores in the experimental and control groups. It could be deduced from the table that there is a statistically significant difference in the mean scores of students taught topographic maps using Hands-On Learning Strategy alone, Conventional Method alone and Hands-On Learning Strategy combined with Conventional Method. This implies that students in the experimental groups taught topographical maps by hands-on learning strategies performed better than those taught by conventional method ($F (2, 260) = 52.105$, $p < 0.05$).

**TABLE IV: TUKEY'S HSD POST HOC MULTIPLE COMPARISONS TEST RESULTS BASED ON STUDENTS' POST TEST SCORES IN THE EXPERIMENTAL AND CONTROL GROUPS**

| Source (I) Teaching Strategies | (J) Teaching Strategies | Mean Difference (I-J) | Sig. (2-tailed) | 95% Interval Lower Bound | Confidence Upper Bound |
|---|---|---|---|---|---|
| Hands-On Learning Strategy | Hands-On Learning and Conventional Method | 5.0059 | .166 | -1.4873 | 11.4992 |
| | Conventional Method | 27.2141[*] | .000* | 20.6360 | 33.7922 |
| Hands-On Learning and Conventional Method | Hands-On Learning Strategy | -5.0059 | .166 | -11.4992 | 1.4873 |
| | Conventional Method | 22.2081[*] | .000* | 15.4220 | 28.9942 |
| Conventional Method | Hands-On Learning Strategy | -27.2141[*] | .000* | -33.7922 | -20.6360 |
| | Hands-On Learning and Conventional Method | -22.2081[*] | .000* | -28.9942 | -15.4220 |

*Significant; $p < 0.05$.

It could be seen from the results in Table IV that there is a significant difference in the mean scores of students taught topographic maps using hands-on learning strategy alone and those taught using conventional method ($p < 0.05$). Similarly, there is a significant difference in the mean scores of students taught topographic maps using hands-on learning strategy combined with conventional method and those taught using conventional method alone ($p < 0.05$). However, there is no significant difference in the mean scores of students taught topographic maps using hands-on learning strategy alone and those taught using hands-on learning strategy combined with conventional method ($p > 0.05$).

**Hypothesis Two:**

There is no significant difference in the retention scores of students taught topographic maps using Hands-On Learning Strategy alone, Conventional Method alone and Hands-On Learning Strategy combined with Conventional Method.

To test the second hypothesis, the retention scores of students in knowledge and comprehension items exposed to topographic maps by hands-on learning strategy alone, conventional method alone and hands-on learning strategy combined with conventional method were analyzed using one way analysis of variance. The One way Analysis of Variance (ANOVA) of students' retention scores in the experimental and control groups is presented in Table V. But to know which group vary significantly from the other, the Tukey's HSD post hoc test was performed using students' retention scores as indicated in Table VI.

**TABLE V: SUMMARY OF ONE WAY ANALYSIS OF VARIANCE (ANOVA) OF STUDENTS' RETENTION SCORES IN THE EXPERIMENTAL AND CONTROL GROUPS**

| Sources of Variation | Sum of Squares | df | Mean Square | F | Sig. (2-tailed) |
|---|---|---|---|---|---|
| Between Groups | 2565.699 | 2 | 1282.849 | 48.477 | .000* |
| Within Groups | 6880.413 | 260 | 26.463 | | |
| Total | 9446.112 | 262 | | | |

*Significant; $p < 0.05$.

Table V shows that there is a statistically significant difference in the retention scores of students taught topographical maps using hands-on learning strategy alone, conventional method alone and hands-on learning strategy combined with conventional method. This result suggests that students in the experimental groups achieved better material retention in topographical map studies than students in the control group $(F (2, 260) = 48.477, p < 0.05)$.

**TABLE VI: TUKEY'S HSD POST HOC MULTIPLE COMPARISONS TEST RESULTS BASED ON STUDENTS' RETENTION SCORES IN THE EXPERIMENTAL AND CONTROL GROUPS**

| Source (I) Teaching Strategies | (J) Teaching Strategies | Mean Difference (I-J) | Sig. (2-Tailed) | 95% Confidence Interval Lower Bound | Upper Bound |
|---|---|---|---|---|---|
| **Hands-On Learning Strategy** | Hands-On Learning and Conventional Method | .6973 | .633 | -1.1043 | 2.4989 |
| | Conventional Method | 7.0621* | .000* | 5.2369 | 8.8873 |
| **Hands-On Learning and Conventional Method** | Hands-On Learning Strategy | -.6973 | .633 | -2.4989 | 1.1043 |
| | Conventional Method | 6.3648* | .000* | 4.4819 | 8.2477 |
| **Conventional Method** | Hands-On Learning Strategy | -7.0621* | .000* | -8.8873 | -5.2369 |
| | Hands-On Learning and Conventional Method | -6.3648* | .000* | -8.2477 | -4.4819 |

*Significant; $p < 0.05$.

Table VI shows that there is a significant difference in the retention scores of students taught topographic maps using hands-on learning strategy alone and those taught using conventional method $(p < 0.05)$. Similarly, there is a significant difference in the retention scores of students taught topographic maps using hands-on learning strategy combined with conventional method and those taught using conventional method alone $(p < 0.05)$. However, there is no significant difference in the retention scores of students taught topographic maps using hands-on learning strategy alone and those taught using hands-on learning strategy combined with conventional method $(p > 0.05)$.

**Hypothesis Three:**

There is no significant difference in the mean scores of Male and Female students taught topographic maps using Hands-On Learning Strategy.

The hypothesis sought to determine if there is a significant difference in the mean scores of students taught topographic maps using hands-on learning strategy based on gender. Students' scores in experimental group A (n = 97, Male = 51, Female = 46) based on gender was obtained and the Independent Samples t-Test statistic was used to analyzed the data. The result is presented in Table VII.

**TABLE VII:  SUMMARY OF t-TEST ANALYSIS OF STUDENTS' POST TEST SCORES IN EXPERIMENTAL GROUP A BASED ON GENDER**

| Source | N | $\overline{X}$ | Mean Difference | SD | df | t | Sig.  (2-tailed) |
|--------|----|--------|-----------------|--------|-----|-------|------------------|
| **Male** | 51 | 51.745 | 3.593 | 20.967 | | | |
| | | | | | 95 | 0.880 | .381 |
| **Female** | 46 | 48.152 | | 19.064 | | | |

Not Significant; p > 0.05.

It could be observed from the analysis in Table VII that there is no significant difference in the mean scores of students taught topographic maps by Hands-On Learning Strategy based on gender. This result shows that male and female students in the hands-on learning group taught topographical maps do not differ significantly in achievements (t = 0.880, df = 95, p > 0.05).

**Hypothesis Four:**

There is no significant difference in the mean scores of Male and Female students taught topographic maps using Hands-On Learning Strategy combined with Conventional Method.

To test the fourth hypothesis, the post test scores of students exposed to topographic maps using hands-on learning strategy combined with conventional method were analyzed using t-test statistical technique to find out if there was significant difference in the achievement of male and female students (n = 85, Male = 48, Female = 37). The result of the analysis is presented in Table 8.

**TABLE VIII: SUMMARY OF t-TEST ANALYSIS OF STUDENTS' POST TEST SCORES IN EXPERIMENTAL GROUP B BASED ON GENDER**

| Source | N | $\overline{X}$ | Mean Differences | SD | df | t | Sig. tailed) | (2- |
|--------|----|--------|------------------|--------|-----|-------|------|-----|
| **Male** | 48 | 46.104 | 2.4 | 21.200 | | | | |
| | | | | | 83 | 0.544 | .588 | |
| **Female** | 37 | 43.649 | | 19.877 | | | | |

Not Significant; p > 0.05.

Table VIII reveals that there is no significant difference in the mean scores of male and female students taught topographic maps using Hands-On Learning Strategy combined with Conventional Method. This implies that Hands-On Learning Strategy combined with Conventional Method improves both male and female students' academic achievement in topographical map studies (t = 0.544, df = 83, p > 0.05).

# 4.  DISCUSSION

This study examined the Effect of Hands-On Learning Strategies on Senior Secondary School Students' Academic Achievement in Topographical Map Studies in Ganye Educational Zone, Adamawa State. Hands on learning is increasingly becoming a popular method of teaching in view of its intuitive benefits and advantages of allowing students do and experience what is being taught, thus enabling them to develop critical thinking and understanding of the basic concept of what is being learnt. The pre-test results provided a bottom line on which it could be reasonably assumed that students in the Experimental and Control groups had similar entry knowledge prior to treatment (F (2, 260) = 1.145, p > 0.05). Thus, after the treatment, results of the achievement test in topographical map studies showed that there was significant difference in the achievement of the three groups.

This study investigated a null hypothesis stating that there is no significant difference in the mean scores of students taught topographic maps using Hands-On Learning Strategy alone, Conventional Method alone and Hands-On Learning Strategy combined with Conventional Method. The finding reveals that there was statistically significant difference in the mean scores of students taught topographical maps using Hands-On Learning Strategy alone, Conventional Method alone

and Hands-On Learning Strategy combined with Conventional Method in Senior Secondary Schools of Ganye Educational Zone, Adamawa State, meaning that students in the Experimental groups performed significantly better than their counterpart in the Control group (F (2, 260) = 52.105, p < 0.05). The null hypothesis is hereby rejected. This finding is in consonance with the submission of [5]; who found out that there was a significant difference in students' performance exposed to topographical maps through computer assisted instruction (Hands-On) and those exposed through conventional method-Talk and Chalk. This finding also supports the view of [10]; [11], [12] and [4], who concluded that there was dire need for a change in teaching strategies/method involved in map work lessons from talk and chalk theoretical approach to an involvement of students in practical work (hands-on).

This study investigated a null hypothesis stating that there is no significant difference in the retention scores of students taught topographic maps using Hands-On Learning Strategy alone, Conventional Method alone and Hands-On Learning Strategy combined with Conventional Method. The second finding reveals that there is a statistically significant difference in the retention scores of students taught topographic maps using Hands-On Learning Strategy alone, Conventional Method alone and Hands-On Learning Strategy combined with Conventional Method (F (2, 260) = 48.477, p < 0.05). By implication, this shows that students in the Experimental groups taught topographic maps by hands-on learning strategies achieved greater material retention than the students taught by Conventional method. Therefore, the null hypothesis has no 'locus standi' in this study and is hereby rejected. This finding is in conformity with many findings reported by researchers such as [13], [14], [15]. According to these researchers, students who practice what they're learning in a hands-on environment can often retain three and half times as much as opposed to just sitting in a lecture room and listening intently. It is also true that good activities develop deep understanding of the important ideas to be learned. Exposing learners to topographical maps through series of activities such as practical, fieldwork and problem solving, enables learners' to concretize their learning experience and as such learners are made to have an imprint of those concepts in map reading which appears abstract to them. Furthermore, their ability to retain the materials learnt is increased which reflected on the students' achievements in the experimental groups as recorded in this study.

A hypothesis stating that there is no significant difference in the mean scores of male and female students taught topographic maps using Hands-On Learning Strategy was investigated in the study. The third finding indicated that there is no significant difference between the performance of male and female students after exposure to topographical maps using Hands-On Learning Strategy (t = 0.880, df = 95, p > 0.05). Therefore, this hypothesis stood every ground to be retained and is hereby not rejected. This implies that hands-on learning strategy is gender-friendly. Irrespective of gender, both male and female students equally benefited from the use of this strategy. The improved performance of the female students might have been due to the enthusiasm they demonstrated in learning map reading. Hands-On Learning environment can quite often stimulate a student to learn as much as possible. This finding corroborates that of [16] in Geography, who found no significant gender difference in the academic achievement of students when exposed to treatment. But in conflict with [17], who revealed that girls do better than boys in geography. The age long notion held by geographers that geography is gender sensitive is untenable here. Therefore, hands-on learning is a gender-friendly instructional technique that can be used to minimize gender disparity in the achievement of students in topographical map studies.

Similarly, a hypothesis stating there that is no significant difference in the mean scores of male and female students taught topographic maps using Hands-On Learning Strategy combined with Conventional Method was investigated in the study. The fourth hypothesis tested reveals that there is no statistically significant difference in the mean scores of male and female students taught topographical maps using Hands-On Learning combined with Conventional Method (t = 0.544, df = 83, p > 0.05). Hence, hypothesis four was not rejected. This result implies that male and female students taught topographical maps using hands-on learning strategy combined with conventional method do not differ significantly in their achievement scores. Therefore, it could be deduced from this finding that hands-on learning is truly an effective instructional strategy in bridging the performance gap between male and female students when used alone or when combined with other instructional methods. This finding agrees with those of [7] and [18], who confirmed that there is no significant difference in the achievement score between males and females in map work. In contrast, this finding disagrees with that of [19] who found a significant influence between gender and academic performance of students in geography. Reference [20] opined that instructional method used in the classroom may influence gender and students' academic achievement in science. Reference [20] also further supported the argument that females performed better than males when co-operative learning strategy is used. On the other hand, when competitive or individualized learning strategy was

used, males did better than females. Therefore, the improved performance of female students might have been influenced by the interactive instructional strategy adopted in this study (hands-on). Based on the finding of this study, hands-on learning strategy is therefore a gender-friendly instructional strategy that can be used to reduce gender disparity in the academic achievement of students in geography.

## 5.  CONCLUSION AND RECOMMENDATIONS

From the results obtained on the effect of Hands-On Learning Strategies on Senior Secondary School Students' Academic Achievement in Topographical Map Studies in Ganye Educational Zone, Adamawa State, the following conclusion were drawn: Hands-On Learning appears to have a strong record of successes in increasing students' motivation to learn and enhancing higher academic achievement. Students taught topographic maps by hands-on approach in the present study performed significantly better than those taught by conventional method. Students taught topographical maps by hands-on approach achieved greater material retention than those taught by the conventional method. This implies that hands-on learning strategy improves students understanding and retention of concepts in in map reading than the traditional lecture approach. The strategy was also found to be gender-friendly as the results from the test of the third and fourth hypotheses indicated that male and female students taught topographic maps do not differ significantly in their performance. Hands-On Learning strategy can be used to address the present trend of poor academic achievement of senior secondary school students in practical Geography examinations as reported in previous studies. Geography teachers at senior secondary level can explore the enormous benefits tied to Hands-On Learning strategy in promoting effective teaching and learning of map reading within the classroom and outside the classroom.

Based on findings of this study, the following recommendations are made: The use of hands-on learning strategy improved the academic achievement of students in the present study. Therefore, geography teachers should endeavour to use hands-on learning strategy as an alternative strategy or incorporate this instructional technique with other teaching methods in order to improve the teaching and learning of topographical maps in senior secondary schools. Since there are different categories of learners in the classroom, Geography teachers should learn to diversify their teaching techniques to ensure proper understanding by students.

The teaching of topographical maps should be practically oriented. Students should be practically involved in the teaching learning process through exposure to topographical maps and fieldwork. Learners should be encouraged to make models and differentiate terms of some geographic features.

 Schools should purchase a variety of topographic maps for use in practical Geography periods. Also, there is the urgent need for Government serving as custodian of public secondary schools to build good Geography laboratories, furnished with relevant instructional materials for conducting practical work sessions in map reading.

Hands-on learning strategy has been shown to improve students' academic achievement in topographical map studies. Conducting training workshops and seminars to acquaint Geography teachers with recent breakthrough in educational researches is of paramount importance.

## ACKNOWLEDGEMENTS

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