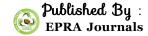ISSN (Online): 2455-7838
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EFFECTS OF HANDS-ON LEARNING STRATEGY AND GENDER ON SENIOR SECONDARY SCHOOL STUDENTS' ACHIEVEMENT IN TOPOGRAPHICAL MAP STUDIES IN MUBI EDUCATIONAL ZONE, NIGERIA

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ABSTRACT

The need to remediate the difficulties of abstraction encountered by senior secondary school students in topographical map studies using hands-on learning Strategy constitute the basis for this research. The study investigated the Effects of Hands-On Learning Strategy and Gender on Senior Secondary School Students' Achievement in Topographical Map Studies in Mubi Educational Zone. Two null hypotheses were formulated and tested. The quasi-experimental non-equivalent pre-test, post test control group design was adopted for the study. Six schools and 278 SS III students offering Geography made up the sample size of the study. Six intact classes (two each) were randomly selected through balloting without replacement and assigned to the two Experimental and Control groups. Instrument used for data collection was Topographical Map Achievement Test (TMAT), structured in line with WAEC and NECO standardized test items in practical Geography. The validity of this instrument was established by two experts in Geography Education and Test and Measurement, while the reliability was established using Guttmann Split-Half statistic. A reliability index of 0.70 was obtained. The hypotheses were tested using Analysis of Variance (ANOVA) and the effect sizes were established using Gabriel's Post Hoc Test. Results revealed significant difference in the mean scores of students taught topographical maps using hands-on learning strategy, hands-on learning strategy combined with conventional teaching method and conventional teaching method alone. Similarly, a significant effect of gender on the achievement of students taught topographical maps using the teaching strategies was observed. Findings of this study suggest that geography teachers should use hands-on learning strategy as an alternative strategy or incorporate this strategy with other instructional methods in order to promote a pragmatic approach to learning topographical maps in secondary schools.

KEYWORDS:*Achievement; Conventional Teaching Method; Effect of Teaching; Gender; Hands-On Learning Strategy; Topographical Map Studies; Topographical Map Achievement Test.*

1. INTRODUCTION

Map is a representation of physical or human/cultural features which are observable on the earth. It is a graphical representation, at an established scale, of a part of the earth's surface, showing important natural and man-made features in their correct positions relative to a coordinate reference system and to each other (Sababa, 2009). Map is the shorthand of geographers and a central communication tools in the axis of geographical studies and Geography education. It is often used to illustrate a major point in any teaching and learning situation in secondary school Geography. Since maps are tools in the hands of geographers, its reading and interpretation becomes paramount and constitute important branch of Geography. Adequate map reading and interpretation is the key that unlocks all the features that are represented in any given map.

Maps pose problems for pupils because each map is a coded representation of an area. Bugdayci and Bildrici (2010) noted that maps are not only used as communication tools, but they've also assume a new role in activating the thinking process of the user. Maps have been categorized into different types by different authors. Amosun (2002) identified four types; sketch maps, distributional maps, atlas maps and cadastral maps. It is believed by the author that all kinds of maps that are available can be categorized under any of these. However Sababa (2009) differs slightly in the classification of maps as Atlas Maps, distribution maps, sketch maps and topographical maps. All these types are being used at secondary schools Geography in Nigeria. The topographical map is one of such maps used in schools Geography in Mubi Educational Zone. Amosun (2016) emphasized the use of topographical maps as the core area of map reading and interpretation in Geography. These are big and wide sheet maps that are of small or large scales. The topographical maps represent physical and man-made features using contour lines and symbols.

Map reading and interpretation is an important aspect in the geography secondary school curriculum in Nigeria and by implication, in Mubi Educational Zone. This area occupies a crucial place in the final Geography examinations. It attracts more marks than any other areas of Geography (Amosun, 2016). The West African Examination Council (WAEC), test students' basic mapping skills in practical Geography examinations using the topographical maps. With the topographical maps, Students will be able to transfer and process data, identify location and perform calculations such as calculating length, scale, direction and bearing. Learners can also perceive spatial distribution using the map, interpret landform features using the topo maps, and students could also create sketch maps.

Amosun (2016) and Amosun (2002) stressed the importance of map work which has been paraphrased as follows; maps record geographical information and knowledge most simply and accurately and these are more precise than verbal accounts. Maps are made to capture considerable analytical values which show the distributions and relationship in land space, time space or voluminous space. Maps help in identifying geographical problems which could be of relevance to the society. Mapwork develops various types of useful skills which are very crucial for securing good jobs. Its proper teaching and learning at this level prepares learners for profitable careers in cartography GIS, urban and regional planning, environmental studies and similar ones. Nigerian secondary school teachers, have been reported in various studies that they scarcely and scantly teach it; and that a lot of students have actually developed hatred for it as they are always scared of it (Amosun, 2016). This on-going ugly trend has also been observed in the study area. Amosun reiterated that teachers are expected to teach this aspect diligently and students are expected to acquire certain skills and abilities in the course of teaching and learning. Some of the skills require in reading and interpretations of topographical maps are; keen observation skill or visual literacy skill, selection skill, location skill, mathematical skill, manipulative skill, analytical skill and interpretation skill. However, these skills are only acquired when students are diligently engaged in the acts of map reading and interpretation right in the geography room.

Mansaray and Ajiboye (1994) in their study entitled "Topic difficulties in senior secondary school geography among Nigerian students" observed that 50% of the topics indicated as problematic by students fall in the area of map readings with specific reference to the use of topographical maps. The students indicated that measurement of gradient, drawing of cross profile and inter-visibility, map enlargement and reduction among others were very difficult. In the same study, Geography teachers also indicated that the same topics were very difficult to teach and difficult for students to understand. Students offering geography in Mubi Educational Zone may also be susceptible to this research findings as the situation in the study area does not different from the reports of Okwilagwe's (2012) who in a study on "influence of teacher factors on attitude of Geography teachers to map work in Nigeria secondary schools" succinctly recorded various comments from the Chief examiners report of West African Examinations Council as follows:

> "Most candidates could not identify simple features on the topographical map, poor performance in questions involving calculations' (May/June, 2005:75). Students have poor knowledge

of map reading and interpretation; and of simple survey. Most of the candidates could not identify the given physical features on the survey maps and were poor in description of relief and the relationship between relief and settlement (May/June, 2007:65)".

According to Egunjobi (2002), topographical map is one of such maps which is an integral tool in map reading at the secondary school level in Nigeria. The researcher chose this map to work on because secondary school students in Mubi Educational Zone of Adamawa State have problem in it. WAEC Chief Examiner's Reports over the years on the achievement of candidates in the O' level Geography examinations show that Geography students who sat for the examinations performed poorly especially on the map reading section (WAEC 2009-2010). Amosun (2016) and Amosun (2002) reiterated similar problems being faced by students in West African School Certificate Examination (WASSCE). According to Amosun, the Chief examiners comments on map reading and interpretation in Geography showed that a whooping majority of the students were unable to reduce and draw the map outline to scale correctly, calculate actual distances on the map by the given scale, use contour lines appropriately to identify features on the map, identify the drainage pattern on the map; measure and insert features inside a reduced map (WAEC Chief Examiners' Report, 1995a, 1996b, 1997a).

Similarly, Yau Wong and Ma (1992) reported students' performance in map reading and interpretation in Hong Kong for a period of ten years. It was shown that map reading results were poor in seven years in a decade. It was particularly recorded that students could not calculate correctly, and that they had poor knowledge of conventional signs and symbols, and consequently had poor analytical thinking of topographical maps given to them each year. Okwilagwe (2012) stated that besides Nigeria, students in some other countries like Britain and Poland face similar difficulties in map reading and interpretation. Thus it is crystal clear that the problems encountered by students in map reading and interpretation as observed in this study area cuts across regions in Nigeria and the world at large. Students offering geography in schools of Mubi Educational Zone, Adamawa State, therefore, stand the chances of being influenced by the findings of this study. However, a conclusion cannot be emphatically drawn except empirical evidence is provided.

Scholars have started to read different meanings to the difficulties students encounter in map reading and interpretation. Students' perceived problems, in the study area, on why they presumed geography to be a difficult subject hence develop phobia for 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 and geography not given sufficient time on the school time-table to cover the wide topics. This observation partly corroborates with the findings of Yau *et al.* (1992) stating that understanding the concept of map reading and interpretation requires mathematical skills. Okwilagwe (2012) argued that these difficulties may not be unconnected with the inability of teachers to properly handle map reading. Amosun (2002) observed that map reading has been categorised among the most difficult aspects of geography, and it seems to account more for the mass failure of students, the consequence of which is to drive many away from offering the subject. In another study by Mwenesongole (2016), who considered the factors influencing learner achievement in Geography map work at Grade 12 level, revealed that most learners do not perform well in map work because; they lack motivation in doing it, they lack basic skills to map reading, and lack basic mathematical skills. The study also revealed the need for re-skilling and retraining for all educators involved in teaching map work in areas of basic skills to map reading and interpretation, basic mathematical skills and the importance of motivation.

From the foregoing it could be said that perhaps, secondary school students under-achievement in practical geography examinations in Mubi Educational Zone may not be unconnected to the abstract manner the subject is being taught; with students and teachers heavily dependent on textbooks. This method of teaching could negatively impact on students' achievement in practical geography examinations. Filgona *et al.* (2016) opines that the problems of under-achievement of students in practical geography examinations may further be exacerbated by poor choice of instructional strategies used in teaching map reading. This is so because the teacher happens to be at the pinnacle of any curriculum implementation process, therefore, the instructional strategy he adopts in teaching the students could promote effective teaching learning outcomes of students if he uses the appropriate strategies. Hands-on learning strategy is a student-centred approach to teaching and learning that gives students the ample opportunity to interact with themselves, the teachers and the instructional materials in lesson delivery. More importantly, it gives students the sense of belonging in the teaching learning process

Research shows that students learn best when they are engaged in real-life, hands-on activities (Filgona *et al.* 2016). Experiential learning or hands-on learning fosters student engagement by creating relevant experiences that spark student curiosity and inspire them to follow their passions. An activity-

based learning for students could lead to broader concept understanding and provides psychological and social benefits, including deeper engagement, increased self-esteem and higher motivation to learn. Students offering Geography in the study area could be more successful when they can connect what they are learning to real-life situations.

Hands-on learning or experiential learning is increasingly becoming popular as an effective instructional strategy used in the field of sciences and education in particular. 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 in the classroom. 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. According to Kolb (1984) experiential learning theory and learning style inventory, learners are expected to pass through four stages of learning in the hands-on learning environment. These stages include, concrete experience, reflective observation, abstract conceptualization and active experimentation. When learners passed through these stages of learning, it is expected that their learning experience would be concretized. The process of concretizing learners' learning experience in topographical map studies through practical and fieldwork, would give learners an imprints of those new, difficult or abstract concepts in topographical map studies. This knowledge which may be stored in their Long Term Memory (LTM) as posited by Kolb, would serve as previous knowledge or foundation for building subsequent behavioural objectives in topographical map studies.

Filgona *et al.* (2016) found out that students in a hands-on learning environment could remember the material better, feel a sense of accomplishment when the task is completed, and be able to transfer that experience easier to other learning situations. When hands-on learning is used in teaching, the knowledge transmitted has a better chance of being stored in the memory for useful retrieval. Students who have difficulty in learning could be found to be on task more often because they are part of the learning process and not just spectators. They support the notion of multi-faceted bombardment of information and experiences so that the retention level is improved. Even though, the use of hands-on learning in teaching requires a great deal of preparation time, once a system is developed, hands-

on teaching makes teaching fun. If the students are learning and having fun doing it, there is the likelihood that they may understand what they did better. Hands-on learning environment forces student thinking by requiring interpretation of the observed events, rather than memorization and regurgitation of what they've been taught. Encourages questioning of the observed events and the resulting data. When students carry out their own experiments, they become very familiar with the events and the variables involved. A hands-on learning environment could often promote cause and effect thinking.

Hands-on learning has been shown to increase learning and achievement. Research indicates that learning that is activity-based such as in hands-on learning could improve students' attitudes toward learning which may subsequently improve their achievement (Filgona *et al.,* 2016; Ash, 2009). Activity-centred classrooms encourage student creativity in problem solving, promote student independence, and could help low ability students to benefit from high ability students. It is expected that the use of hands-on learning strategy in teaching topographical maps could help remediate the difficulties of abstraction experience by secondary school students in Mubi Educational Zone.

The principles of hands-on learning strategy in respect to this study are embedded in the use of hands-on learning strategy in teaching topographical maps. These principles, when carefully observed, give the Geography teacher the role of a facilitator instead of directing the teaching learning process. Adherence to these principles would lead to activity based learning, where students direct their own learning which may subsequently improve their achievement in topo map studies. Conversely, non-adherence to these principles may hamper students' enthusiasm in learning topographical maps. Even though, several factors like unavailability of instructional materials, poor infrastructural facilities and poor teaching learning environment. may likely be some of the reasons for the non-adherence to the use of this instructional strategy by geography teachers in schools of Mubi Educational Zone.

Several research findings have created a stronghold for hands-on learning strategies as a pragmatic approach to learning that promotes effective teaching learning outcome of students in Geography. The findings from the works of Ozgen (2011), Gokce (2009), Bekmezci and Unlu (2007), Koseoglu and Unlu (2006), and Coskun (2004) stating that active learning (hands-on) techniques make a positive contribution to Geography education corroborates this assertion. These authors found out that geography students exposed to active learning strategies such as hands-on learning performed significant than those taught by traditional lecture method.

Tshibalo (2003), Haliru (2015) investigated the use of lecture method in geography to teach map work (map reading/practical geography) and concluded that the poor academic performance of students in map work was due to the use of lecture method as instructional strategy. Secondary school teachers are usually cautioned as recommended in previous studies over the use of lecture method at this level not only in Geography but virtually in all the subjects. However, Ezeudu (2011) and Mahuta (2009) gave some of the strengths of the lecture method; namely, it helps teachers cover vast areas at a limited time as it deals with lengthy explanation. It is cheap and less expensive as it does not demand any significant financial expenditure. It is further believed to help the students to cultivate the skills of note-taking and is good for adult classes and people of higher mental ability. Countering this submission are Yusuf and Afolabi (2010) stating that learners taught by hands-on learning approach, would achieve remarkable results than those taught by conventional method.

The lecture method has been often criticized for being ineffective in Geography teaching (Haliru, 2015). Corroborating this view, Aydin (2011) attributed the problem of poor teaching and learning of Geography to ineffective teaching techniques employed by the secondary school teachers which make some students generally passive. Nevertheless, there is also the view that no instructional strategy can truly replace the lecture method. Hands-on learning is a teaching strategy structured on the principles of practical engagement of the learner. These principles when carefully observed will lead to an activity-based learning. The teacher is expected to painstakingly observe these guidelines when using hands-on learning as an instructional strategy to teach in the classroom. These underlying principles are what made hands-on learning strategies unique and superior over the traditional lecture method. But is hands-on learning really superior over the traditional lecture method as observed in previous studies? Are geography teachers adhering to these principles when teaching topographical maps in schools of Mubi Educational Zone? These questions still linger and begging for cogent answers backed with empirical evidence. Therefore, the present study examined which of these methods/strategies will give greater achievement scores to students in topographical map studies.

Several extant studies have indicated gender to be one of the predictor variables that could be factored in students' academic achievement (Hesbon, Mark, Okere & Samuel 2014, Obiageli, 2014, Ifeakor, 2003). Conversely, other studies have also found students gender not to have a significant effect on students' academic achievement (Filgona, Sababa & Iyasco 2016, Dantani, 2011). It is however pertinent to note that researches on gender and academic achievement have been inconclusive. Pettigrew and Zakrajsek's (1996) stated that females preferred organization of course materials, copious reading assignments, whereas more males preferred pragmatism in learning or "hand-on" learning tasks. It is in this light that this study assumed the existence of a "gender gap" in students' achievement in map reading in Mubi Educational Zone, and thus hypothesized that males may perform better than females.

1.1. OBJECTIVES OF THE STUDY
The objectives of this study include:
(i). To determine the academic achievement of students taught topographical maps using Hands-On Learning Strategy and Conventional Teaching Method.
(ii). To establish the influence of Gender on academic achievement of students taught topographical maps using Hands-On Learning Strategy and Conventional Teaching Method .

1.2. RESEARCH HYPOTHESES
The following research hypotheses were formulated and tested at 0.05 level of significance:

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

H_{O2}: There is no significant difference in the mean scores of Male and Female students taught topographical maps using Hands-On Learning Strategy, Hands-On Learning Strategy Combined with Conventional Teaching Method and Conventional Teaching Method alone.

1.3. SIGNIFICANCE OF THE STUDY
Beneficiaries from this research include: students, teacher educators and geography teachers, researchers, curriculum planners, educational administrators, policy makers, school administrators, inspectors of education and ministry of education, teacher training institutions such as colleges of education, faculties of education and institutes of education in Nigerian Universities, Government, parents and the community at large. Incorporating hand-on learning strategies in teaching and learning in the classroom promote effective students engagement. Learning that is student-centered and activity based has shown to improve learning outcomes. The process of interaction with all categories of learners in the classroom ensures that all learners are carried along in the teaching learning process. Therefore, a study of this nature exposes students to topographic maps using hand-on learning strategies. This increase learners' enthusiasm in understanding basic concepts in map reading and to interpret landform features using topographical

maps, thereby improving learners' performance and helping them to have a better understanding of their immediate physical environment.

Understanding topographic maps is synonymous to acquiring the basic knowledge of map reading and applying the knowledge using topographic maps. Findings from this study provide new insights and raise new questions in this aspect of geography (map reading) that continue to pose threat to students in secondary schools. Teacher educators could benefit from the pieces of information that this study provides. This could be used by teacher educators in educating and enlightening teachers generally and geography teachers in particular, on the need to incorporate hands-on learning in teaching map reading other than the conventional method. The findings from this study also provide information to which educational administrators could organize workshops, seminars and conferences for geography teachers. Such in-service training programmes would acquaint geography teachers with this alternative strategy for teaching Geography or otherwise. The findings from this study could also be of immense benefit to training teachers in institutions such as colleges of education, faculties of education and institutes of education in Nigerian Universities. The geography methods course would be enriched by the use of hands-on learning strategies.

A study of this nature would educate and enlighten geography teachers on the processes involved in using hand-on learning strategies to teach topographic maps. Geography teachers are the key drivers of knowledge transmission. Therefore, the instructional strategies they adopt in teaching map reading can promote effective teaching learning outcomes if they incorporate the hands-on strategies. Incorporating hands-on learning strategies in teaching and learning of topographic maps provides a remedy to students' problems in map reading.

This study would enlighten the curriculum planners by exposing all the principles and benefits attached to hands-on learning as pedagogy in the classroom. Curriculum planners will therefore see the need of re-emphasizing hands-on learning as a technique used in teaching map reading in Senior Secondary Schools Curriculum. Furthermore, it is expected that the results of this study may be of help to administrators and policy makers in knowing whether to emphasize hands-on learning strategies in teaching geography. The study could allow the policy makers to see the patterns of performance within the region. The study brings forth factors affecting achievement of students in practical geography examinations, which can be a basis of looking into ways of improving overall performance of students in the study area.

It is expected that this study could be constrained to certain topics in geography and delimited to a particular locality. Findings from this study is therefore of immense benefit to researchers, as it serve as a stepping stone for other researchers to build on. It would also add on to research efforts geared towards improving students' performance in practical Geography examinations.

It is hoped that the result of this study, would create awareness of the importance of hands-on learning strategies in teaching map reading. It is also intended to guide parents on how best to advice their children on the need to embrace geography as one the subjects offered in senior secondary schools. To school administrators, who include principals, vice principals and heads of departments, the study provides data that could be used to improve management practices for improved academic performance. By establishing the extent to which the use of hands-on learning strategies could improve students' achievement in topographical map studies, the study could stimulate strategic thought among school administrators. By identifying the strategies employed by well performing schools, poorly performing schools could learn lessons that could enable them improve academic performance of their students.

By providing empirical evidence related to the efficacy of hands-on learning strategies in teaching map reading, inspectors of education would see the dire need of ensuring that this instructional strategy is fully adopted and implemented by geography teachers in secondary schools. Conversely, it is also true that geography laboratories where practical work can be done barely exist in public schools. Ensuring that this instructional strategy is fully implemented in schools would be a herculean task. Therefore, inspectors of education and Ministry of Education would need to table this complain before the government serving as custodian of these institution, to build good geography laboratories in secondary schools and provide instructional materials for conducting practical work sessions.

The study is also significant to the community in that their investment in education is expected to translate to quality education. With the under achievement of students in practical geography examinations in the study area, findings from this study would provide the best recommendations on how students under-achievement in practical geography examinations could be addressed. The study also adds to the existing body of knowledge on determinants of academic performance of students in geography.

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 represented as follow:

$$O_1 \qquad X_1 \qquad O_2$$
$$O_3 \qquad X_2 \qquad O_4$$
$$O_5 \qquad X_3 \qquad O_6$$

where:

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

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

X_1 = Experimental treatment using Hands-On Learning Strategies

X_2 = Experimental treatment using Hands-On Learning Strategies Combined with Conventional Method

X_3 = Control treatment using Conventional Method.

2.1. Sample and Sampling Technique:-

The sample for the study comprised students offering geography in all public Senior Secondary Schools in Mubi Educational Zone. Multi-stage sampling technique at four levels involving random sampling technique at each stage was used in the study. The Local Government Areas, The schools, the schools to be assigned what treatment and the intact classes used for the study were selected using simple random sampling technique by balloting with replacement at one level and balloting without replacement at another level. The simple random sampling by balloting without replacement was used in selecting three out of five Local Government Areas in Mubi Educational Zone. These Local Government Areas were Mubi North, Michika and Maiha. Balloting without replacement was used because the first three local governments that were picked were used for the study. The simple random sampling technique was used in selecting six Senior Secondary Schools in the three Local Government Areas. Two schools each from the sampled Local Government Areas were randomly selected. Simple random sampling technique involving the use of balloting without replacement was used to select schools to be assigned what treatment.

The sample size of the study comprised 278 Senior Secondary (SS III) students offering Geography in Mubi Educational Zone. This sample comprised 155 Male and 123 Female students. Six intact classes were used in the study. Students from two of the intact classes were clustered and assigned to Experimental group X_1 (N = 103: Male = 64; Female = 39), another two intact classes were merged and assigned to Experimental group X_2 (N = 78: Male 41; Female = 37). The students from the last two intact classes were also clustered and assigned to the Control group (N = 97: Male = 50; Female = 47). The SS III geography students were used specifically for the study because they were preparing to sit for their final examinations

(WAEC/NECO); hence the need for the practical knowledge of map reading and interpretation. The Experimental Groups (X_1 and X_2) were taught concepts in map reading and exposed to topographic map using hands-on learning strategies (practical and fieldwork) while the Control group (X_3) was taught concepts in map reading 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 and 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 67 marks. The test was administered to students in the two 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 treatment before the administration of TMAT as 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. In this group, the teacher only directs the teaching learning process and learners were expected to listened and take notes. The Experimental groups were exposed to the learning of the same concepts both theoretically and exposure to hands-on learning activities using topographic maps. Experimental Group X_1 was exposed to those concepts in map reading using topographical maps and fieldwork with the teacher acting as a facilitator and the learners directing their own learning. The Experimental Group X_2 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 six weeks. The table of item specification for the topics in the instrument measuring five cognitive domains in the Blooms taxonomy of behavioural objectives namely: knowledge, comprehension, application, analyses and syntheses were used to derive the items instrument.

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 Education and Test and Measurement 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 16 items to seven items and the objective items be increased from 24 to 33. 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 test was carried out using 60 students offering Geography in two schools of Yola North Local Government Area. The achievement scores of each student obtained after the test were correlated using Guttmann Split-Half statistic. This yielded a reliability index of 0.70. This reliability index suggests that the internal consistency of the instrument was adequate for the study.

2.5. Method of Data Collection:-

Geography teachers in secondary schools used for this study were contacted through the principals of the schools, after the researcher tendered the introductory letter and gained permission from the principals to use the schools for the study. Two Geography teachers were trained by the researcher as research assistants to facilitate the hands-on learning strategies and conventional teaching method. The training exercise was based on the purpose of the study, the topics to be taught, the strategies/method to be used, the use of the lesson plans, the administration of TMAT as well as general conduct of the study. All the teachers used the same length of time (six weeks) for instructional treatment. Throughout the exercise, the researcher went round to supervise and ensure smooth learning in all classes. Two tests (pre and post tests) were used to obtain data from the subjects of the study. Pre-test was administered to students at the pre-treatment stage in the first week before instruction. Post test was administered after treatment was given to the Experimental and Control groups. The researcher collected all test scripts after the administration and scored students over hundred. For the purpose of clarity, the procedure for data collection for this study was made up of five stages, namely: preliminary stage, pre-treatment stage, treatment stage, post-treatment stage and post test stage.

Preliminary Stage: The researcher sought for permission from authorities of the sampled schools whose students were involved in the study. This was to enable the researcher use intact classes for treatment and test administration. The first week was used for the training and orientation of two geography teachers who served as research assistants in the study. The cooperation and understanding of the principals and those teachers were also solicited for.

Students in the schools used for the study were also assigned to their groups viz: experimental and control groups respectively. These research assistants were given lesson plans for the period that the study will last and given instruction on how to use the lesson plans to teach students in the selected schools. Teachers performing experimental treatment used lesson plans designed for hands-on learning strategy and were also given topographical maps and other instructional materials to aid in the application of hands-on learning strategy. The teachers performing controlled treatment using lecture method were given lesson plans prepared for the application of conventional teaching method. The research assistants were also drilled on how to administer the pre and post tests. The training lasted for three days.

Pre-Treatment Stage: During the first week, the administration of the TMAT as pre-test was also conducted in the schools selected with the help of research assistants. The instrument contains 33 multiple choice items and seven essay items to which subjects were given two hours thirty minutes to respond. Verbal explanation was given to respondents on how to answer questions in addition to the written instruction on the question papers distributed to them.

Treatment Stage: The second to fifth weeks were for the treatment in the experimental and control groups. The 181 students in the schools assigned to experimental groups were exposed to topographical map studies using hands-on learning strategy (practical and fieldwork) with the help of the geography teachers, while the 97 students in the control group were taught topographical maps by conventional teaching method. The topics taught were basic concepts in map reading, measurement of distance, direction and bearing, map reduction and enlargement, interpretation of physical and cultural features and settlements.

Revision Stage: At this stage the research assistants were asked to revise the topics treated with the students to prepare students for the post test. All the topics taught during the course of the study were carefully revised. This was also done at the fifth week.

Post Test Stage: The sixth week was characterized by the administration of TMAT again as post test, concurrently in the schools used for the study. Both the experimental and control groups were given the same test. The test scripts were collected after the administration of post test and marked over 100. Table 1 shows the schedule and stages of treatment procedures in topographical map studies.

Table 1: Schedule and Stages of Treatment Procedures in Topographical Map Studies

Week	Activity/Topics Taught	Stages
1.	Training of research assistants and administration of pre-test	Preliminary and pre-treatment
2.	Teaching of basic concepts in map reading/map distances, direction and bearing	Treatment
3.	Teaching of map reduction and enlargement	Treatment
4.	Teaching of interpretation of physical and cultural features	Treatment
5.	Teaching of settlements/Revision	Treatment
6.	Administration of post test	Post-Treatment

2.6. Method of Data Analysis:-

The hypotheses were tested using Analysis of Variance (ANOVA). Gabriel's Post hoc Mean Comparisons Test was used to establish the effect sizes because samples were unequal. 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

Results in Table 2 show a descriptive analysis of students' pre-test scores in the two experimental and control groups at the commencement of the study. The descriptive analysis shows that the mean scores of students in the three groups were relatively close indicating that students in the two experimental and control groups were of equal performance at the pre-test stage. The scores were as follows: Hands-On Learning Strategy Group (M = 17.359), Hands-On Learning Strategy Combined with Conventional Teaching Method Group (M = 18.539) and Conventional Teaching Method Group (M = 15.103).

Table 2: Summary of Descriptive Statistics of Students' Pre-test Scores in the Two Experimental and Control Groups

Source	N	Mean	Std. Dev.
Hands-On Learning Strategy	103	17.359	11.937
Hands-On Learning Strategy and Conventional Teaching Method	78	18.539	14.687
Conventional Teaching Method	97	15.103	13.408
Total	278	16.903	13.293

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To determine whether the mean scores of the three groups were significant, the data was subjected to analysis of variance. The ANOVA result is presented in Table 3. The table shows comparison of mean achievement scores of students in the two experimental and control groups at the commencement of the study. The table reveals that there was no significant difference in the academic achievement of students in the three groups in topographical map achievement test at the pre-test level (F $(2, 275)$ = 1.546, p = 0.215). This implies that the students in the experimental and control groups had equivalent entry behaviour prior to treatment.

Table 3: Summary of One Way Analysis of Variance (ANOVA) of Students' Pre-test Scores in the Two Experimental and Control Groups

Source of Variation	Sum of Squares	df	Mean Square	F	Sig. (2-tailed)
Between Groups	544.315	2	272.158	1.546	.215
Within Groups	48402.062	275	176.007		
Total	48946.378	277			

Not Significant; $p > .05$.

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

To test this hypothesis, the experimental and control groups students' mean scores were analyzed using One Way Analysis of Variance (ANOVA). The descriptive analysis is presented in Table 4.

Table 4: Summary of Descriptive Statistics of Students' Post Test Scores in the Two Experimental and Control Groups

Source	N	Mean	Std. Dev.
Hands-On Learning Strategy	103	49.942	19.751
Hands-On Learning Strategy and Conventional Teaching Method	78	44.333	20.709
Conventional Teaching Method	97	26.299	17.207
Total	278	40.119	21.754

Students in the experimental groups gained the highest mean scores in topographical map studies compared to their counterparts in the control group (Table 4). Students exposed to topographic maps by Hands-On Learning Strategies (M = 49.942) and Hands-On Learning Strategies Combined with Conventional Method (M = 44.333) scored higher than students in the Control group (M = 26.299). To determine if these mean scores were significantly different, the ANOVA was applied. The result is summarized in Table 5.

Table 5: Summary of One Way Analysis of Variance (ANOVA) of Students' Post Test Scores in the Two Experimental and Control Groups

Source of Variation	Sum of Squares	df	Mean Square	F	Sig. (2-tailed)
Between Groups	29849.769	2	14924.885	40.543	.000*
Within Groups	101235.314	275	368.128		
Total	131085.083	277			

*Significant; $p < .05$.

Results obtained from the ANOVA analysis of students means scores in the experimental and control groups revealed that there was a significant difference in the mean scores of students taught topographic maps using Hands-On Learning Strategies, Hands-On Learning Strategies Combined with Conventional Teaching Method and Conventional Method alone (F (2, 275) = 40.543, p = 0.000) (Table 5). This implies that students in the experimental groups taught topographical maps by Hands-On Learning Strategy performed significant than those taught by Conventional Teaching Method. In order to know which groups specifically differ significantly from the other, the post test scores of the students were further subjected to Gabriel's post hoc test which displays a table of multiple comparisons. The result is presented in Table 6.

Table 6: Gabriel's Post Hoc Multiple Comparisons Test Results of Students' Post Test Scores in the Two Experimental and Control Groups

Independent Variable (I) Teaching Strategies	Independent Variable (J) Teaching Strategies	Mean Difference (I-J)	Sig. (2-tailed)
Hands-On Learning Strategy	Hands-On Learning Strategy and Conventional Teaching Method	5.608	.148
Hands-On Learning Strategy and Conventional Teaching Method	Conventional Teaching Method	23.643	.000*
	Hands-On Learning Strategy	-5.608	.148
	Conventional Teaching Method	18.034	.000*
Conventional Teaching Method	Hands-On Learning Strategy	-23.643	.000*
	Hands-On Learning Strategy and Conventional Teaching Method	-18.034	.000*

*Significant; $p < .05$.

The results in Table 6 revealed a significant difference in the mean scores of students taught topographic maps using Hands-On Learning Strategy and those taught using Conventional Teaching Method ($p = 0.000$). Similarly, there is a significant difference in the mean scores of students taught topographic maps using Hands-On Learning Strategy Combined with Conventional Teaching Method and those taught using Conventional Teaching Method alone ($p = 0.000$). However, there is no significant difference in the mean scores of students taught topographic maps using Hands-On Learning Strategy and those taught using Hands-On Learning Strategy Combined with Conventional Method ($p = 148$). Students in the two experimental groups had remarkable results than their counterparts in the control group.

H_{O2}: There is no significant difference in the mean scores of Male and Female students taught topographical maps using Hands-On Learning Strategy, Hands-On Learning Strategy Combined with Conventional Teaching Method and Conventional Teaching Method alone.

Results for the descriptive statistics for H_{O2} are presented in Table 7. Male students exposed to topographic maps by Hands-On Learning Strategy (Mean = 48.188) scored lower than their Female counterparts (M = 52.821). Male students in Hands-On Learning Strategy Combined with Conventional Method Group (M = 45.024) gain higher mean scores compare to their Female counterparts (M = 43.568). Male students in the Control group (Mean = 21.980) had lower mean scores compared to their Female counterparts (M = 30.894).

Table 7: Summary of Descriptive Statistics of Students' Post Test Scores in the Two Experimental and Control Groups by Gender

Source	N	Mean	Std. Dev.
Male Hands-On Learning Strategy	64	48.188	20.673
Female Hands-On Learning Strategy	39	52.821	18.026
Male Hand-On Learning Strategy and Conventional Teaching Method	41	45.024	21.612
Female Hands-On Learning Strategy and Conventional Teaching Method	37	43.568	19.928
Male Conventional Teaching Method	50	21.980	14.517
Female Conventional Teaching Method	47	30.894	18.749
Total	278	40.119	21.754

However, to know if these mean scores were significantly different, the post test scores of the three groups by gender were further subjected to One Way Analysis of Variance (ANOVA) (Table 8). The result indicated a significant difference in the mean scores of Male and Female students in the three groups (F (5, 272) = 17.814, p = 0.000).

Table 8: Summary of One Way Analysis of Variance (ANOVA) of Students' Post Test Scores in the Two Experimental and Control Groups by Gender

Source of Variation	Sum of Squares	df	Mean Square	F	Sig. (2-tailed)
Between Groups	32336.084	5	6467.217	17.814	.000*
Within Groups	98748.998	272	363.048		
Total	131085.083	277			

*Significant; p < .05.

It was apparent that Male and Female students in the experimental groups achieved better results in topographical map studies than their counterparts in the control group. But to know which groups' (Male or Female) mean vary significantly from the other, the Gabriel's post hoc test was performed using students' achievement scores as indicated in Table 9.

Table 9: Gabriel's Post Hoc Multiple Comparisons Test Results of Students Post Test Scores in the Two Experimental and Control Groups by Gender

Independent Variable (I) Gender	Independent Variable (J) Gender	Mean Difference (I-J)	Sig. (2-tailed)
Male HLS	Female HLS	-4.633	.978
	Male HLSCTM	3.163	.000*
	Female HLSCTM	4.610	.981
	Male CTM	26.208*	.000*
	Female CTM	17.294	.000*
Female HLS	Male HLS	4.633	.978
	Male HLSCTM	7.796	.649
	Female HLSCTM	9.253	.412
	Male CTM	30.841	.000*
	Female CTM	21.927	.000*
Male HLSCTM	Male HLS	-3.163	.000*
	Female HLS	-7.796	.649
	Female HLSCTM	1.457	.000*
	Male CTM	23.044	.000*
	Female CTM	14.131	.009*
Female HLSCTM	Male HLS	-4.610	.981
	Female HLS	-9.253	.412
	Male HLSCTM	-1.457	.000*
	Male CTM	21.588	.000*
	Female CTM	12.674	.039*
Male CTM	Male HLS	-26.208	.000*
	Female HLS	-30.841	.000*

	Male HLSCTM	-23.044	.000*
	Female HLSCTM	-21.588	.000*
	Female CTM	-8.914	.282
Female CTM	Male HLS	-17.294	.000*
	Female HLS	-21.927	.000*
	Male HLSCTM	-14.131	.009*
	Female HLSCTM	-12.674	.039*
	Male CTM	8.914	.282

*Significant; p < .05.

Legend: HLS: Hands-On Learning Strategy
           HLSCTM: Hands-On Learning Strategy and Conventional Teaching Method
           CTM: Conventional Teaching Method

Results in Table 9 shows that Male students in Hands-on Learning Strategy group did not differ significantly in their achievement scores when compared to their female counterparts in the same group (p = 0.978). Male students in Hands-on Learning Strategy group achieved better results than their Male counterparts in Hands-on learning Strategy Combined with Conventional Teaching Method group (p = 0.000). Male students in Hands-On Learning Strategy group did not differ significantly in their achievement scores when compared to their Female counterparts in Hands-On Learning Strategy Combined with Conventional Teaching Method group (p = 0.981). Furthermore, Male students in Hands-On Learning Strategy group achieved better results than the students in the Conventional Teaching Method group (p = 0.000) (Table 9).

The table further reveals that Female students in Hands-On Learning Strategy group did not differ significantly in achievement scores when compared to their Male counterparts in Hands-On Learning Strategy Combined with Conventional Teaching Method group (p = 0.649). Also, there is no significant difference in the mean scores of Male and Female students taught topographical maps using Hands-On Learning Strategy and Hands-On Learning Strategy Combined with Conventional Teaching Method   (p = 0.412). However, Female students in Hands-On Learning Strategy group did performed significant when compared to their counterparts in the Control group (p = 0.000) (Table 9).

Male students in Hands-On Learning Strategy Combined with Conventional Teaching Method group achieved better results than the students in the Control group (p = 0.000). In the same vein, Female students in Hands-On Learning Strategy Combined with Conventional Teaching Method group achieved better results than their Male (p = 0.000) and Female (p = 0.039) counterparts in the Control group. However, Male and Female students taught topographical maps using Conventional Teaching Method did not differ significantly in their achievement scores (p = 0.282). Thus, this is an indication that the gender of the students could play a significant role in their achievement when different strategies are used in teaching topographical maps (Table 9).

4. DISCUSSION

There are a plethora of benefits that teachers and curriculum developers adduce to hands-on learning strategy to justify the approach in science education. Benefits for students are believed to include increased learning; increased motivation to learn; increased excitement in the teaching learning process; increased skill proficiency, including communication skills; increased independent thinking and decision making based on direct evidence and experiences; and increased perception and creativity. The pre-test results of the students in the three groups showed that students entry behaviour at the commencement of the treatment was identical (F (2, 275) = 1.546, p = 0.215) (Table 3).

Result obtained by testing hypothesis one revealed a significant difference in the achievement scores of students taught topographic maps using Hands-On Learning Strategy, Hands-On Learning Strategy Combined with Conventional Teaching Method and Conventional Teaching Method alone. This implies that the students in the two experimental groups achieved better results in topographical map studies than the students in the control group (F (2, 275) = 40.543, p = 0.000) (Table 5). This finding coincides with that of Filgona *et al.* (2016) who found a significant difference in the academic achievement of students taught topographic maps using Hands-on Learning Strategies and those taught using Conventional Method. Furthermore, this finding is in line with the findings from the works of Ozgen (2011), Gokce (2009), Bekmezci and Unlu (2007), Koseoglu and Unlu (2006), and Coskun (2004) stating that active learning techniques such as hands-on learning strategy could make a positive contribution to learning Geography. This finding also buttresses the

work of Amosun (2002) which showed an improved students' performance in map work when newer and effective strategies were employed. Amosun's finding further revealed that students with low mathematical ability performed better as they were helped by others in the groups. A similar occurrence was observed in this study, as students with lower ability learned from students with higher ability through classroom interaction. Therefore, when appropriate methods or strategies are used for teaching, students' may likely perform better in map reading and interpretation with no prejudice to their mathematical ability or drawing skills.

The mean scores of Male and Female students taught topographical maps using Hands-On Learning Strategy, Hands-On Learning Strategy Combined with Conventional Teaching Method and Conventional Teaching Method alone was investigated in the study. A significant difference in the mean scores of students taught topographic maps using Hands-On Learning Strategy, Hands-On Learning Strategy Combined with Conventional Teaching Method and Conventional Teaching Method alone (F (5, 272) = 17.814, p = 0.000). This implies that the achievement of students in the experimental groups was significant in topographical map studies compared to their counterparts in the control group. This finding agrees with the reports of previous studies which noted that male and female students would differ significantly in their achievement scores when exposed to treatment (Hesbon, Mark, Okere and Samuel, 2014, Obiageli, 2014, Ifeakor, 2003). However, this finding is in conflict with the works of some authors who found out that gender of the students could not be factored in their achievement (Filgona *et al.* 2016; Dantani, 2011 and Amosun, 2002). From this finding, it is crystal clear that gender could stand as one of the predictor variable that could be factored in students' achievement in Geography. Therefore, the notion that the researcher had at the commencement of the study that Geography as a subject offered in secondary schools could be gender sensitive is tenable here.

5. CONCLUSION

From the results obtained on the Effects of Hands-On Learning Strategy and Gender on Senior Secondary School Students' Achievement in Topographical Map Studies, it can be concluded that Hands-On Learning Strategy have a strong effect on students' potentials to enhance their academic achievement. This is due to the higher motivation experienced in the hands-on approach in their learning. Moreover, the students taught by the hands-on approach in the study performed better than those taught by the conventional teaching method. Hands-On learning is therefore a strategy for enhancing students' learning of topographical maps. The hands-on learning strategy also promotes differential learning outcomes of male and female students in topographical map studies. It is thus not a means of removing gender performance differences in the study of geography at the senior secondary school level. Therefore, the use of hands-on learning strategy in teaching will alleviate poor achievement among students who offer Geography in senior secondary schools.

6. RECOMMENDATIONS

The use of hands-on learning strategies 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 practical 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.

The geography laboratory which serves as the 'engine room' for conducting practical works is very essential in topographical map studies. Therefore, Nigerian public schools should be equipped with the necessary facilities and the relevant instructional materials for conducting practical work sessions.

Enlightenment campaign, workshops and seminars should be organized for geography teachers by Education Authorities. These authorities include: Federal and State Ministries of Education, Institutes and Colleges of Education etc. This could be done in order to create awareness among geography teachers on the efficacy of the strategies/methods and then sensitize them on the adoption of the methods/strategies in teaching topographical maps.

AUTHORS' CONTRIBUTIONs

This work was carried out in collaboration between all authors. Authors Jacob Filgona and Ndatuwong G. Lazarus contributed to conception and designing of study. Author Jacob Filgona managed the literature searches and data collection. Authors Jacob

Filgona, Joel Filgona and Ndatuwong G. Lazarus contributed in developing statistics, analyses of data and drafting of manuscript. All authors reviewed and approved the final manuscript.

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