COGNITIVE STYLES IN SECONDARY SCHOOLS IN KENYA: COMPARING GENDER AND DISCIPLINE AREAS

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A Research Project report Submitted to the University of Nairobi in Partial Fulfilment of the Requirements for the award of Master of Education Degree (M.Ed.) in Measurement and Evaluation.

2020

DECLARATION

This research project is my original work and has not been presented to any other University for any award.

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E58/80404/2015

This research project has been presented for examination with my approval as the University of Nairobi supervisor.

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DEDICATION

This research is dedicated to The Almighty God for giving me the necessary intelligence and good health through the length of this course.

This research is also dedicated to my late Father Mr David Oginga Omenda who instilled in me the desire to achieve academically from my young days as a boy, my mother Evelyn Auma, my Sisters, Julian, Molly, Dalsey and Trina my aunt Eunice and my Uncles Didmus and Professor Bebe for the immense support towards this achievement.

ACKNOWLEDGEMENTS

First, I wish to express deep respect and gratitude to Dr. Karen T. Odhiambo who was my Supervisor, Lecturer and course coordinator. Dr. Karen T. Odhiambo showed a great deal of patience and wisdom throughout the coursework, advised me with her immense experience towards the writing of this research document.

ABSTRACT

This study sought to find out the patterns that arise in different subject areas taught in secondary schools in Kenyan classrooms in the context of cognitive styles. Cognitive style refers to the habitual ways in which individuals acquire and process information. It is an aspect of cognition that measures of how brain perceives, manipulates, encodes, decodes and retrieves information and not indication of the content. With the modern world requiring individuals that are self-directed in learning, Learners and Educators need to be aware of their thinking skills and how to apply them in a learning situation.

The objectives for the study were a) Determine what cognitive styles arise looking at field dependent and independent cognitive styles; b) Determine the gender perspective and cognitive styles and c) Determine patterns of learning arising from discipline areas Mathematics, English, Biological Sciences and History in the context of Field dependent/Field Independent Cognitive styles. To address these objectives, Descriptive research design with a quantitative approach was used. Random purposive sampling was done to select a homogenous classroom of form three students in each of the schools that participated in this study. Participants responded to Group Embedded Figures Test (GEFT) questionnaire. The questionnaire contained two sections: personal information of the students, and the GEFT. Students' scores from Continuous Assessment Tests were also extracted and compared with their respective Cognitive Styles. Data analysis involved frequencies and percentages for the first objective. Analysis for the second and third objectives involved frequencies, percentages and t-Test analysis to test the hypotheses. The data collected was subjected to hypothesis testing at $\alpha=0.05$ using statistical package for social scientists (SPSS) to determine the mean, standard deviation and t-Test results in Mathematics, English, Biological Sciences, History and Mean Academic achievement scores. Results revealed the presence of Field Dependent and Field Independent Cognitive styles among learners. Gender was found to have no statistically significant influence on learners' cognitive style. Cognitive styles was also found to have a statistically significant influence on the students' performance in Mathematics, Biological Sciences and Mean Achievement. However, it's Influence on English and History was found to be statistically insignificant.

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ACRONYMS

ANOVA-   Analysis of variance

CAT-   Continuous Assessment Tests

EFT-   Embedded Figures Test

FD-   Field Dependent

FI –   Field   Independent

GEFT-   Group Embedded Figures Test

HGEFT-   Higher Group Embedded Figure Test Score

LGEFT-   Low Group Embedded Figure Test Score

MA-   Mean Achievement

MFFT-   Matching Familiar Figures Test

SPSS-   Statistical Package for Social Scientists

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CHAPTER ONE

COGNITIVE STYLES

1.1 Background Information

"Cognitive styles" refers to an individual's preferred way of colleting, processing and evaluating information (Allinson & Hayes 2012). It has an influence on how an individual scans his/her environment for information, organizes and interprets it, and how the information is integrated into mental models and subjective theories which influences a person's behaviour. "Cognitive styles", is a construct stemming from Cognition in Cognitive Psychology. Cognition is a "mental process of knowing which includes the acquisition, organization, and use of knowledge." It's defined as the process through which stimuli/information gets transformed, elaborated, reduced, stored and later retrieved for use. (Neisser 1976).

Individuals approach the same task in different ways. The different ways individuals attend to their environment are collectively referred to as cognitive styles. Some individuals are influenced by the context in which a task is presented while others are hardly influenced by the context in which the task is presented. Individuals influenced by their immediate environment are labelled as Field Dependent while those not influenced by their environment are referred to as Field Independent (Witkin 1972).

With the modern world demanding individuals to be equipped with 21st century skills of problem solving, innovation and creativity as seen in an Authentic learner. Lombardi (2007) describes the authentic learner as an individual who typically focuses on complex problems of the real-world, discovers their solutions, using problem based tasks, case studies, role-playing exercises and participation in virtual communities of practice. Martinsen and Kaufmann (1999) therefore suggests cognitive styles as a construct that encompasses perception, learning,

language, thinking, creativity and problem solving. Martinsen & Kaufmann (1999) were interested investigating cognitive styles and creativity reviewed Articles on field independent/field dependent cognitive styles. A majority of the results pointed out that individuals having field independent to be more creative. Additionally Ausuburn and Ausuburn (1978) discussed the implications of cognitive styles as a crucial factor in designing classroom instruction to meet the deficiencies of individual learners. They went ahead to present the idea that students process and transform learning stimuli or information in a manner influenced by the cognitive styles they have and then use the transformed stimuli to generate their own solutions during the learning process. In Education, cognitive styles affect learners instructional preferences, assessment preferences, their performance in competency based exams, choice of learning style, career choice and motivational preferences of learners with different styles. During instruction and Assessment, Sadler-Smith & Riding (1999) reported that learners by large extent showed a preference for field-dependence by being more comfortable with the teacher takes charge of the learning environment and not autonomous and collaborative learning environments.

There are many dimensions of cognitive styles. Of these Field dependence/Independence cognitive style dimension has so far been the most researched. It is a measure of extent to which the presentation of a field affects his/her perception of its components. Field Dependent individuals are those that their perception is greatly influenced by organization of a presented field and likely to adhere to the presentation of a field as it was presented to them. They are also more attuned to the social aspects that an environment presents. In contrast Field Independent individuals are those who perceive components of a field as distinct from its environment. They have an ability to restructure it and impose their own organization of a field (Witkin 1973).

Children with Field-independent Cognitive Style tend to have a larger capacity compared to field dependent children in terms of 'active analysis' and perceptual 'differentiation' (Witkin et al 1997). A Field Dependent individual is more attracted to choose independent activities, have self-motivated intentions/goals, responds more positively to intrinsic reinforcements and prefers to make a new structure or restructures what he/she learnt on his/her own. He/she is also likely to come up with his/her own strategies during learning. Field-dependent learners tend to prefer learning together as a group, have frequent interactions with their fellow learners or with their teachers, respond more positively to extrinsic reinforcements and guidance, and have predetermined aspirations or established structures in an activity (Holmes, Linden & Shin 2013).

Studies in cognitive processes originate from Gestalt psychologists, Max Wertheimer, Kurt Koffka & Wolfgang Kohler and works of cognitive development of children done by Piaget in 19th century. Later in the 20th century, Carl Jung classified Psychological types by postulating that personality is composed of three facets of Attitude, Perception and Judgement. Attitude ranges from extraversion (outgoing personalities) to introversion (inwardly focused personalities). Perception is an individual's manner of attending to stimuli; an intuitive individual is more focused on meaning whereas a sensory person is more focused to detail. Judgement is last aspect of personality. It is an individual's approach in making decisions; a "feeling person" judgement is guided values whereas a "thinking person" is guided more by active analysis and logic.

A review of scholarly articles show that different scholars have used different terms such as "thinking styles", "learning style", "mind style" and the common cognitive style. All these terms point at a lack of a common identity of style constructs. As summarized by Kozhevnikov

(2007) after a review of different style labels the explosion of different labels on styles were developed from various applied fields where the styles were studied and as a result, the labels "learning styles", "personal styles" and "decision making styles" arose without any clear explanations of how they were different from the "basic" cognitive styles. The same challenge of different labels for style construct was noted by Riding (1997) who found that different scholars working in different contexts assigned the different labels without paying considerable attention to pre-existing works of other scholars. Schmeck (1988) elaborated the relationship between learning styles and cognitive styles by saying that learning styles were simply the use of an individual's cognitive style when applied to a learning context. Since 1951, the phrase "cognitive styles" was and has been widely accepted as a major term on how individuals perceive and manipulate their environment.

The phrase "Cognitive Styles" was first coined in 1951 by Klein as noted by Kozhevnikov (2007). Before 1951 the different individual differences on how people perceived their environment were described using many different terms which included cognitive attitudes, perceptual attitudes, predispositions, modes of responses among others. Despite all the different classifications, all researchers aimed at showing individual differences. Basic research on cognitive styles before 1951 mainly focused on identifying how individuals performed trivial cognitive challenges and to show that Individuals showed differences in ways of perceiving and solving tasks. Today, Studies on cognitive styles do not only stop at identification of individual differences but relating the individual differences to other complex tasks e.g. management, academic achievement, decision making among others.

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There has been some confusion between the constructs of ability and cognitive styles e.g. Carroll (1993) concluded that cognitive styles are in fact ability measures. This confusion has however been dispelled by other researchers (McKenna, 1984 & Riding, 2002) who illustrated a clear distinction between ability and cognitive styles. McKenna (1984) gave differences between cognitive styles and ability by highlighting that ability focuses more on performance levels, whereas style focuses on the manner a task was performed. Ability is measured in a unipolar manner (more ability vs. less ability), whereas style is measured in a bipolar manner. Values from measurements of ability are either desirable or undesirable while in styles, neither pole is considered better overall.

A Learner's cognitive style whether Field Dependent or Field Independent is a factor which requires to be considered, since it can interfere with the desirable expectations on Teaching, Learning, and Assessment and student achievement. The major concern for this research is to find out cognitive style patterns of secondary school students, how their respective cognitive styles affect their achievement in selected disciplines (English language, Mathematics, Biological Sciences, History and Mean Achievement) and if there exists a significant interaction between Cognitive styles and gender.

1.2 Statement of the Problem

A number of studies have been done to find out the interaction between cognitive styles and academic acievement in different disciplines. A majority of studies such as Onyekuru (2015) and Lu & Suen (1995) have showed that field independent individuals have greater and significant achievement in Sciences when compared to field dependent individuals in both males and females whereas Field-Dependent students posted a higher mean Achievement when it came Art disciplines than their Field-Independent counterparts. Assessment approaches also

favour Results reported performance-based assessments appeared to favour field independent subjects.

Dependent on the purposes and intended uses of assessment and learning, this outcome raises concerns for validity based on either fairness or curriculum relevance. Pursuant to the trend above, there is a deficiency of knowledge on the influence of cognitive styles in instruction thus affecting students' performance negatively thereby hindering optimal performance by students especially in the Kenyan context where there exists scanty research related to cognitive styles in relation academic achievement. This study therefore seeks to investigate patterns and relationships between learners' cognitive styles and their relationships to academic achievement in Mathematics, English Language, Biological Sciences and History. It will also look into Gender perspective in the context of cognitive style.

1.3 Purpose of the Study

The purpose of this study is to determine the learning patterns regarding cognitive styles and its impact on Academic performance on selected Disciplines.

1.4 Objectives of the study

a) To determine the cognitive styles that arise looking at Field Dependent and Field Independent cognitive styles.

b) To determine the gender perspective of cognitive styles regarding Field Dependent and Field Independent Cognitive style.

c) To determine the interaction between cognitive styles and achievement in Mathematics, English, Biological Sciences, History and mean achievement.

1.5 Research Questions

1. Which cognitive styles arise looking at Field Dependent/Field Independent cognitive styles?

2. What is the gender perspective regarding Field Dependent/Field Independent cognitive styles?

3. What are the patterns of arising from interaction of Field Dependent/Field independent arising from learning Mathematics, English, Biological sciences, History and Mean Achievement?

1.6 Research Hypotheses

Under the 2nd and 3rd objectives, the following Hypotheses were generated.

. H_{01}: Gender has no influence on a learner's Cognitive style.

H_{A1}: Gender has an influence on a learner's Cognitive Style.

H_{02}: Patterns of learning regarding Cognitive Styles in English have no tendency towards Field Dependence versus Field Independence Cognitive styles.

H_{A2}: Patterns of learning regarding Cognitive Styles in English have a tendency towards Independence versus Field Dependence Cognitive Styles.

H_{03}: Patterns of learning regarding Cognitive Styles in Mathematics have no tendency towards Field Dependent versus Field Independent Cognitive Style.

H_{A3}: Patterns of learning regarding Cognitive Styles in Mathematics have a tendency towards Field Dependent versus Field Independent Cognitive Style.

H_{04}: Patterns of learning regarding Cognitive Styles in Biological Sciences have no tendency towards Field Dependent versus Field Independent Cognitive Style.

H_{A4}: Patterns of learning regarding Cognitive Styles in Biological sciences have a tendency towards Field dependent versus Field Independent cognitive style.

H05: Patterns of learning regarding Cognitive Styles in History have no tendency towards Field Dependent versus Field Independent Cognitive Style.

HA5: Patterns of learning regarding Cognitive Styles in History have a tendency towards Field Dependent versus Field Independent Cognitive Style.

H06: In terms of Mean Achievement, the higher achievers have a tendency towards Field Dependent versus Field Independent Cognitive Style.

HA6: In terms of Mean Achievement, the higher achievers have a tendency towards Field Dependent versus Field Independent Cognitive Style.

1.7 Significance of the study

This research adds value to existing cognitive styles research. It also seeks to find out existing trends in Field dependent and Field Independent cognitive styles in relation to learning and achievement in various disciplines.

Learners who are concious of their cognitive styles abilities and deficiencies will be able to adjust their learning abilities to bridge their deficiencies in the different disciplines they take. By knowing the style patterns in their classrooms, Teachers who are the curriculum implementers will also make informed pedagogic decisions during teaching and especially in instances of individualized instruction. This will be a major step towards addressing the deficiencies of learners and their various cognitive styles. It will also help understand how their students think and even use the various teaching strategies that meet inadequacies of students having different cognitive styles hence optimize learning.

Similarly policy makers and curriculum designers e.g. Ministry of Education will find useful information from cognitive style trends to make informed policies that take into consideration the cognitive styles of learners.

Finally schools may use deductions from cognitive styles in this study to advise learners on what disciplines they are good at and in career counseling.

1.8 Justification of the Study

Learning is an activity that takes place in the mind. It is a psychological aspect that involve mental operations, it is believed that cognitive Styles alongside learning styles and Metacognition have an influence on how mental operations are executed. Execution of the mental operations during the learning process are either positively or negatively influenced by Cognitive Styles.

Performance statistics from both formative and summative evaluations show that a majority of students achieve below average in all disciplines and more especially in mathematics and science disciplines. Quite a number of researches on cognitive styles in relation to learning of various subject disciplines exist. Few researches have dwelt on sciences and mathematics especially in the Kenyan context.

This Research seeks add value to existing knowledge regarding field dependence/field independence as it intends to investigate the existing differences in cognitive styles among students in secondary schools in Kenya, the cognitive styles patterns of learning in relation to academic achievement in Mathematics & Biological sciences and further find out the learning trends in English language and History.

1.9 Terminologies

Cognitive styles: Cognitive styles are an individual's favoured methods of collecting, processing and evaluating sensory material.

Cognition: Process by which sensory information is changed, elaborated, reduced, stored, retrieved, and later used (Neisser 1967).

Personality: individual differences in habitual patterns of thinking, feelings and behavior or differences between individuals 'average level of behavior that are repeatable across time and/or contexts

Field Independence: Extent to which an individual's perception of a component in a field is viewed as a distinct entity from its environment rather than being embedded as part of the field. Or extent to which the presentation of a field affects his/her perception of its components.

Field Dependence: Extent to which an individual's perception of a component in a field is viewed as embedded in its environment rather than being a distinct entity. I.e. Perception is less dominated by the more salient cues presented in a field.

Gender: a term that describes roles as well as responsibilities that a culture/society or families places on men and women. It also includes aptitudes, expectations and probable behaviours of men or women which are learnt.

Learning: Acquisition of new, modification or reinforcement of existing knowledge, skills, behaviours and/or values which may involve synthesizing. Act of acquiring knowledge skills or attitudes by studying, practicing, being taught or through experiencing a phenomenon.

Academic Achievement: Average of a student's score in four subjects (Mathematics, Biology, English, and History)

Authentic learner: Learner with the ability to connect learning content from a classroom to real world issues, problems and applications that reflect complexities and ambiguities of the real world.

21st Century Skills: Dispositions such as problem solving, creativity and innovation that are being required for success as regarded by educators, business leaders, academic and government agencies.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Related Studies

Section 2.1 narrows down on the objective themes. The researcher gives the related studies and literature necessary to prepare the context, evidences and arguments of relevance to accomplish the research objectives. This sub-chapter identifies and appraises literature that is relevant to answer the research questions.

2.1.1 Presence and Patterns of Cognitive Styles

In a study done by Witkin & Ash (1948) who an experiment to find out how individuals make perceptions was done. Subjects in the experiment were presented with a rod and frame test. Different individuals perceived the same visual image of a rod and frame in different ways. Some individuals perceived the rod as vertical only when the rod was in perfect alignment with edges of the frame while others appeared undistracted by the orientation of the frame. Individuals who were distracted with the orientation of the frame were labelled as Field Dependent. Individuals were not distracted by the orientation of the frame were referred as Field Independent. He conducted a series of other different tests but the outcomes revealed different perceptions for the same task.

In a different experiment, the same outcome was reported by (Pask, 1972; Pask & Scott, 1972) who used a different experiment to find out individual differences among individuals. Differences between individuals were clear. Some individuals responded to a series of problem solving tasks in a step by step strategy while others chose a global approach. Subjects who used the step by step approach were labelled as Serialists preferring to work on only small quantities of material at a go before combining these steps. Their counterparts who used a global approach

were labelled as Holistic since they preferred to use large amounts of information to start with then seeking to gain understanding through identification and putting focus on major patterns from the presented materials.

In a separate and different study, (Gardner et al., 1959) measured Equivalence range. An extent to which individuals get impelled to focus on or neglect consciousness of differences. Respondents were provided with "Object-sorting-test "a test that assesses whether a person prefers to classify objects into man categories with each category having a few objects or few categories each having more objects. The test comprised of portraits of people, written characteristics of individuals among others. A section of the individuals opted for a narrowed clustering of the objects presented in the test while others opted for a broadened categorisation. Differences between individuals were clear as each respondent used a number of different categories.

The above experiments show that individuals have their own unique ways of perceiving their environments. The unique ways are also different from one individual to another and also affect individuals in all aspects of life which includes the learning environment and thus the presence of different cognitive styles among individuals.

2.1.2 Cognitive Styles and Gender

In a study by Okoye (2016) aimed at investigating the relationships between cognitive styles and gender, the objective was to determine influence of cognitive styles on the mean achievement of male and females in public secondary school students in biological sciences. A substantive interaction between cognitive styles versus gender was found. Male learners appeared to be more field dependent compared to their female counterparts.

In a different study by Jantan (2014), the aim was to find out the influence that cognitive styles has on the mean scores of male and female learners in biology, 150 learners in year 6 from selected schools took part in the study. The null hypothesis stated that "There is no significant difference in students' between boys and girls" cognitive styles. Results showed substantive disparities in cognitive styles between males and females in the school. More girls appeared to be Field Dependent as compared to boys who were more of Field Independent.

In another Study done by Musya (2015) carried out a research aimed at determining extent to which cognitive styles influences achievement in chemistry and disparities in leaners ̈cognitive styles among boys and girls. 200 secondary school students responded to field dependent-Field independent questionnaire. Data analysis which involved Pearson Product Moment Correlational Analysis revealed more male students being field dependent as opposed to females who were more of field independent.

Jantan (2014) and Onyekuru (2015) concurs with Okoye (2016) by reporting that a majority of boys were field independent when compared to girls. Musya (2015) however disagreed with (Jantan 2014 and Okoye 2016) by concluding that females were more field independent than their male counterparts.

2.1.3 Cognitive Styles and Mathematics

In a study done by Roberger & Flexor (1983), aimed at finding out the effects of field dependence-independence on mathematics achievement of learners in elementary schools, A random sample of 150 students from each of grades 6, 7 and 8 were selected and responded to Group Embedded Figures Test (GEFT). MANCOVA analysis of standard scores on the mathematics achievement tests showed significant main effects in relation to field-

dependent/Independent cognitive style. Results showed Field-independent learners scored significantly higher than field-dependent students on the total number of concepts, and problem solving tasks offered to them. Their conclusion was that field independent learners used their analytical abilities that contributed to a pronounced influence on their mathematics achievement.

In another study Jantan (2014) to examine interaction between learners' cognitive style in relation to their achievement in Mathematics. One hundred and fifty students' students in year 6 from selected schools were selected as participants for study. Students responded to Group Embedded Figures Test. There were two types of analysis used in this study, descriptive and inferential statistical analysis. A low positive correlation between learners' cognitive styles and their mathematics achievement was reported. Field independent learners were found to achieve higher compared to field dependent learners.

Umaru and Tukur (2013) did another study whose objective was to investigate influence of Field-dependent and independent cognitive styles learners' Mathematics achievement. A multistage sample 100 learners drawn from senior high school learners responded to Group Embedded Figures Test by (Witkin & Goodenough, 1984). The test was used to reveal the participants' Cognitive style and the outcomes compared to Mathematics Achievement Test (MAT). A mean, standard deviation and t-test analysis showed that learners with independent cognitive style achieved significantly higher than their Field dependent counterparts in Mathematics Achievement Test. They concluded that cognitive styles be treated as a variable that may expound on differences revealed among learners in mathematics achievement.

This trend is further explained by Buriel (1978), who reported that mathematical problems requires executing "disembedding procedures", mathematical problems requires the separating of numbers and their sub-components then joining them to make new totals.

These findings confirm and extend the results of previous investigations of the impact of such factors on the mathematics achievement. Witkin et al, (1977) further explained mathematics as a subject that required a greater level of disembedding and restructuring competencies and that Field Independent learners had an edge when it comes to restructuring and disembedding.

2.1.4 Cognitive Styles and English

In a study done by Souzandehfar (2011), the relationship between cognitive styles versus gender on performance in speaking of English as a second language was investigated. Objectives of his study included finding out effects of degree of field dependence/independence (FD/I) and gender on speaking performance. A sample of 72 learners answered Group Embedded Figures Test and the Oxford placement Test. Results from Pearson Correlation and ANOVA revealed a negatively insignificant disparity in achievement statistics of field dependent and field independent students in relation to English as a second language speaking performance.

Additionally, Al-Hajaya (2011) carried out a study between cognitive style and achievement in English reading achievement. Results revealed statistically insignificant difference at α = 0.05 between average scores of students with analytical style to students of global style of learning on reading performance that would be attributed to the instructional methods. He concluded that field independence may not be an advantage in learning of English as a second language.

Similarly, in another study carried out by Al-Hajaya (2011), the objective was to investigate cognitive learning style based reading program on performance of English among first years in Jordan and the relationship between instructional strategies and cognitive learning styles on reading performance. A sample of 104 freshmen were presented with analytic-global learning styles inventory, an instructional reading program having two strategies, and a reading exam. Analysis of data involved a T-test and two way ANOVA on the reading achievement test. Results showed statistically insignificant disparities in the students' means on the reading achievement test between the analytic group and the global group. However the relationship between instruction strategies and cognitive learning styles revealed a significant influence on student motivation and performance. She recommended that Teachers are called upon to balance analytic style strategies with global style strategies focusing much on formal learning (analytic) with open ended unstructured tasks that stress on conversations and cultural contexts of English language.

In another study by Nozari and Siamian (2015), objective of the study sought to find the interaction between field dependence/independence and English text reading comprehension, learning of English as a foreign language and academic achievement. A random sample of 305 male and female learners from junior high school students did a Group Embedded Figures Test. Results from regression analysis showed an increase field independence leads to a higher score in comprehension reading skills and English learning and better academic achievement will result. They concluded that knowledge of cognitive styles helps clarify the understanding of language learning.

Nozari and Siamian (2015) results are in contrast with Al-Hajaya (2011) and Souzandehfar (2011) in that field independent learners were found to achieve higher in reading and comprehension skills, learning of English language and academic performance compared to field dependent students. A majority of these studies suggest that field independent learner to be superior in learning of mathematics.

2.1.5 Cognitive Styles and Biological Sciences

In a study done by Muhammad et al (2015) to determine the interaction between Field dependence/Independence cognitive styles and scientific achievement in both Males and Females in Biological sciences and integrated science was investigated. From a population of 700 students, a random sample of 150 students were selected to respond to Witkin's Latent Patterns Test. A significant influence between cognitive styles and academic performance was found. Results showed that Field independent students had a greater correlation coefficient towards achievement in biology when compared to field dependent students in both genders. Similarly, in another study by Safyanu, Maruta & Olarunoye (2016) whose purpose was to investigate interaction between cognitive styles, and performance in science process skill among senior secondary school biology learners, a random sample of 216 learners sat for Group Embedded Figures test and biology Science process skills achievement test. Results showed that, field dependence, field-independence and field Neutral were significantly related to achievement in science process skills. Field independent learners achieved higher than field dependent learners.

Contrastingly, in a study done by Okoye (2016), to find out Influence of Gender and Cognitive Styles on Students' Achievement in Biological Sciences, the study's objective was to investigate the effect of cognitive styles on the mean achievement scores of boys and girls in

biology. Results of the study revealed that gender and cognitive styles have insignificant, influence on achievement scores of students in biological Sciences.

Safyanu, Maruta & Olarunoye (2016) concurs with Muhammad et al (2015) by reporting that a substantial interaction between Field dependent and Field independent students and achievement in Biological Sciences. Okoye (2016) disagrees with (Muhammad et al 2015 & Safyanu, Maruta and Olarunoye (2016) by concluding that cognitive styles appeared to have an insignificant effect on achievement of biology learners. A majority of these studies suggest that field independent learner to be superior in learning of Biological Sciences.

2.1.6 Cognitive Styles and History

Research involving cognitive styles in relation to achievement in History as a subject is scanty. The same was noted by Tinajero and Paramo (1998). However, History can be viewed generally as a social science subject.

In a study conducted by Onyekuru (2015), relationship influence of cognitive styles on gender, career choice and academic performance in sciences and arts was investigated. A random sample of 158 respondents sat for Group Embedded Figures Test. A t-test calculation found a substantial interaction between cognitive styles and academic achievement.

Field dependent subjects had a highly significant achievement in arts subjects when compared to Field independent students.

In a study done by Ruble & Nakamura (1972), aimed at finding out how related cues presented by an experimenter may differentially influence performance of a task versus cognitive styles of children on two games. The children were subjected to a rod and frame test which was used

to group them into Field Dependent and Field independent. Children who participated were provided with concept attainment tasks. Some of the tasks were laced with social cues while other tasks were not. Field Dependent Children exhibited better learning on concept attainment tasks that were laced with social cues than their Field Independent counterparts.

Ruble & Nakamura (1972) are in congruence with Onyekuru, in that Field dependent perform better in socially oriented tasks. This outcome was further explained by Crutchfield et al (1958) who said that Field-dependent individuals had a superior memory in remembering information laced with social content. Other different studies despite few tend to disagree with (Onyekuru 2015 & Ruble and Nakamura 1972) e.g. in a study done by Roszkowski and Snelbecker (1987) aimed at investigating interaction between peripheral laterality, field independence/dependence and academic performance was investigated. A sample of 58 third grade students responded to children's Embedded Figures test. Their research established that field dependence was correlated with lower scores on standardized social science exams.

There appears to be mixed outcomes on the relationship between Field dependence-Independence and social science research. This mixed outcomes are noted from a review done by Tinajero & Paramo (1998) attributed the mixed result in cognitive styles and social sciences to difficulties in developing appropriate tests in social sciences and/or due to inadequate understanding of basic practices behind learning of art disciplines.

2.1.7 Cognitive Styles and Academic Achievement

In a study done in Kenya by Musya (2015), cognitive styles versus academic performance among high school chemistry students was investigated. Besides the existence of different cognitive styles, a substantial interaction between cognitive styles and achievement in

chemistry was found. Results processed by Pearson's product correlation analysis from a stratified sample of students' scores in chemistry revealed that Field independent learners were found to achieve significantly higher compared to Field Dependent learners. Jolly (1980), Ahmadzade & Shojae (2013) concurs with Musya (2015).

Ahmadzade & Shojae sought to investigate the relationship between field dependence/independence and academic performance among University learners in Iran. A clustered sample of 1009 students responded to Latent-Patterns test that was used to label them as either Field dependent or Field Dependent. Correlation analysis found significant interaction between the variables. Field independent students achieved better when compared to Field dependent students.

Ahmadzade & Shojae further contends that individuals having field dependent cognitive style tended to be more analytical, had intrinsic positive attitude towards learning of social material, do not respond to criticism, do not get easily distracted by their environment, and assume a proactive role during learning. However, field dependent individuals tended to employ a holistic approach towards learning, were extrinsically-motivated to learn social content, responded to critics, were more influenced by their environment, learnt social content better, and showed a passive character during learning. Dubois and Cohen's (1970) research concurs with this hypothesis after finding significant interaction between the field dependence-independence test scores in overall mark in a university admission examination. Consistently (Witkin et al 1977) in their review explained that individuals who are Field Independent are likely to impose their analytic character to restructure the organization of a field, when given information in a dominantly organised field. Their Field Dependent counterparts on the other hand will tend to adhere to the same format the field was presented to them.

From the review done in section 2.1 above, it appears that cognitive styles influences personality & psychological behaviours of learners and affects their perceptions, interactions as well as responses to the learning environment. Consequently, educators need to understand that from a wide variety of different learning styles show in a classroom environment, it's imperative that Teachers need to understand their students learning styles and adjust them accordingly to meet deficiencies in their learners' abilities. The purpose of this research is to investigate the relationships between learners' cognitive styles and students' performance in secondary schools.

Summary of the outcome of the studies

a) Individuals with both Field dependent and field independent mode of perception are present in any population.

b) Majority of studies suggest males to be more field dependent than females.

c) In cognitive style by Subject areas.

- Field Independent persons achieve higher in mathematics and Biological sciences when compared to Field dependent individuals.

- In English language there appears to be mixed results with a majority of studies suggesting that field independent individuals having a slight advantage over field dependent individuals in terms of achievement

- In art and socially oriented disciplines, there appears to be mixed results with few studies suggesting that Field dependent individuals perform slightly higher than field independent individuals. Furthermore, research involving cognitive styles and history as a discipline is scanty.

2.2 Related Literature

To understand cognitive styles, cognitive psychology and cognition should first be understood.

Cognitive psychology is the branch of psychology that looks at how individuals perceive, learn, remember, and process information.

Cognition is term used in cognitive psychology to represent mental processes such as acquisition, storage, retrieval and processing of knowledge. Simply put, it includes the mental processes used by individuals to perceive, attend, remember, think, categorize, reason, make decisions and solve problems.

Individuals perceive and attend to information in different ways. This suggests that there is a mediating interface between cognition and personality. The same was noted by Stenberg and Grigorenko (1997). Huge volumes of previous research have demonstrated that Cognitive styles have an influence on intellect and academic achievement. "Cognitive styles" therefore are a person's favoured way of colleting, processing and evaluation of information (Allinson & Hayes 2012).

There has also been some confusion between the constructs of ability and cognitive styles e.g. Carroll (1993) concluded that cognitive styles are in fact ability measures. This confusion has however been dispelled by other researchers (McKenna, 1984 & Riding, 2002) who illustrated a clear distinction between ability and cognitive styles. (McKenna, 1984) went further and gave differences between cognitive styles and ability by highlighting the following:

- Ability focuses more on performance levels, whereas style focuses on the manner a task was performed

- Ability is measured in a unipolar manner (more ability vs. less ability), whereas style is measured in a bipolar manner.

- Values from measurements of ability are either desirable or undesirable while in styles, neither pole is considered better overall.

Other psychologists equate intelligence with 'cognitive abilities' e.g. Hunt (1986) opined 'Intelligence' to be a term used to express variation in performance of cognitive tasks or a collective term used to demonstrate individual differences in mental abilities.

However, Hilliard (1976) concluded that there was a clear difference between cognitive style and intelligence. The same was also supported by Tinajero & Paramo (1998) who cited (Bush and Dridder 1971) who stressed a lack of relationship between the two.

Studies in cognitive processes originate from Gestalt psychologists, Max Wertheimer, Wolfgang Kohler and Kurt Koffka and works of cognitive development of children done by Piaget in 19th century. In order to explain individual differences in in cognition Rayner & Riding (1997) cited that Allport (1937), may have beenthe first to use the style construct to try and explain individual differences in cognition and was the first to develop the idea of life styles. Later in the 20th century, Carl Jung classified Psychological types by postulating that personality is composed of three facets of Attitude, Perception and Judgement

a) attitude ranges from extraversion (outgoing personalities) to introversion (inwardly focused personalities),

b) Perception is an individual's manner of attending to stimuli; an intuitive individual is more focused on meaning whereas a sensory person is more focused to detail.

c) Judgement is last aspect of personality. It is an individual's approach in making decisions; a "feeling person" judgement is guided values whereas a "thinking person" is guided more by active analysis and logic.

Cognitive styles therefore are the interface that mediate between the above three aspects of personality and the environment.

2.2.1 The concept 'Cognitive Styles'

Introduction

This section first defines the concept cognitive styles. Later it proceeds to present and explain three different models of cognitive styles. The models are

a) The McKenny's model

b) The Hill model

c) Cognitive dimensions model

From the three models, this study focuses on the cognitive dimensions model. Under the cognitive dimensions model, the Field-dependent/Independent dimension will form the basis for this study.

Definition of Cognitive Styles

Cognitive styles are an individual's favored methods of collecting, processing and evaluating sensory material. It has an influence on how an individual scans his/her environment for information, organizes and interprets it, and how the information is integrated into mental models and subjective principles that influences behavior. (Allinson & Hayes 2012). There are three models of cognitive styles

McKenny's Model of Cognitive Styles

This model is based on the assumption that information processing in humans is a combination of two aspects of behavior: first is communication with his/her environment in terms of seeking information from the environment/people and returning information to other individuals. Second is how information is received is later organized to make a relevant experience in order to make useful predictions.

This model is of the view that a humans information processing is simply a cognitive process of communication with his/her environment and manipulation of information presented. (McKenney 1972). Martens (1975) cited Nelson (1974) who said that the environment presents a wide range of information to a person and in response, a person selects and attends to only part of the wide range of information. McKenney further opines that people normally come up with both conscious and unconscious habits of obtaining information and scrutinizing the presented material in order to solve a problem and arrive at decisions. As opposed to being bipolar as seen in the Cognitive dimensions model, McKennys model has two dimensions that influence the different aspects of information gathering and processing. These are information gathering and information evaluation.

Individuals differ in their information gathering habits. The information gathering dimension is a perceptive stage in which the mind organizes and encodes stimuli. Individuals can either be "Preceptive" or "Receptive".

i.   "Receptive individuals" are more responsive to the stimulus itself. They dwell more on detail as opposed to relationships and form the attributes of the information from direct examination rather than fitting it into their preconceptions.

ii. "Preceptive thinkers" bring together concepts, focus more on relationships between variables and check for deviations from their preconceptions

People are also different in the ways in which they process and analyze information. The information evaluation dimension which encompasses problem solving strategies.

i.   "Systematic thinkers" are likely to attend to a task by structuring it in a manner that when followed through will lead to a likely solution.

ii. "Intuitive individuals" are likely to use a trial and error strategy testing one method followed by another to arrive at a solution.

In McKenny's model, an individual's model can be more of preceptive or receptive during information gathering and more of systematic or intuitive during evaluation of data.

The Hill Model of Cognitive Styles

In this model, cognitive styles is viewed as a Cartesian project of different sets each comprising elements that interact with elements of another set to form a person's cognitive style.

According to Hill (1970) the first set comprise symbols and meanings. Symbols are either qualitative or Theoretic. Theoretical symbols have generalized meaning and comprise wordings and numerals. Qualitative symbols are those which an individual develops a personalized meaning of them. Meaning is derived from three areas, Sensory information, personally constructed formalisms e.g. games and programmatic effects of objects that give an impression of an image, scene, event and an operation.

In the second set, symbols are manipulated by a person on basis of cultural background or cultural influences on meaning. The determinant elements in this set include family influences, associates or friends. After symbols are modified by cultural determinants, they are transferred to the third set.

In the third set, a person makes a temporary conclusion on meanings based on their characteristic thinking processes. The thinking processes here are either deductive or inductive reasoning.

Cognitive dimensions model

Messick (1969) assembled and listed up to nine bi-polar dimensions from different proponents during the 20th century. The various dimensions were conceptualized as cognitive styles that represented an individual's mode of perception, remembering, thinking and problem solving.

As reviewed by Kozhevnikov (2007), among the earliest documented experimental evidences on Cognitive dimensions model of cognitive styles were done by Hanfmann (1941) and Witkin & Ash (1948). Hanfmann 1941 demonstrated how some subjects used a perceptual strategy while others used a conceptual strategy when grouping blocks. Later Witkin & Ash (1948) demonstrated an experiment to show how individuals perceived orientation of a rod as upright. Some individuals judged the rod to be upright when it was parallel with the axes of its frame even after the frame was tilted by 30^0 whereas other individuals were not influenced by the orientation of the frame. Individuals whose perception was affected by the orientation of the frame were labelled as Field dependent while individuals whose perception was not affected were labelled Field Independent. During this period the phrase "cognitive style was yet to be introduced.

After 1940s, different researchers from different fields published a tremendous amounts of style types all of them sought to identify individual differences in cognition which were stable over time, value free and related to personality and social relationships. Alongside Hanfmanns conceptual versus perceptual and Witkin's field dependent versus field independent style dimensions, there was an explosion of different style dimensions for instance levelling and sharpening, impulsivity versus reflectivity, conceptual tempo among others were introduced each with its own label.

A review of scholarly articles show that different scholars have used different terms such as "thinking styles", "learning style", "mind style" and the common cognitive style. All these terms point at a lack of a common identity of style constructs. Proponents of the various different styles failed to give clear explanations of how they were different from the "basic" cognitive styles. The same challenge of different labels for style construct was noted by Riding

(1997) who found that different scholars working in different contexts assigned the different labels without paying considerable attention to pre-existing works of other scholars. Schmeck (1988) elaborated the connection between learning style and cognitive styles by saying that learning styles were simply the use of an individual's cognitive style when applied to a learning context.

The phrase "Cognitive Styles" was first coined in 1951 by Klein as noted by Kozhevnikov (2007). Since 1951, the phrase "cognitive styles" was and has been widely accepted as a major term on how individuals perceive and manipulate their environment. Studies on cognitive styles did not only stop at identification of individual differences but relating the individual differences to other complex tasks e.g. management, academic achievement, decision making among others.

Field dependence/Field Independence cognitive style dimension has so far been the most researched. Alongside it are other dimensions listed and elaborated in section 2.2.1.1 of this research document.

2.2.1.1 Dimensions of Cognitive Styles

Dimensions are a variety of cognitive style measures that are elaborated in this section. Simply Dimensions can be regarded as different perspectives of viewing cognitive styles. This section lists and elaborates the dimensions.

a) Field Dependence/Field Independence Dimension

Field Dependent/Field Independent cognitive style is measure of the extent to which the presentation of a field influences perception of its components. Simply put it, it is the extent to

which a person perceives a component of a field as distinct from its environment as a whole, as opposed to being embedded as part of a field.

Field dependent individual is a person whose perception is easily influenced by the surrounding environment and rely more on external frames of reference or Individuals who can insufficiently isolate a component from its context.

Field Independent Individual is that whose perception is not influenced by the surrounding environment and relies more on internal frames of reference i.e. Individuals who find it easy to isolate a component from an organised field and separate it from its context.

Field Dependence/Field Independence Dimension was introduced by Witkin and so far the most studied (Kozhevnikov 2007). As elaborated by Witkin et al (1977

Field-dependent students are likely to prefer learning in groups, frequently interact with their colleagues or with their teacher, respond more positively to extrinsic reinforcements and direction, and predetermined aspirations or established structures in an activity. Relatively field dependent students were likely to enrol in disciplines such as, sociology, social work, humanities, languages, social services (religion), elementary school teaching, languages, education, writing, clinical psychology and nursing. According to Witkin et al (1997) Field Dependent individuals in particular showed interest in and selectively focused their attention to social aspects of the surrounding, such individuals were better at learning and remembering materials with social content than individuals who were relatively Field Independent. In general differences in characteristics between Field dependent and independent persons can be tabulated as below.

Table 2.1: Difference between Field Dependent and Independent Individuals

Field Independent	Field Dependent
Deals with complex problems and isolated facts	Finds it difficult to break information into isolated facts in order to solve a problem
Isolates and uses the relevant from the irrelevant	Finds it difficult to isolate the relevant from the irrelevant
Imposes his own organisation to content	Finds it difficult to provide his own organisation to content
Performs better in standardized tests	Performs relatively poor in standardized tests
Performs better in science and mathematics	Performs relatively better in humanities and social sciences
Reflective	Impulsive
Self-reliant	easily seeks help from others
Focuses more on mastery of concepts	Focuses more on relationships
Independent and enjoys individual work than working in groups	Relies more on direction; enjoys working in groups
Dependent on intrinsic reinforcement/motivation	Dependent on extrinsic reinforcement and motivation
Flexible in learning situations	Finds it difficult to change strategies
Comes up with own strategies and learning aids for learning.	Relies on instruction and direction from others for learning content
Objective	Affective

b) Holist-Serialist thinking Dimension

A measure of person's propensity to respond or solve a problem holistically or by a "step-by-step" approach in order to assimilate details. (Pask and Scott 1972);

Serialists are individuals who prefer a step-by-step strategy to solve the problems at hand, preferring to work on only small quantities of material at a go then later combining these steps.

Global/Holistic are individuals who prefer larger amounts of material to start with then looking to gain understanding though identification and putting focus on the salient trends from the given material.

To measure this dimension, Pask & Scott, 1972 provided a collection of problem-solving undertakings that were designed to make respondents to adopt either a step-by-step (serial) or a global (Holistic) approach to problem solving. This dimension of cognitive style was first put forward by (Pask, 1972; Pask & Scott, 1972).

c) Breadth of categorisation dimension/Equivalence range

It is a measure of preference for broader classifications with many items as opposed to narrow categories containing few items. Individuals are grouped into two poles. Can also be interpreted as the extent to which individuals are likely to work on or ignore an awareness of differences.

Broad categorizers are individuals with a tendency to form more categories of items each with fewer objects when provided with object grouping tasks.

Narrow categorizers are individuals with a tendency to form fewer categories of items each with more objects when provided with object grouping tasks.

By using an Object Sorting Test, (Gardner, 1953) explains it as the intensity to which an individual is impelled to focus on or neglect differences. It's a measure of preference for

more groups, each with a fewer objects, or fewer groups, each having larger amounts of objects.

d) **Range of Scanning**

A dimension that refers to a person's consistent habits in attentional strategies e.g. extensiveness of scanning.

Extensive scanners are individuals with a tendency to sample a greater volume of content before committing to a response.

Limited scanners individuals with a tendency to sample a lesser amount of content before committing to an answer.

The proponent of this dimension (Gadner et al, 1959) used the Size Estimation Test in which subjects were called upon to adjust a variable circular light to the size of different disks held in their hands. Extensiveness of eye movements during the test was measured. The subjects were then grouped into two poles as either Extensive Scanners or Limited Scanners.

e) **Conceptual Style Dimension**

A measure of preference towards simple conceptions over complex ones. It refers to a subject's personal differences in the depth to which elements of a concept are considered as distinct from each another in various categories within a concepts range of reference. Individuals are grouped into relational style and inferential categorical style.

Relational style are individuals with a tendency to group items together based on functional thematic relations

Inferential categorical style are individuals with a tendency to group items together based on abstract characteristics that cannot be seen in a picture.

This dimension is measured by use of Keegan ,Moss & Sigel test (Stenberg and Zhang 2014) where respondents are called upon to sort known personalities; in the course of each

sorting, the subjects are asked to give ways that in which two of the individuals are similar or how they differ from a third person. The number of constructs used during the test is measured and the subjects are grouped as conceptually simple on one pole and conceptually complex on another pole.

f) <u>Impulsivity-Reflectivity dimension/ Conceptual Tempo</u>

Cognitively Impulsive are individuals who make decisions shortly after briefly reviewing possible options.

Cognitively reflective are individuals who do extensive deliberations first before responding, carefully considering various options available.

This dimension was first put forward by (Kagan et al., 1964) and they used the "Matching Familiar Figures Test "(MFFT) to measure it. This style-dimension built on previous works on investigation on impulsivity-reflectivity dimension which aimed to measure speed with which a person makes a decision when faced by uncertainty conditions.

g) <u>Verbal-Visual Representation Dimension</u>

This dimension was interested in finding out an individual's preference during information processing by verbal or by imagery means.

Visualizer- Individual with a tendency to use visual representations during thinking while **verbalizers** are individuals with a tendency of using verbal representations during thinking. It is measured by use of Visualizer-Verbalizer Questionnaire developed by Richardson where subjects are called upon to evaluate the extent to which they frequently used verbal or image-based mental processing.

h) <u>Locus of Control Dimension</u>

Refers to an extent to which a person has generalized expectations for external versus internal locus of control.

Persons having **Internal Locus of control** are those who have a belief that their actions dictate and have control in their lives. Internals view reinforcement as a consequence of their own actions.

Individuals with **External Locus of control** are individuals who believe that their own actions are not a determinant of consequences in their lives.

Postulated by Rotter (1966) as cited by Kozheznikov (2007). This dimension it is measured by Locus of Control Test.

2.2.2 Practice and Application of Field Dependence/Independence Cognitive Style in Education.

In Education, Cognitive styles has been used not only in pedagogy but in assessment, designing curricular content, developing computer adaptive learning programs and even in predicting educational and vocational interests.

2.2.2.1 Field Dependence-Field Independence and Pedagogy

In Pedagogy, this dimension has been and continues to be instrumental student reinforcement during the process of learning in relation to cognitive styles, (Witkin et al 1997) demonstrated that field dependent learners are more likely to positively respond to externally motivated aspirations and reinforcements in comparison to field independent learners who tended to have their own self developed ambitions and reinforcement strategies.

Cognitive styles have also been considered when making pedagogical strategies for instance, Messick (1974) proposed the development of matching strategies to modify instruction to bridge the deficiencies in students. In particular he gave four matches

1. Remedial for equipping learners with missing skills.

2. Compensatory measures in which instructional approach avoids using of skills that the

learner lacks.

3. Capitalization to develop programs which enhance on strengths of students.

4. Deliberate mismatch of teacher and learners styles with the hope of making the learner flexible.

2.2.2.2 FDI and Students Learning

In Cognitive style measures have also been used to investigate students learning as elaborated by Witkin et al (1977), they used the Field Independent/Field Dependent dimension to find out how students learn. Field Dependent individuals in particular showed interest in and selectively focused their attention to social aspects of the surrounding, such individuals had an advantage in learning and remembering materials with social content than people who were more of Field Independent. Onyekuru (2015) concurs that Field-independent learners have a better academic achievement in science disciplines when compared to their field dependent counterparts while field dependent learners had a better mean in art disciplines.

Thornell (1994) contends that the sensitivity of the teachers in coping with cognitive style differences in individual learners has a significant influence on learning. Teachers with a deeper understanding of cognitive styles can provide multiple cognitive strategies and are able to find feasible cognitive strategies in terms of class time and effectiveness for both Field dependent and independent learners. Cognitive style differences are also used to determine the depth of instructional guidance required by both field dependent and independent learners. Martens (1975) prescribed that where possible, matching students' cognitive style with that of their learners may serve as a beneficial strategy to influence learning or learners may be put in circumstances where his/her style may be expanded with activities tailored to incorporate new elements to his/her style.

Letteri (1980) used a multidimensional approach which he called cognitive profile to identify learning deficits to accurately identify the specific dimensions of a persons' thinking and learning patterns that contributed significantly to their levels of academic achievement. He proceeded to propose that teachers or other professionals have an accurate report concerning where the particular deficit is and can focus their efforts in a more informed and efficient manner to address learning deficits.

2.2.2.3 Cognitive Styles and Assessment

In assessment, cognitive styles have been used for example Ghalib & Al-Hattami (2015) sought to find out performance of holistic versus analytic scoring rubrics in English writing. In trying to investigate variance between different raters, The ANOVA results revealed no substantive differences between three raters when analytical rubric was applied in grading learners' performance which significantly differed when the raters used a holistic rubric. Their findings were in congruence with those of Chi (2001).

Cognitive styles also affect test takers e.g. Lu & Suen (1995) analysed results on multiple choice questions versus performance based assessment on field independent and field dependent learners. Results showed that performance based assessments had a tendency to favour field independent learners. Additionally, Eleni (2004) investigated performance of learners in different formats of assessment versus their cognitive style, personal preferences, and intellectual development. Results from convergent/divergent pupils had a correlation with their outcomes in assessment especially where language was a major factor. However, in algorithmic-type of test items or in questions that required use of symbolic items and reduced use of wordings, the convergent/divergent characteristics were not related to pupils' performance. The short answer or open ended questions gave an advantage to divergent pupils

compared to objective questions since in short answer items pupils needed to articulate their thoughts, and divergent pupils were the ones with the ability to do it better.

2.2.4 Theoretical Perspectives

2.2.4.1 Cognitivists theory of Discovery Learning by Jerome Brunner.

Discovery learning theory is anchored on the belief that a learner constructs a new concept based on his/her preconceptions. Learning is viewed as an active process. Learning process includes selecting and transforming stimuli, making decisions, generation and testing of hypotheses, and developing new meaning from learning material and experiences. Bruner was inspired by works of Piaget in cognitive development in children. He contended that children as active problem-solvers with the ability to explore "difficult concepts". This was a different perspective from the views in education during that time.

Brunner gave key themes under discovery learning;

- Motivation, Culture and Personal factors moves an individual towards love for learning and that learning and problem solving are as a result of exploring the environment and the teachers role is to direct a learners spontaneous attempts towards learning.
- Knowledge would be grasped readily if it is organized in a manner that it allows a learner to absorb it easily. This is only for cases of individualised instruction since learners have different preferences.
- Understanding the structure of learning material makes the material easy to comprehend.
- Effective sequencing will be appropriate for any learner when material is sequenced in order of increasing difficulty.

Bruner focused more on categorizing information and constructing internal cognitive maps. He is of the belief that perception, conceptualization, learning, decision making, and making inferences all involve categorization. He recommended a coding system in which individuals form a hierarchies of related categories. Each successively higher level of category becoming more distinct.

Implications of discovery learning theory to learning include;

1. Instruction should be personalized based on learners pre dispositions to raise learner's interest towards learning.

2. Learning material should be organized in a manner that allows a learner to easily grasp it.

3. Sequencing of learning content is a vital aspect for presentation of learning content and requires to be done in a manner that allows learners to build understanding.

4. Reinforcements, rewards and punishments should be carefully chosen and paced.

2.2.4.2 Constructivists' Theory

According to (Bhattacharjee 2015) Constructivism as put forward by Jean Piaget posits that individuals construct new knowledge from their experiences and is internalized by learners through accommodation and assimilation. Assimilation refers to combining of new information into existing information without alteration to existing information. Assimilation may occur when new experiences are not understood or when new experiences are matched with their pre-existing mental models.

Accommodation is where a person encounters experiences that contradict their mental representations and change their perception to fit into their internal representations. It involves reframing mental models of their external environment to incorporate new material.

According to Bodner (1986) Child's day to day awareness of events are viewed as an ordered framework of ideas that are subjected to a common sense interpretations of their personal encounters with real world phenomena. Constructivist's theory places emphasis on a learners' personal construction of knowledge and the conceptions that they develop about natural phenomena. Hein (1991) concurs with (Bodner 1986) and (Bhattacharjee 2015) that an individual constructs the world by different ways and tests out his construction against his experiences and goes ahead to conclude that the interaction of learners' cognitive structures with physical events and phenomena is important to this approach (Bodner, 1986).

Hein (1991) proceeds by saying that the important act of developing meaning is mental and takes place in the mind. Physical activities and hands on experiences may be important for learning to occur, more so in young learners, but they are not enough; there is need to design tasks that requires use of both mind and hands.

Implications towards Teaching and Learning involves encouraging students to adopt active techniques such as experimenting, solving real-world problems in order to create more understanding, then reflect on and talking about the task they are performing and how their understanding has changed. The teacher's task is to make sure makes sure he/she has understood the students' pre-existing misconceptions then guides the learning activity to address them and build on them(Oliver, 2000).

2.2.5 Theoretical Framework of the study:

Rand J. Spiro's Cognitive Flexibility Theory

This study is based on 'Cognitive flexibility theory' which is of the view that a learner is the one who can easily restructure and apply Knowledge depending on the different situational

demands. For a learner execute this, He/she must understand a problem in its full complex form and review the problem multiple instances to analyse how a shift in variables changes the problem space. How well a learner is able to operate this way is dependent on concept representation and processes that work with mental representations. This theory views a successful learner as a "Cognitively Flexible" person who easily reorganizes and applies knowledge in a manner that the situation at hand demands.

Major concern for this theory is the transfer of learnt concepts from initial learning to a new unrelated context.

During initial learning, learners learn basic concepts and theories in a linear contexts but when advanced knowledge acquisition takes place, a nonlinear strategy is required to meet demands of an ill structured context from which the learning occurred. This means that learning material should be presented in different perspectives.

It is anchored on the belief that individuals have an ability to restructure knowledge as an adaptive reaction to varying situational demands. Spiro rejected the common perspective of constructivists, saying that it put too much emphasis on "the retrieving of organized bundles of information from memory". Spiro's view on constructivism was less rigid and suggested two aspects of a constructive process:

(1) Understanding is construction made by use of prior conceptions that goes deeper than the information presented; and

(2) Prior conceptions that are accessed are also constructed as opposed to being recalled in their intact form.
. Implications of this theory recommends that;

1. Various representations of learning material should be given to the learner in an interconnected manner rather than non-linear.

2. Oversimplification of learning material should be avoided to recognize the interconnections of ideas in advanced knowledge domains.

3. Multiple examples be given to show a variety of situations that a concept may be applied.

4. Presentation of real world contexts to allow learners to transfer concepts in dynamic situations.

5. Encourage construction of knowledge rather than transmission of knowledge to allow leaners to develop their own representations to enable them use it in different situations.

2.3 Conceptual Framework

Independent Variables

Cognitive Style

- Field Dependent
- Field Independent

Dependent Variables

Achievement in

1. English Language
2. Mathematics
3. Biological sciences
4. History
5. Mean Achievement

Outcomes

Influence of Field Dependent/ Field independent Cognitive Style on Achievement in;

1. English Language
2. Mathematics
3. Biological sciences
4. History
5. Mean achievement

Intervening Variables

- Gender
- Teachers Cognitive Style
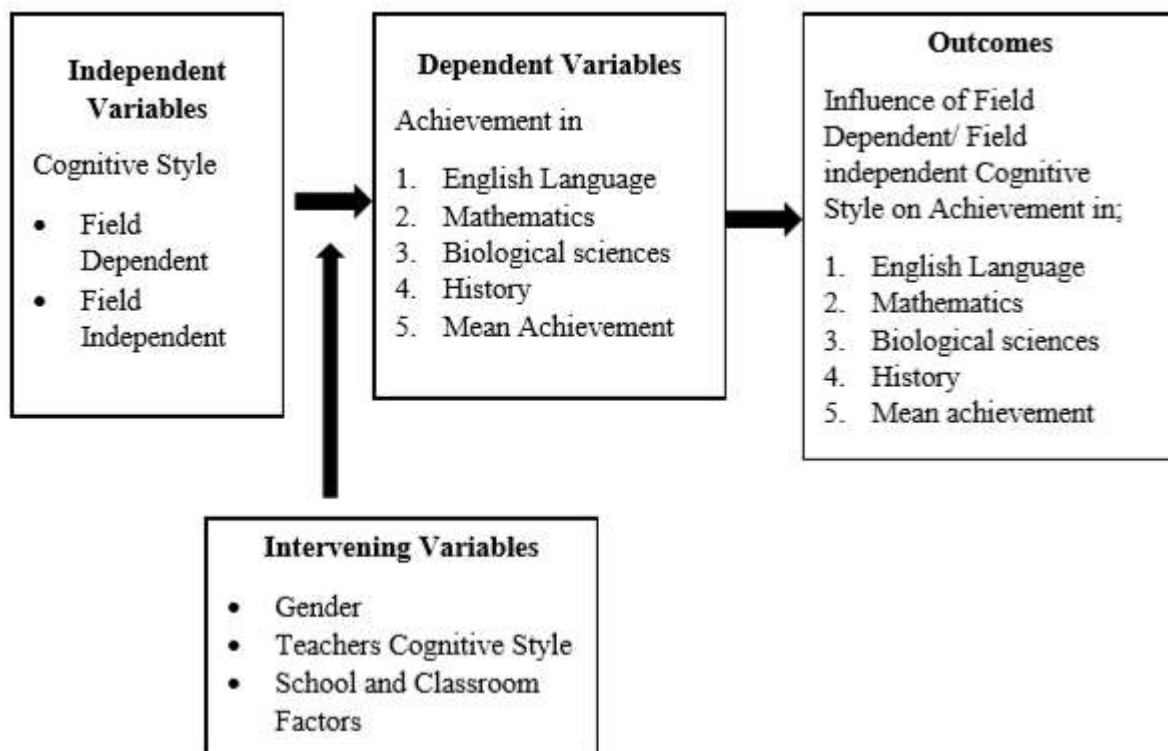- School and Classroom Factors

Figure 2.1: Conceptual Framework

CHAPTER THREE

3.0 METHODOLOGY

3.1 Context of the research

This study was be done in Nakuru County of the former Rift Valley Province in the republic of Kenya. Nakuru County is located in the south-rift region of the former Rift-Valley province. Nakuru County has schools classified as National, Extra-County, County and Sub-County schools with varied levels of infrastructure development and mean achievements in national exam results. A majority of the schools registers low performance in national examinations.

3.2 Research Design

This research employed a descriptive research design with a quantitative approach since the aim was to make counts of observations in an attempt to explain observations. According to (MacDonald & Headlam, 2008) a quantitative approach involves the use of making counts of observations in order to explain them.

It involved a survey on learning patterns that arise in the context of cognitive styles in relation to academic achievement In Mathematics, English, Biology and History and mean (overall) academic achievement i.e. Mean achievement. Orodho (2003) defines descriptive design as a process of obtaining data from interviews or administration of questionnaires to a subset of the population. Descriptive research design is suitable since it describes what happens to enable the research make conclusions based on objective knowledge obtained from the field.

3.3 Sample of the Study

The sample for this research was drawn from Public secondary schools in Kenya. Schools which posted a mean of 7 and above were selected due to homogeneity in grades of their students. A complete classroom of form three students was drawn from each of the four participating schools. A total of 100 girls and 100 boys from the sampled classes participated. The classrooms were be chosen randomly.

3.3.1 Population of the study

The sample for this research was drawn from Public secondary schools in Kenya. Public schools were favoured owing to uniformity of student admission. Students in form three from four schools that posted a mean of between 7 and 8 points based on results from 2018 Kenya Certificate of Secondary Schools Examinations. Form three students were chosen due to a higher stability on their exam scores compared to the lower classes.

3.3.2 Sampling Design

Random purposive sampling technique was used to select four Public schools owing to uniformity of student admission and homogeneity in student academic performance statistics. Students in form three from four high performing boarding schools based on results from 2018 Kenya Certificate of Secondary Schools Examinations. Form three students were chosen due to a higher stability on their exam scores compared to the lower classes. Purposive sampling of full homogenous classrooms that show a symmetric academic performance curve in their academic CAT scores. This is in congruence to recommendations of Munyoki & Mulwa (2012).

Table 3.1: Data Collection Instruments

	Objectives	Information Desired	Data collection Instrument	Data analysis Procedure
1	Determine what cognitive styles arise looking at FD and FI cognitive styles.	Students Cognitive Styles Scores from Group Embedded figures test. Scores will be used to group Students as Field Dependent or Field Independent.	Group Embedded Figures Test by Norman Reid(2016)	Frequencies and percentages
2	Determine the gender perspective and cognitive styles.	Students Personal Information on Gender.	Personal information section of the Group Embedded figures Test	Frequencies, percentages and independent samples t-Test
3	Determine patterns of learning regarding Field Dependent/Field independent arising from subject areas • Mathematics • English • Biological Sciences and • History	Percentage Scores of students' Academic Reports that will be generated from students CAT scores in the respective Disciplines.	Broadsheets of students' Scores in the four Disciplines from examination departments of Respective Schools.	Frequencies, percentages and independent samples t-Test

Table 3.1: Table of data collection Instruments and information desired in relation to Objectives.

This study used Group Embedded Figures Test (GEFT) by Norman Reid (2016) to identify and label students as field dependent or Field Independent. Students' scores from Continuous Assessment Tests (CAT) administered by their respective schools were also collected for analysis of their relationship with their respective cognitive styles.

GEFT consists 20 test items where simple geometric forms are hidden within progressively increasing complex geometric design. Each selected student received a booklet containing the 20 complex geometric designs, 25 minutes was the time allocated for the test. The test shall called upon students to trace an outline of the simple form located in complex form. Their responses were scored as one when respondents correctly located the figure and as zero when they failed to. Test score shall be the total number of figures correctly located.

The cut-off marks were classified as HIGH GEFT (HGEFT) with a score of 11-20, and LOW GEFT (LGEFT) 0-10. Students with scores of 10 and below 10 were labelled Field dependent while those who attain scores above 10 shall be considered field independent.

 GEFT was adopted since it is culture free and relatively easy to work with large classes. The Group Embedded Figure Test (GEFT) which is used all over the world is a standardized psychological test. It is adopted, culture free and standardize test therefore, and the GEFT was not subjected to validation.

3.4 Data collection Procedure

The GEFT was given to students in each of the sample schools by the researcher. The scripts were collected on the spot and scored after administration. The GEFT has two sections, personal information section and the Embedded Figures Test section. Students were to state their gender and admission number in the personal information section. The Embedded Figures Test section was used to separate learners as Field Dependent or Field Independent groups.

Alongside the GEFT, students' performance statistics in the four selected disciplines were obtained from their schools' examination departments. All the copies administered were collected on the spot. Continuous assessment exam scores were obtained from the respective examinations department of the respective schools.

3.5 Ethics consideration of the study

According to recommendations by Orodho (2009), the following ethical recommendations will were taken into consideration.

- The researcher informed the participants of the importance of this research then sought their voluntary consent to participate in the data collection process.

- Since it involves schools, permission from school administrators and teachers was also sought and granted.

- The researcher pledged by writing an assurance of confidentiality of information given by the respondents by substituting their names with codes to increase the degree of anonymity.

A preliminary meeting with teachers followed by students was done to establish a working relationship with participants.

3.6 Data Analysis Procedure

Participants were grouped into either Field Dependent or Field Independent cognitive Style using the Group Embedded Figures Test (GEFT) by Norman Reid (2016). GEFT is a Cognitive style Test Consisting of twenty tasks each representing a score of one. The cut off for Field dependent and field dependent will be 10. Students with a score of 10 or less were labelled as Field Dependent. Those with a score of 11 and above were labelled as Field Independent. Tables showing frequencies and percentages of participants in each Cognitive style was used to answer research Question 1.

For the second and third Research Questions, Hypotheses were developed and independent t-Tests were used to compare means and test the hypotheses. Using a computer software (SPSS)

the hypotheses were tested at α=0.05 to generalize findings from the data, using the t-test statistics. The independent t-test assesses whether means of two groups are statistically different from each other (MacDonald & Headlam, 2008).

Research question 2 tested the gender perspective versus Field Dependent/Field Independent cognitive styles. Independent samples t-Test was used to test the hypothesis and analysed data was presented in form of tables showing frequencies, percentages and t-Test results.

To test the Hypotheses under Research Question Three, Continuous Assessment Tests (CAT) scores in each subject and mean achievement of all participants. The CAT scores were the dependent variables for this study. The independent variable was the low and high GEFT scores representing Field Dependent and Field Independent students respectively. Independent samples t-Test was used to test the hypothesis and analysed data was presented in form of tables showing frequencies, percentages and t-Test results.

CHAPTER FOUR

RESEARCH RESULTS

4.1 Introduction

This study was on Cognitive styles in secondary schools in Kenya: Gender and selected Disciplines based on the objectives related;

a) To determine the cognitive styles that arise looking at Field Dependent/Independent cognitive styles.

b) To determine the gender perspective and Field Dependent/Independent Cognitive styles.

c) To determine patterns of learning with regard to Field Dependent/Field independent arising from learning Mathematics, English, Biological Sciences and History.

4.1.2 Response Rate

This research targeted public schools in Nakuru County in Kenya. The Group Embedded Figures Test (GEFT) data collection instruments were administered by the researcher to a total of 200 students spread over four schools. All GEFT questionnaires administered were collected on the spot. This gave a response rate of 100%.

Findings from the data collected are given below.

4.2. Results

4.2.1. Objective 1: To determine the cognitive styles that arise looking at Field Dependent/Independent cognitive styles

This objective sought to find out the cognitive styles of students from the sampled schools. Pursuant to this, all students who participated were presented with Norman Reid's (2016) GEFT. GEFT was used to group students into Field Dependent or Field Independent Cognitive Styles. The tests were marked and each student grouped into His/her respective Cognitive style. Students who scored from 0 to 10 were labelled as Field Dependent (FD) while students who scored from 11 to 20 were labelled as Field Independent (FI).The researcher first gives the

trends in each of the four schools that were sampled then later aggregates (total) data from the four schools. Results are shown below.

Table 4.2.1 1 Cognitive Styles patterns in sampled schools

School	Gender	Sample Size	Cognitive Style Frequencies			
			FD	FD Percentage	FI	FI Percentage
1	Female	N=58	33	56.8%	25	43.2%
2	Female	N=42	23	54.76%	19	45.24%
3	Male	N=48	25	52.08%	23	47.92%
4	Male	N=52	23	44.23%	29	55.77%
		Total=200	*Total*=104	*Average %* $\bar{x}$ *=52%*	*Total*=96	*Average %* $\bar{x}$ *=48%*

Table 4.2.1.1 above summarizes cognitive styles patterns derived from the four schools that the samples were drawn from. Schools 1 and 2 were girls' only schools while schools 3 and 4 were boys' only schools. Sample sizes drawn from each school accompanied by their percentages in each school sample. The overall totals and their averages for all the respondents who took part in the study are given in the last row. 52% of the participants appeared to be Field Dependent while 48% of the participants were Field Independent. This findings led the researcher to conclude that there are both Field Dependent and Field independent cognitive styles among learners in Kenyan secondary schools.

4.2.2 Objective 2:

To determine the gender perspective and Field Dependent/Independent Cognitive styles

This objective sought to find out FD/FI Cognitive Style Patterns in relation to Gender in Kenyan Schools. From Norman Reid's (2016) GEFT section on Personal Information, Student's Gender Information was extracted. Cognitive Style scores were also extracted from the same instrument of Data collection. The researcher first gives the trends in each of the four

schools that were sampled then later aggregates (total) data from the four schools. The conclusions were drawn from t-Test analysis on the aggregate statistics. The results are shown below.

Table 4.2.2 1: Cognitive Styles patterns in relation to gender

From the (table 4.2.2 1), majority (52%) all the students who participated Field Dependent. Their Field Independent counterparts were the minority with 46%.

School	Gender	Sample Size	Cognitive Style Frequencies		Percentages of cognitive style frequencies	
			FD	FI	FD	FI
1	Female	N=58	33	25	56.89	43.11
2	Female	N=42	23	19	54.76	45.24
3	Male	N=48	25	23	52.08	47.92
4	Male	N=52	23	29	44.23	55.77
		Total=200	*Total*=104	*Total*=96	*Average* $\bar{x}$ =52%	*Average* $\bar{x}$ =48%

Table 4.2.2 2: Percentages of Cognitive styles within gender

Gender	Females		Males	
Cognitive Style	Field Dependent	Field Independent	Field Dependent	Field Independent
Frequency	56	44	48	52
Percentage by Gender	56%	44%	48%	52%

From the results in (Table 4.2.2 2) it was evident that by a slight margin, a higher percentage of the males (52%) are of Field Independent while 48% of the males had Field Dependent Cognitive styles. For females, students having Field-dependent cognitive style were the majority (56%) while their Field Independent counterparts were the minority with (44%). In males, a slight majority of 52% were Field Independent, while a minority of 48% had Field Dependent cognitive style.

Students who are Field Dependent and Field Independent Cognitive Styles are present in Kenyan Schools. A significance test showing whether the means between Field dependent and Field Independent students in relation to Gender are significantly different is presented in table 4.2.2.3 below.

Table 4.2.2.3: Independent Samples t-Test for Cognitive Style Patterns in relation to Gender

Independent Samples t-Test For Cognitive Style Patterns in relation to Gender							
Cognitive style	N	Mean	Std. Dev.	Df.	t-cal	Sig	Conclusion
FI	92	$\bar{x} = 1.53$	5.02	198	0.850	0.396	No significant difference
FD	108	$\bar{x} = 1.47$	5.02				

Table 4.2.2 3 displays the t-test analysis for field independent and field dependent participants' in relation to Gender. It also displays a significance test on whether means of the two cognitive styles in relation to gender are statistically significant. The calculated t-Test value of 0.850 is less than the critical value of 1.972. For this reason the researcher rejects the alternate

hypothesis and accept the Null Hypothesis and conclude that: Gender has no influence on a person's Cognitive style.

4.2.3 Objective 3:

To determine Dependent-Field independent patterns arising from learning Mathematics, English, Biological Sciences and History

This objective sought to find out FD/FI Cognitive Style Patterns arising in relation to Performance in Selected subject areas and in Mean Achievement among Students in Kenyan Schools. Selected subject areas selected were English, Mathematics, Biological Sciences and History. Students' percentage scores in Continuous Assessment tests (CATS) were subjected to an independent t-Test in relation to FD/FI Cognitive Styles. Mean achievement was the Averages of each student's percentage scores in the four selected Disciplines. The hypotheses were subjected to a t-Test at a significance level of $\alpha=0.05$.

4.2.3.1 Hypothesis 2:

H_{02}: Patterns of learning regarding Cognitive Styles in English have no tendency towards Field Dependence versus Field Independence Cognitive style

Table 4.2.3.1.1 below displays the frequency distribution of FI and FD cognitive styles distribution in relation to gender and English language mean scores distribution in the four schools that were sampled.

Table 4.2.3.1.1: Cognitive Styles patterns in relation to English achievement in schools

School	Sample Size	Gender	Cognitive Style and English language Mean scores			
			FD $f=$	Mean Score	FI $f=$	Mean Score
1	58	Female	33	52.4%	25	54.56%
2	42	Female	23	54.87%	19	57.79%
3	48	Male	25	42%	23	45.57%
4	52	Male	23	57.74%	29	59.14%
	Total=200		Total=104	Average % $\bar{x}$ =51.91%	Total=96	Average % $\bar{x}$ =54%

Table 4.2.3.1.1 displays the frequency distribution of FI and FD cognitive styles distribution in relation to gender and English language mean scores distribution in the four schools that were sampled. From the overall sample of 200, 104 Field dependent learners had a mean score of 51.91% while 96 Field Independent learners had a mean score of 54% in English Language. Field Independent learners had a slightly higher mean score in comparison to Field Dependent learners.

To test whether the English language means between Field Dependent students and Field Independent students are significantly different, Table 4.2.3.1.2 below displays a t-test analysis on whether means of Field Dependent and Field Independent students are significantly different.

Table 4.2.3.1.2: t-Test analysis of Cognitive Styles Patterns in relation to English Performance

Independent Samples t-Test For English							
Cognitive style	N	Mean	Std. Dev.	Df.	t-cal	Sig	Conclusion
FI	92	$\bar{x} =54.00$	9.390	198	1.502	0.385	No significant difference
FD	108	$\bar{x} =51.91$	10.251				

Table 4.2.3.1.2 displays the t-test analysis for field independent and field dependent participants' in relation to achievement in English language. The calculated t-Test value of 1.502 is less than the critical value of 1.972. For this reason the researcher rejects the alternate hypothesis and accepts the Null Hypothesis then conclude that: Patterns of learning regarding Cognitive Styles in English have no tendency towards Field Dependence or Field Independence.

4.2.3.2 Hypothesis 3:

H_{03}: Patterns of learning regarding Cognitive Styles in Mathematics have a tendency towards Field Dependence versus Field Independent Cognitive Style

Table 4.2.3.2.1 below displays the frequency distribution of FI and FD cognitive styles distribution in relation to gender and Mathematics mean scores distribution in the four schools that were sampled.

Table 4.2.3.2 1: Cognitive Styles patterns in relation to Mathematics Performance in Schools

School	Sample Size	Gender	Cognitive Style and Mathematics Mean scores				
			FD *f=*	Mean Score	FI *f=*	Mean Score
1	58	Female	33	43.58%	25	51.6%
2	42	Female	23	33.09%	19	50.79%
3	48	Male	25	43%	23	54.13%
4	52	Male	23	37%	29	53.83%
	Total=200		**Total=104**	**Average %** $\bar{x}$ **=38.53%**	**Total=96**	**Average %** $\bar{x}$**= 51.37%**

Table 4.2.3.2.1 displays the frequency distribution of FI and FD cognitive styles distribution in relation to gender and Mathematics mean scores distribution in the four schools that were sampled. From the overall sample of 200, 104 Field dependent learners had a mean score of 38.53% while 96 Field Independent learners had a mean score of 51.37% in Mathematics. Field Independent learners had a higher mean score in comparison to Field Dependent learners. Table 4.2.3.2.2 below tests whether the two means are significantly different.

Table 4.2.3.2.2: t-Test analysis of Cognitive Styles Patterns in relation to Mathematics Performance

Independent Samples t-Test For Cognitive styles and Mathematics Achievement							
Cognitive style	**N**	**Mean**	**Std. Dev.**	**Df.**	**t-cal**	**Sig**	**Conclusion**
FI	92	$\bar{x}$ =51.37	15.73	198	1.972	5.498	Significant
FD	108	$\bar{x}$ =38.53	18.839				

Table 4.2.3.2.2 displays the independent t-Test analysis of Mathematics means between Field Dependent and Field independent learners. The calculated t-Test value of 5.498 is greater than the critical value of 1.972. This means there is a significant difference between means of Field Dependent and Field Independent learners. The researcher rejects the null hypothesis and accept the Alternate Hypothesis and conclude that: Patterns of learning regarding Cognitive Styles in Mathematics have a tendency towards Field Independence.

4.2.3.3 Hypothesis 4:

H$_{04}$: Patterns of learning regarding Cognitive Styles in Biological Sciences have a tendency towards Field Dependence

Table 4.2.3.2.1 below displays the frequency distribution of FI and FD cognitive styles distribution in relation to gender and Biological Sciences mean scores distribution in the four schools that were sampled.

Table 4.2.3.3 1: Cognitive Styles patterns in relation to Biological Sciences Performance in Schools

School	Sample Size	Gender	Cognitive Style and Biological Sciences Mean scores			
			FD $f=$	**Mean Score**	**FI** $f=$	**Mean Score**
1	58	Female	33	51.5%	25	59.04%
2	42	Female	23	38.39%	19	50.89%
3	48	Male	25	43.36%	23	52.61%
4	52	Male	23	46.57%	29	54.90
	Total=200		**Total=104**	**Average %** $\bar{x}=$ **44.96%**	**Total=96**	**Average %** $\bar{x}=$**54.31%**

Table 4.2.3.3.1 displays the distribution of FI and FD cognitive styles distribution in relation to gender biological sciences mean scores distribution in the four schools that were sampled. From the overall sample of 200, 104 Field dependent learners had a mean score of 44.96% while 96 Field Independent learners had a mean score of 54.31% in biological sciences. Field Independent learners had a higher mean score in comparison to Field Dependent learners.

Table 4.2.3.3.2 below tests whether the two means are significantly different.

Table 4.2.3.3 2: t-Test analysis of Cognitive Styles Patterns in relation to Biological Sciences Performance

Cognitive style	N	Mean	Std. Dev.	Df.	t-cal	Sig	Conclusion
FI	92	$\bar{x}=54.35$	11.945	198	1.972	5.231	Significant
FD	108	$\bar{x}=44.96$	13.447				

Table 4.2.3.3.2 displays the t-Test analysis of Biological Sciences means between Field dependent and Field independent learners. The calculated t-Test value of 5.231 is greater than the critical value of 1.972. For this reason the researcher rejects the null hypothesis and accept the Alternate Hypothesis and conclude that: Patterns of learning regarding Cognitive Styles in Biological Sciences have a tendency towards Field Independence.

4.2.3.4 Hypothesis 5:

H05: Patterns of learning regarding Cognitive Styles in History have no tendency towards Field Dependent versus Field Independent Cognitive Style.

Table 4.2.3.2.1 below displays the frequency distribution of FI and FD cognitive styles distribution in relation to gender and History mean scores distribution in the four schools that were sampled.

Table 4.2.3.4 1 Cognitive Styles patterns in relation to History Performance in School 1

School	Sample Size	Gender	Cognitive Style and History Mean scores			
			FD f=	Mean Score	FI f=	Mean Score
1	58	Female	33	61.45%	25	63.96%
2	42	Female	23	59.00%	19	61.54%
3	48	Male	25	61.71%	23	72.33%
4	52	Male	23	64.58%	29	63.65%
	Total=200		**Total=104**	**Average %** $\bar{x}$**=61.83%**	**Total=96**	**Average %** $\bar{x}$**=64.18%**

Table 4.2.3.4.1 displays the distribution of FI and FD cognitive styles distribution in relation to gender and History mean scores distribution in the four schools that were sampled. From the overall sample of 200, 104 Field dependent learners had a mean score of 61.83% while 96 Field Independent learners had a mean score of 64.18% in History. Field Independent

learners had a slightly higher mean score in comparison to Field Dependent learners. Table 4.2.3.4.2 below tests whether the two means are significantly different.

Table 4.2.3.4.2: Table 4.35: t-Test analysis of Cognitive Styles Patterns in relation to History Performance

Independent Samples t-Test For Cognitive Styles and Achievement in History							
Cognitive style	N	Mean	Std. Dev.	Df.	t-cal	Sig	Conclusion
FI	92	$\bar{x} =64.18$	12.221	198	1.115	0.165	No significant difference
FD	108	$\bar{x} =61.83$	13.929				

Table 4.2.3.4.2 displays the t-Test analysis of History means between Field dependent and Field independent learners. The calculated t-Test value of 0.165 is lower than the critical value of 1.115. This means there is no significant difference between means of Field Dependent and Field Independent learners. The researcher therefore rejects the null hypothesis and accept the Alternate Hypothesis to conclude that: Patterns of learning regarding Cognitive Styles in History have a tendency towards Field Independence.

4.2.3.5 Hypothesis 6:

H_{06}: In terms of Mean Achievement, the higher achievers have a tendency towards Field Dependent versus Field Independent Cognitive Style.

Table 4.2.3.5.1 below displays cognitive styles distributions among the sampled schools. The totals of each cognitive style are also given in the lower column.

Table 4.2.3.5.1: cognitive styles distributions among the sampled schools and totals for each cognitive style.

School	Gender	Sample Size	Cognitive style Frequencies	
			FD	FI
1	Female	**N=58**	33	25
2	Female	N=42	23	19
3	Male	N=48	25	23
4	Male	N=52	23	29
		Total=200	*Total*=104	*Total*=96

From table 4.2.3.5.1 above, sample sizes from sampled schools with their respective cognitive styles are given. From a total sample of 200, 104 respondents had Field Dependent cognitive style while 96 students had Field Independent cognitive style.

Table 4.2.3.5.1: cognitive styles distributions among the sampled schools and totals for each cognitive style.

In the table 4.2.3.5.2 below, the researcher calculates the mean achievement by adding the means for each subject with its respective cognitive style and dividing by the number of subject areas.

Table 4.2.3.5.2: mean achievement of Field dependent and Field Independent students

	Means by Cognitive Style	
	Field Dependent	Field Independent
English Mean	51.91%	54.00%
Mathematics Mean	38.53%	51.37%
Biological Sciences Mean	44.96%	54.35%
History Mean	61.89%	64.18%
Mean Achievement	$\bar{x}$ =**48.57%**	$\bar{x}$ =**55.62%**

Table 4.2.3.5.2 displays the mean achievement of Field dependent and Field Independent students. The mean achievement figure of $\bar{x}$ =48.57% for Field Dependent and $\bar{x}$ =55.62% for field Independent were arrived at by finding the average of their total scores in all four subjects for each cognitive style.

Table 4.2.3.2.2 below tests whether the Mean achievements between Field Independent and Field Dependent students are significantly different.

Table 4.2.3.5.2

Independent Samples t-Test For Cognitive Styles and Mean Achievement.							
Cognitive style	**N**	**Mean**	**Std. Dev.**	**Df.**	**t-cal**	**Sig**	**Decision**
FI	92	$\bar{x}$ =55.62	9.047	198	1.972	5.345	Significant
FD	108	$\bar{x}$ =48.57	9.542				

Table 4.2.3.5.3 displays the t-Test analysis of History means between Field dependent and Field independent learners. The calculated t-Test value of 5.345 is lower than the critical value of 1.972. This means there is a significant difference between mean Achievements of Field Dependent and Field Independent learners. For this reason the researcher rejects the null hypothesis and accept the Alternate Hypothesis and conclude that: Higher achievers have a tendency towards Field Independent Cognitive Style.

CHAPTER FIVE

DISCUSSIONS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Discussion

5.1.1 Cognitive styles that arise looking at Field Dependent/Independent cognitive styles

Findings from analysis of collected data reveal that Field dependent and Field Independent Cognitive styles are present among students in Kenyan secondary school. Further, findings showed that Field Dependent students were more though by a slight difference in percentage. The findings are in congruence with findings from other scholars such as Hassan (2002), Stenberg & Grigorenko (1997) and Witkin & Ash (1948) whose studies agree and concluded that cognitive styles are present and that they have an influence on nearly every aspect of our lives. The implication of this is that Educators need to be flexible to meet the deficiencies of students having different cognitive styles.

5.1.2 Gender perspective and Field Dependent/Independent Cognitive styles

Findings drawn from this study revealed that though by slight percentages, males have a tendency towards Field Independence while Females have a tendency towards Field dependence. However the tendencies are insignificant and just occurred by chance as confirmed by the t-Test analysis which led to the conclusion that Gender has no influence or tendencies towards a particular cognitive style.

The findings are in contrast with findings of Musya (2015) who concluded that male learners are field more Field dependent compared to Females who were more of field Dependent. This study's findings are also in contrast with findings of Jantan (2014) and Okoye (2016) and Onyekuru (2015) who concluded that males had a tendency towards Field Independence while females had a tendency towards Field dependence.

The implication of this finding is that though the slight disparity between boys and girls is insignificant, the Educators need to ensure equality in terms of opportunities to both boys and girls.

5.1.3 Patterns of learning regarding Field Dependent/Field independent arising from learning English, Mathematics, Biology and History

a) Patterns of learning regarding Field Dependent/Field independent arising from learning of English

Analysed data from this study reveal that though by a very slim difference, the means of Field Independent learners was greater compared to those of Field Independent students in all the four schools sampled. A t-Test analysis however found that slim mean to be statistically insignificant and that the slight means were due to a matter of chance. This led to the conclusion that Patterns of learning regarding Cognitive Styles in learning of English language have no tendency towards Field Dependence or Field Independence.

Findings from this study concur with those of Souzandehfar (2011) who investigated interaction between cognitive styles and gender on performance in second language speaking performance in English and found a negatively insignificant relationship in outcomes of field dependent and field independent respondents in relation to English speaking performance as a second language. Additionally, Al-Hajaya (2011) studied the interaction of cognitive styles and achievement in English. His study found no substantive disparity at α =0.05 between the means of analytic learners and global learners on the reading post-test results that could be ascribed to pedagogic strategies. However Findings from Noozari and Siamian (2015) are different from findings in this research which found Field Independent learners to be better in reading comprehension skills, English language learning as well as academic achievement compared to field dependent students.

Implication is that deeper research requires to be done especially into the topics under English language.

b) Patterns of learning regarding Field Dependent/Field independent arising from learning of Mathematics

Analysed data from this study reveal a huge difference in the means of Field Independent learners which was greater than those of Field Independent students in all the four schools sampled. A t-Test analysis of aggregated data for all the schools sampled found the huge difference in the means of Field Independent learners and Field Dependent learners to be statistically significant. These statistics lead to the conclusion that Patterns of learning regarding Field Dependent/Field independent arising from learning of Mathematics have a tendency to favour Field Independent Students.

Findings from Jantan (2014) whose study investigated the interaction between Cognitive Styles and performance in mathematics among boys and girls in sixth grade students. A low positive correlation between students' cognitive styles and performance in mathematics was reported. Additionally, Studies done by Ogun (2012), Hassan (2002), Umaru (2013) and Roberger & Flexer (1983) reported a higher mean achievement by Field independent students in most of the mathematical topics investigated.

This trend was further explained by Buriel (1978), who reported that mathematical operations requires execution of "disembedding procedures", that required separating values/numerals and their sub-elements and joining them into new totals. Witkin et al, (1977) also explained mathematics as a subject that required a higher aptitude in disembedding or restructuring competency and that Field Independent students were better in restructuring and disembedding. Implications for this objective is that the teachers need to be aware of their students' cognitive styles to be able to design individualised instruction to the field dependent group. Further teachers can make learners be aware of how they process information and teach their students

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on alternative ways they can process learning material. This is referred to as metacognitive teaching and will raise their performance in Mathematics.

c) Patterns of learning regarding Field Dependent/Field independent arising from learning of Biological Sciences

Analysed data from this study reveal a huge difference in the means of Field Independent students was greater in comparison to those of their Field Independent counterparts in all the four schools sampled. A t-Test analysis of aggregated data for all the schools sampled found the huge disparity in means of Field Independent learners in comparison to those of Field Dependent students to be statistically significant. These statistics lead to the conclusion that Patterns of learning regarding Field Dependent/Field independent arising from learning of Biological Sciences have a tendency to favour Field Independent Students.

In congruence, Muhammad et al (2015) determined the interaction of cognitive styles (Field dependence/Independence) and science performance in Male and Female learners of Biological Sciences and Integrated science. The study found a significantly substantial relationship between cognitive styles and academic performance. Results showed that Field independent learners had a higher correlation coefficient towards achievement in biology when compared to field dependent learners from both genders. Additionally, Walundari et al (2016), Sara, Maruta & Olarunoye (2016) and Onyekuru (2015) concur with findings from this study and Muhammad et al (2015) by concluding that there is a significant relationship between Field dependent and Field independent students and achievement in Biology.

This research findings are however in contrast with conclusions by Okoye (2016) concluded that cognitive styles had no significant interaction on achievement scores of students in biological sciences.

Implications for this objective is that the teachers need to be aware of their students' cognitive styles to be able to design individualised instruction to meet deficiencies of their field

dependent students. Further teachers can make learners be aware of how they process information and teach their students on alternative ways they can process learning material. This is referred to as metacognitive teaching and will raise their performance in Biological sciences.

d) Patterns of learning regarding Field Dependent/Field independent arising from learning of History

Analysed data from this study reveal mixed patterns looking at History learning with regard to trends shown in different schools sampled.

A t-Test analysis however found a slim difference means of Field Dependent and Field Independent students to be statistically insignificant and that the slim differences in means were due to a matter of chance. Furthermore History was an optional subject and only a section of the students sampled had their history score considered for this research. This led to the conclusion that Patterns of learning regarding Cognitive Styles in learning of English language have no tendency towards Field Dependence or Field Independence.

Results of this study show a different trend from those of Onyekuru (2015) and Ruble & Nakamura (1972). This trend of mixed results for cognitive styles in relation history was also noted by Tinajero & Paramo (1998) attributed the mixed result in cognitive styles and social sciences to difficulties in developing appropriate tests in social sciences and/or due to inadequate understanding of basic practices behind learning of art disciplines.

Implications for this trend is that deeper research requires to be done especially into the topics that make up social science disciplines. Further more appropriate tests and adequate understanding of basic practices behind learning of Art disciplines is required.

e) Patterns of learning regarding Field Dependent/Field independent in relation to mean achievement

Analysed data from this study reveal a huge difference between the Mean-achievement averages of Field Independent and Field Dependent students. Mean Achievement of Field Independent learners was greater in comparison those of Field Independent learners in all the four schools sampled. A t-Test analysis of aggregated data for all the schools sampled found the huge deviation in means of Field Independent learners and Field Dependent students to be statistically significant. These statistics lead to the conclusion that higher achievers have a tendency towards Field Dependence Cognitive Style.

This research's findings conforms to findings by Jolly (1980), Ahmadzade & Shojae (2013) and Musya (2015) that field independent students are better in learning and academic achievement when compared to Field dependent students. Ahmadzade & Shojae further contended that individuals having field independent style are more analytic, are intrinsically motivated to learn, do not respond to critics, do not get distracted by their environment, and assume a proactive position during learning. However, field dependent individuals tend to adopt a holistic mind-set towards learning, respond advantageously to extrinsic motivation, favour the learning of social material, respond to critics, are easily distracted by their environment, and show an inactive character during learning. Dubois and Cohen's (1970) research concurs with this hypothesis after finding significant complementary relationship between the field dependence-independence test and scores in overall mark in a university admission examination. Consistently (Witkin et al 1977) in their review explained that individuals who are Field Independent are likely to impose their analytic character to restructure the organization of a field, when given a field with a dominant organization. Field Dependent individuals on the other hand will tend to stick to the same format the field was presented to them.

Implications from this study include;

a) Teachers should be aware of their students' cognitive styles in order to meet deficiencies of their learners

b) Teachers need to make their learners aware of their cognitive styles and teach them alternative cognitive strategies to approach a particular task. This is referred to as metacognitive teaching.

c) Curriculums need to provide equal opportunities to students' of both cognitive styles.

5.2 Conclusion

 The researcher concluded that students' ways of collecting and processing information versus cognitive styles reflect both Field Dependent and Field Independent cognitive styles.

With respect to gender, this study revealed that gender of person has minimum influence on a person's cognitive style. Results in this study also revealed the following trends in learning of some selected disciplines offered in secondary schools in Kenya to the extent that,

Cognitive Styles have no significant influence when it comes to learning of English language and History. However, Cognitive Styles has a significant Influence in the learning of Mathematics and Biological Sciences.

5.4 Recommendations

This research recommended that

a) There is need to come up with more information on patterns of cognitive styles that arise in learners.

b) Teachers need to be made aware of cognitive styles in their teaching.

c) There is need for more research on cognitive styles specifically on Field dependent-Field Independent cognitive styles so as to establish the trends that arise in learners.

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APPENDICES

Appendix I: Letter of introduction to respondents.

Appendix II: Letter of introduction to schools.

Appendix III: permission to use GEFT questionnaire

Appendix IV: research permit

Appendix V: Group Embedded Figures Test Questionnaire

APPENDIX 1: LETTER OF INRODUCTION TO RESPONDENTS

Dear student,

RE: THE IMPACT OF COGNITIVE STYLES ON ACADEMIC ACHIEVEMENT IN

I am a post graduate student at the University of Nairobi pursuing a Master of Education degree in Measurement and Evaluation conducting a research on the above topic.

I am kindly requesting you to respond to the questionnaire schedule attached as honestly as possible. The information is required for academic reason only and will be treated with utmost confidentiality. Do not put your name or any other form of identification on the questionnaire.

I look forward to your honest participation.

Thank you for accepting to participate.

APPENDIX II: LETTER OF INTRODUCTION TO SCHOOLS

Jusper Mboya Oginga

University of Nairobi

Department of Psychology

Box 30197

Nairobi.

To

The Head teacher

--- Secondary school

Dear sir/madam

RE: PERMISSION TO CONDUCT RESEARCH AT THE SCHOOL

I am a post graduate student at the University of Nairobi pursuing a Master of Education degree in Measurement and Evaluation conducting a research on the topic "Impact of cognitive styles on academic achievement in chemistry"

I am therefore requesting you to allow me to visit your school and collect the required data. The information collected will be treated with utmost confidentiality and will only be used for the purposes of research.

Thank you in advance for cooperation.

Yours faithfully

Jusper Mboya Oginga.

University Of Nairobi

APPENDIX III: PERMISSION TO USE GEFT QUESTIONNAIRE
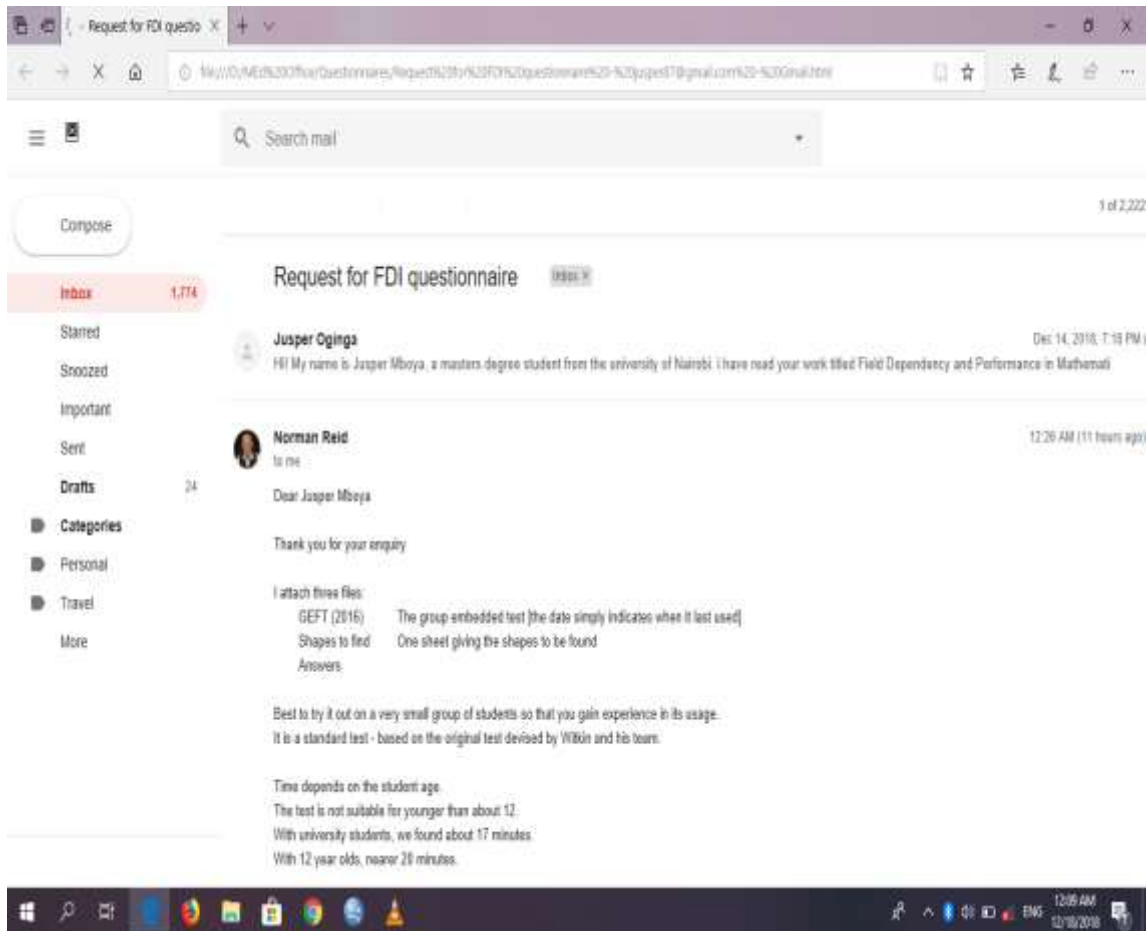
APPENDIX IV: RESEARCH PERMIT

NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY & INNOVATION

AC 1564

OFFICIAL RECEIPT

Station:	Nairobi	**Date:**	07/Oct/2019
Received from:		Jusper Mboya Oginga	
Shillings:		*** One Thousand only ***	
On Account of		Research Permit Fees ref 0000-0002-8570-1417	
Vote Head		R-43	

USD	
Kshs	1,000
AC	
NO	

Item	A-1-A
Cash/Cheque No	MPESAExpress

APPENDIX V: GROUP EMBEDDED FIGURES TEST QUESTIONNAIRE

Group Embedded Figure Test

Shape recognition within complex patterns

This test seeks to find your ability in recognising shapes in complex patterns.
The results of the test will NOT affect your course assessment in any way.

Enjoy the challenge and do your very best.

The total time allowed is limited and you may not finish in this time.

About yourself

Your Name: .... Your class: ....

Are you: ☐ Boy ☐ Girl

Instructions

This is a test of your ability to find a simple form when it is hidden within a complex pattern.

Here is a simple example.
Can you find this triangle in the shape below?
Shade it in.

Triangle
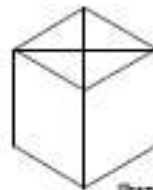
Shape

Now Turn Over

Did you spot the right answer ?

The triangle must be the same shape and facing the same way.

Here is another one.
Look at this diamond shape in the diagram below

Trace the diamond shape hidden in the diagram below using a pencil or pen.

Did you get it right ?

On the following pages, there are 20 puzzles like this.

Each puzzle will have a letter underneath.

You will be given a sheet with the shapes to find and these are labelled by letters.

(1) Do the puzzles in order. However, if you are completely stuck, move to the next puzzle.

(2) Trace only ONE shape in each puzzle.

(3) The shapes you are to find in the puzzles are the SAME SIZE, the SAME PROPORTIONS, and FACING IN THE SAME DIRECTION as they appear on the sheet showing all the shapes.

DO NOT TURN OVER

DO NOT START UNTIL YOU ARE TOLD TO DO SO

Page 3

83
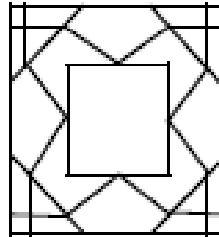
Find Shape B

Find Shape D
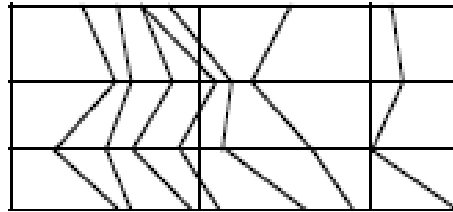
Find Shape H
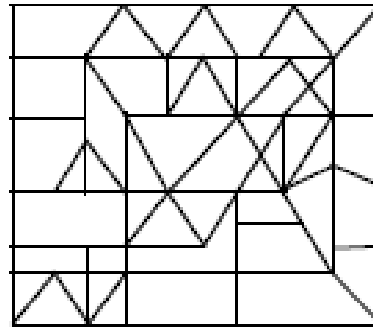
Turn Over

Find Shape E
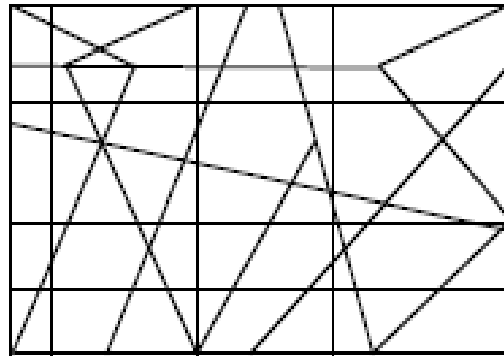
Find Shape F

Find Shape A
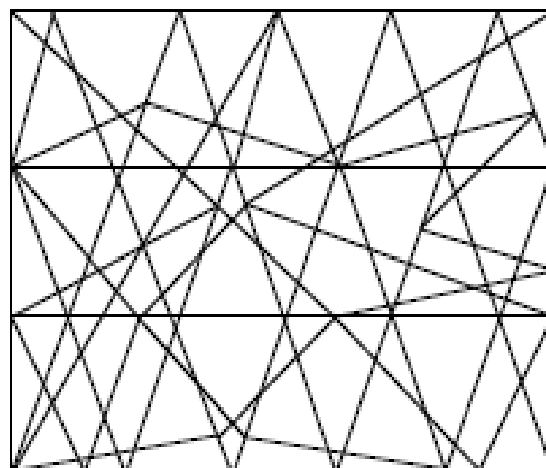
Find Shape E

Find Shape H
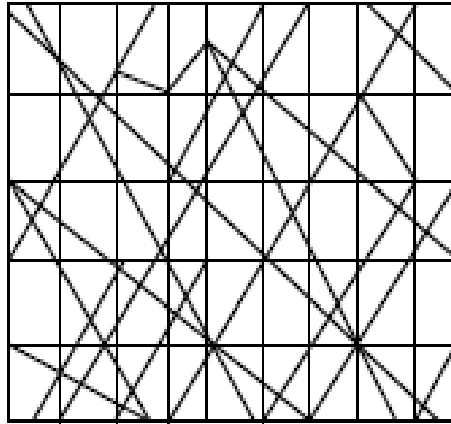
Find Shape D
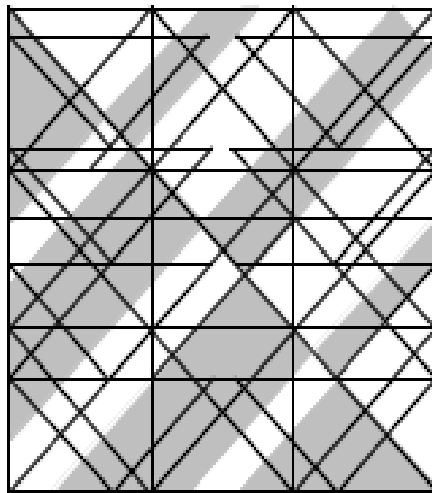
Turn Over

Find Shape G
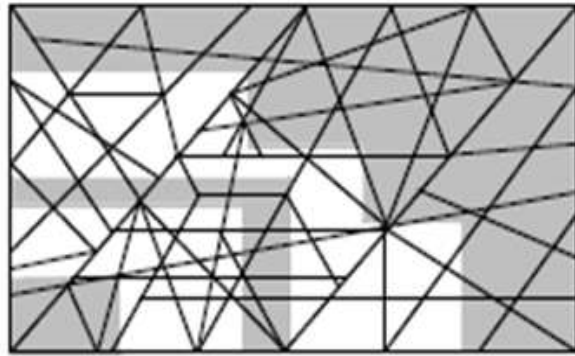
Find Shape C
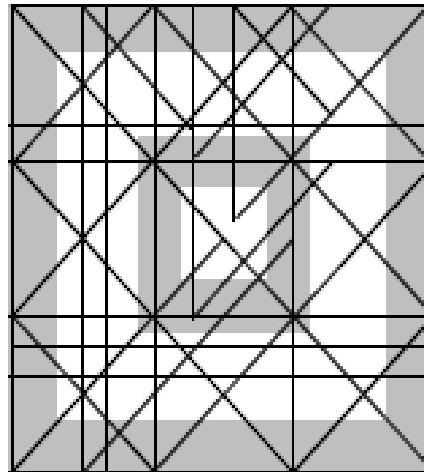
Find Shape B

87
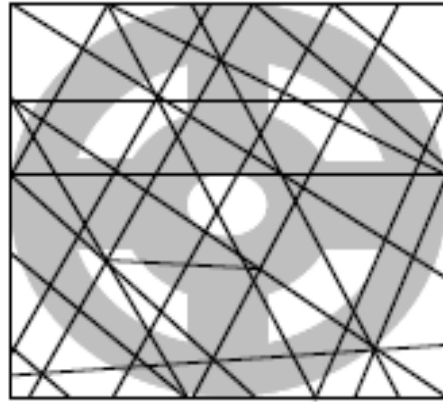
Find Shape G

Find Shape H
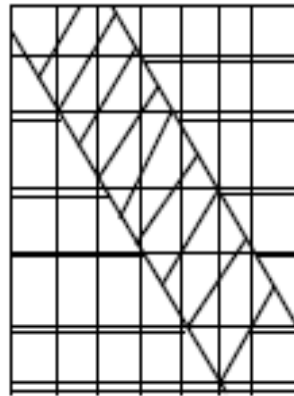
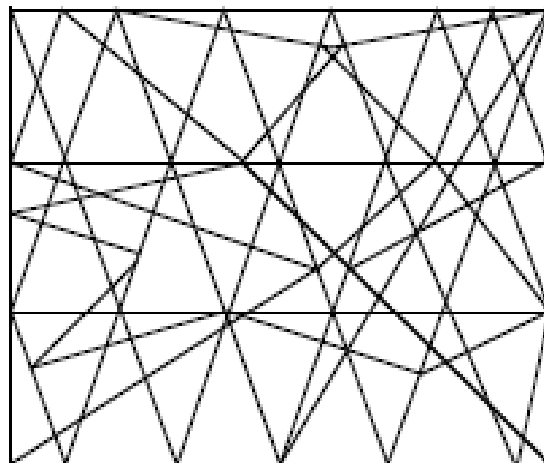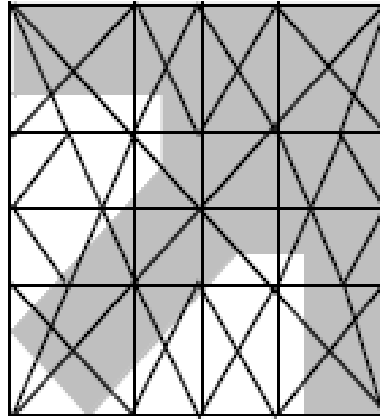Find Shape C
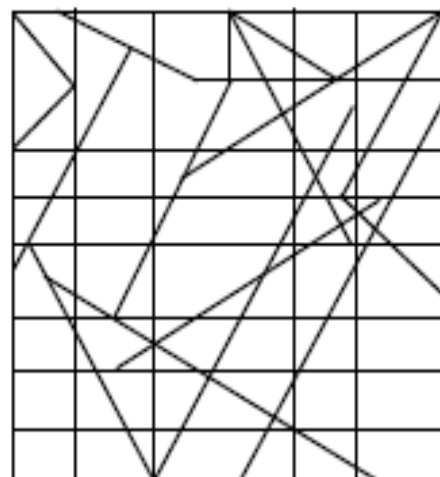
Turn Over

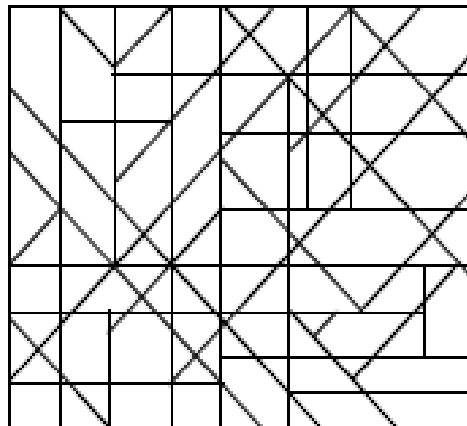Find Shape B
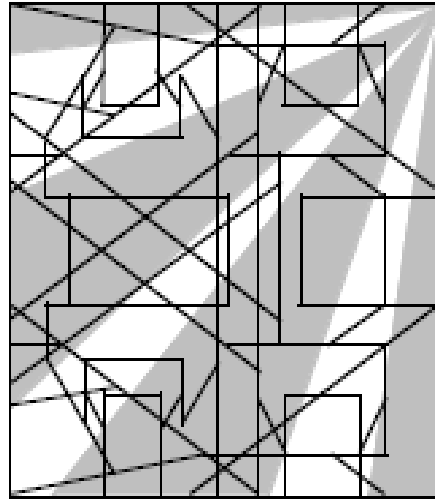
Find Shape D

Find Shape A

Turn Over

Find Shape E
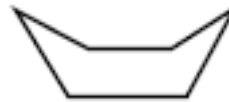

Find Shape F

End of Test

Shapes to Find

Shape A

Shape B

Shape C

Shape D

Shape E

Shape F

Shape G

Shape H