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Influence Of Cognitive Styles On Technical Drawing Students' Achievements In Senior Secondary School In Federal Capital Territory, Abuja

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Abstract

There are different cognitive strategies for processing information which in turn influence students' academic achievement. This paper reports an investigation of cognitive styles and achievement scores of secondary school students. In the study, the standardised Group Embedded Figures Test was used to determine the influence of student's cognitive styles on Technical Drawing students' achievement in Senior Secondary Schools in Federal Capital Territory (FCT), Abuja. A research question and null hypothesis tested at 0.05 level of significance guided the study. The design of the study was a causal comparative or (expost-facto) design. The sample for the study consisted of 87 Senior Secondary School Two (SSSII) Technical Drawing students drawn from the three sampled schools in three Area Councils of FCT. The students were categorized into three groups based on Group embedded figure test (GEFT). The instrument used for data collection was Technical Drawing Achievement test (TDAT). The instrument was face and content validated by three Technical Drawing Lecturers and two experts in Measurement and Evaluation. The reliability coefficient of Basic Electricity Achievement Test (BEAT) was established using Kuder- Richardson formula 20 (K-R20) and this yielded an index of 0.69. Data were analyzed with mean, standard deviation and analysis of variance (ANOVA). Results of the study revealed that cognitive style significantly influenced students' achievements in Technical Drawing. Recommendations made among others were that students' cognitive styles be adopted for effective teaching of Technical Drawing in Secondary Schools.

Keywords

cognitive styles, technical drawing, achievement and group embedded figure test

Introduction

Nigeria is moving through an era of development in gearing towards becoming a developed nation. As part of its effort, education is indeed considered as a vital aspect in achieving the goal. The National Policy on Education clearly states that individual potential development should be emphasized throughout the learning process. Education in Nigeria is an on-going effort towards developing the potential of individuals in appropriate skills, mental, physical and social abilities and competencies to empower the individual to live and contribute positively to the society. Such an effort is designed to inculcate in Nigerian citizens respect for the worth and dignity of the individual, faith in human's ability to make rational decisions, moral and spiritual principles in inter-personal relations, shared responsibility for the common good of human, promotion of the physical, emotional and development of all children and acquisition of functional skills and competencies for self- reliance (Federal Government of Nigeria, 2013).

Based on this philosophy, individuals' development must be addressed. It also can be clearly seen that the objective of Nigerian National Policy on science, technology and innovation, is to produce students who can initiate, support and strengthen strategic bilateral and multilateral co-operations in scientific, technological and innovation activities across all sectors of the economy (Federal Republic of Nigeria, 2012). Thus, to produce such individuals, students should not only be science and technology literate but be able to think critically and creatively as well.

In this research, focus will be on the difference in cognitive styles among Technical Drawing students. The implication of this is that educators should always be aware of their significant roles to ensure the national aspirations are achieved. Thus, the focus and objectives of teaching and learning should be on the development of the students' potential. Cognitive abilities for instance, have a significant impact on the way teaching and learning processes are conducted. Students with high cognitive ability are assumed to be able to engage in learning, especially in a highly skill tasks. Therefore, their cognitive development should be emphasized in terms of enabling them to do specific tasks, such as problem solving, creative and innovative thinking.

Cognitive style is a psychological construct which is concerned with how an individual learns, thinks, solve problems, remembers and relates to others (Hall, 2000). Cognitive style is an individual characteristic mode of perceiving, and processing information in the environment (Governor, 1998). An individual is either Field-independent (Fl) or Field- dependent (FD) (Witkin, 1977; Hall, 2000). A Field independent (Fl) cognitive style learner is described as analytic, competitive, individualistic, task-oriented, internally referent, intrinsically motivated (self-study), self-structuring, detail oriented and visually perceptive, prefers individual project work and has poor social skills, while a field dependent (FD) cognitive style learner is described as global (holistic), group-oriented sensitive to social interactions and criticisms, externally motivated, externally referential, not visually perceptive, a non-verbal and passive learner who prefers external information and group projects (Hall, 2000).

Cognitive processing styles affect how one stores knowledge and retrieves it, when it is needed (Tinajero and Paramo, 2000). The students' cognitive styles may hinder or facilitate the acquisition of knowledge in science and technology subjects (Okwo and Otuba, 2007). There is a need to investigate how students' cognitive styles may influence achievement in Technical Drawing. This is because the knowledge of student cognitive style is very useful in teaching him or her (Bahar and Hansell, 2000). Students' learning outcome in a subject is associated with their cognitive styles. This helps to measure teacher effectiveness and learning outcome (Kalu, 2004).

The performance of students with different cognitive styles in a given tasks will determine how effective the teacher is in delivering instruction that are related to the tasks and whether the objective of the learning is achieved or not.

Studies have shown that thinking skills are related to the students' cognitive styles and thus, will affect their achievement in learning (Hall, 2000; Okwo and Otuba, 2007). Teachers should therefore identify their students' cognitive styles so as to improvise their teaching technique to match the students' cognitive styles. In the study presented here are of cognitive styles, whether it has a significant impact on the students' learning styles and their thinking ability. It is necessary then to determine whether the students' cognitive processing styles affect their achievement in Technical Drawing. The result will enable the researcher to determine whether the use of students' cognitive styles could improve their achievement in Technical Drawing. Therefore, this study is aimed at investigating the influence of students' cognitive styles on achievement in Technical Drawing in senior secondary schools in Federal Capital Territory, Abuja.

Statement of the Problem

Technical Drawing is a popular science and technology subject offered by both science and technology oriented students in Senior Secondary School Certificate Examination (SSSCE). Students continue to enroll yearly in SSCE Technical drawing, but each year students achieve poorly in the examination. Literature has however revealed that students' underachievement in science and technology subjects such as Technical Drawing is linked to the inability of the students to think properly and also the inability of teachers to assist students to think when faced with problems in technical drawing and solve the problems. The persistent poor performance coupled with poor classroom practices has resulted in few students choosing Technical drawing related courses as career. The yearly poor performance in Technical Drawing has therefore created an educational gap of students not continuing their studies in Technical Drawing at tertiary level. This gap can be filled by devising a more effective strategy for improving the situation in order to meet the needs of the students and the society at large. It is therefore certain that without using an effective remedial strategy, Technical Drawing teaching and learning may continue to be poor in our schools.

In view of this situation, adequate knowledge of students' cognitive styles may be useful in teaching Technical Drawing in order to improve the students' poor performance in the subject. The problem of this study posed as a question therefore is: What influence do students' cognitive styles have on their achievement in Technical Drawing in Senior Secondary Schools in Federal Capital Territory (FCT)?

Methodology

Design of the Study

The study was a causal comparative or (expost facto) design, where the independent variables among subjects cannot be manipulated or controlled. The subjects are studied in the natural settings without any behaviour modifications introduced by the researcher.

Population and Sample of the Study

The population of the study consisted of all Senior Secondary School two (SSSII) Technical Drawing students numbering 148 students in government-owned secondary schools in Gwagwalada, Abaji and Kwali Area Council of FCT (Education Resource Centre, 2015). The sample of the study consisted of 87 Senior Secondary School Two (SSSII) Technical Drawing students drawn from the three sampled schools in Gwagwalada, Abaji and Kwali Area Councils of FCT through simple random sampling technique. One intact Technical Drawing class of SSSII was randomly drawn from each school. The three sampled schools were assessed each with Group Embedded Figure Test (GEFT).

Instrument for Data Collection

The Technical Drawing Achievement Test (TDAT), constructed by the researcher, was the only instrument used for data collection in this study. TDAT is a multiple-choice objective test. Each item has 5 options lettered A — E. The test was based on the units of study in SSSII Technical Drawing curriculum used for the study. The researcher initially constructed 100 multiple-choice items before face validation. The items measured the six objectives in the cognitive domain of Bloom's taxonomy of educational objectives. A table of specification was used in constructing the TDAT objectives items. The weighting for the objective levels were based on the proportion of the low and high order performance objectives in the unit of study. The TDAT, which was constructed by the researcher, was validated by three Technical Drawing Lecturers from Department of Industrial and Technology Education, Federal University of Technology Minna and two Technical Drawing Teachers from Government Secondary School Minna, all in Niger State. The face validation involved checking the items of the instruments for arrangement and logical sequence. Based on the experts' suggestions, a revision was carried out on the instruments. The items that remained after face validation were trial-tested on 20 students in a Senior Secondary School outside the area of the study. The result of the trial-testing was used for item analysis. The item difficulty and discriminations indices, were calculated for each item, consideration for including an item in the final version of TDAT was based on the item satisfying the psychometric qualities of having:

(i) An item difficulty facility level of between 0.30 and 0.70 and

(ii) Any item that the discrimination index falls within +0.30 and +1.0 were selected.

At the end of the analysis, 40 multiple items were selected and other items were dropped because they did not fall within the required range.

The TDAT reliability coefficient was determined with Kuder-Richardson 20 (K — R20) methods. The reliability index was found to be 0.69. The TDAT items being dichotomously scored meant that the K-20 method used was, appropriate. The high scores 0.69 signifies a large degree of coherence in interpretation and answers by the students. Any correct answer in TDAT was awarded one mark, giving a maximum of 40 marks. The total score of each student was calculated and recorded.

Training Programme of Research Assistant

The researcher briefly trained two research assistants for two hours each day for three days on the concepts of cognitive styles. The research assistants were taught how to make use of Group embedded figure test (GEFT) to classify learners into different categories of learning. The relevance was to assist in meeting the learners' needs during teaching/learning processes. They were also taught the various categorizations using a Group Embedded Figure Test (GEFT) into Field-dependent (FD3), Field Intermediate (FInt) and Field-independent (FI). The need to use a categorization test in teaching/learning situation was emphasized.

Categorization Procedure or Grouping

The group embedded figure test (GEFT) developed by Witkin, Oltman, Raskin & Karp (1971) was adopted and used for categorising students into FD, FInt and FI. The test is used to test the ability of students to find a simple form when it is hidden within a complex pattern. GEFT consists of simple forms of large complex figures (i.e extracting the embedded figure from a field figure). The test instrument consists of three sections within 25 items. The first section was given for practice purposes and included 7 items. Both the second and third sections contained 9 items each. The second and third sections of the GEFT, which are complex figures, contained ten items each for scoring. The simple figures (each identified by a letter) and cannot be viewed at the same time as the complex design. The GEFT has a score range of 0 to 18, a student that scored 0 to 6 was classified as Field-dependent (FD) while 7 to 12 was classified as Field Intermediate (FInt) and 13 to 18 was classified as Field-independent (FI) cognitive style. This took a total of 40 minutes to be solved. The GEFT provides a guideline to categorize learners into different types of cognitive styles. During the administration of the GEFT, the exact procedures set out in the technical manual (Witkin, et al., 1971) regarding time limits and directions were closely followed.

Finally, the TDAT instrument was administered to each of the students in the sampled schools. The scripts from students were marked and recorded using the marking guide. The scores collected were used for data analysis.

Method of Data Analysis

The research question was answered with mean and standard deviation. While Analysis of Variance (ANOVA) was used to test the null hypothesis at 0.05 level of significance, ANOVA was used to determine whether there is any significant different between two or more mean at a selected probability. To determine the direction of the difference for significant mean, post-hoc multiple comparison tests were conducted, using the Scheffe method. This provided a guideline to identify different type of cognitive styles in a classroom.

Results and Discussion

The results of this study are presented in accordance with the research question and hypothesis that guided the study.

Research Question

What is the influence of students’ cognitive styles on the mean achievement scores in Technical Drawing?

Table 1: Mean Achievement scores and Standard Deviation of Students’ Cognitive Styles in Technical Drawing.

Groups	Students’ Cognitive Styles	N	Mean	Standard deviation
COG Style 1	Field Dependent (FD)	22	22.51	6.80
COG Style 2	Field Intermediate (FInt)	29	24.50	5.94
COG Style 3	Field Independent (FI)	36	27.19	6.04
	Total	**87**		

Data on table 1 reveals that field independent (FI) students had the highest mean score of 26.18, followed by students with field intermediate (FInt) cognitive style which has mean achievement score of 24.50. The students with field dependent (FD) cognitive style had the lowest mean achievement scores of 22.51. With this result, students with field independent (FI) cognitive style achieved more in Technical drawing than any other cognitive style. The standard deviation also revealed that the student scores are not far from the mean.

The relative effectiveness of students’ cognitive styles influencing mean achievement scores in Technical Drawing could be due to the personality characteristics associated with field-dependent (FD) and field independent (FI) characteristics that are quite different. Cognitive style is an individual characteristic mode of perceiving, organizing information and using the acquired knowledge (Brenner, 1997). Luk (1998), added that cognitive style reflects an individual’s preferred way of actively processing, and transforming information, categorizing new knowledge, and integrating it within the memory structure. This result is in line with the finding of Hall (2000) that reported field-independent individuals as self-reliant, unaware of social stimulus value, inner-directed and individualist. They have a greater aptitude for cognitive restructuring and functioning autonomously (Tinajero and Paramo, 1998). The field-independent learners set goals for themselves, relying on intrinsic reinforcement to devise their own strategies for learning (Raynor and Riding 1997). This makes their achievement scores differ significantly to others.

On the other hand, field independent individuals have a greater aptitude for interpersonal skills (Raynor and Riding, 1997). They also have the tendency to relate well with others and are often characterized as warm, affective, and accommodating (Tinajero and Paramo, 1998). However, Hall (2000) observed field-dependent individuals as socially dependent, eager to make a good impression, conforming and sensitive to the social surroundings. These qualities cause Field-dependent learners to prefer to work in small groups and have stated goals and structured activities. As a result of interaction with peers and teachers, field-dependent learners receive extrinsic reinforcement which influences their learning experiences (Raynor and Riding, 1997). These personality traits may have made their mean achievement scores in Technical Drawing to differ significantly. This result is also in line with Richardson and Turner (2000) findings, that reported differences in the approaches taken by field-independent and field-dependent individuals in selective encoding (which involves sifting out relevant from irrelevant information), selecting compiling (which is the task of compiling new knowledge with the aim to create an integrated whole) and selecting comparing (which takes new knowledge and relates it to the "old knowledge to form a connected whole"). These differences in approaches lead to qualitative and quantitative differences in their preferences for choosing certain cues and ignoring others (Richardson & Turner, 2000).

Besides, field-independent learners have a greater ability to structure information, solve problems and think reflectively on concept cues (Brenner, 1997). They tend to have greater intellectual curiosity as they express desires to investigate new ideas and seek for additional information (Raynor and Riding, 1997). All these qualities may cause their mean achievement scores to differ significantly from others. Field-independent subjects tend to be better at analytic activities. They can solve complex problems, recall information, isolate facts and separate the relevant from the irrelevant (Felder, 1993). They can perceive an item as discrete from its background, and impose structure when it is lacking content, quickly and accurately (Richardson and Turner, 2000; Tinajero and Paramo, 1998). This may be the reason why they performed better than other groups. However, field-dependent learners, tend to be global or wholistic in the analysis of learning situations. They have difficulty in breaking information into isolated parts (Tinajero, and Paramo, 1998; Rayner and Riding, 1997). They cannot perceive or have difficulty in an item as discrete from its background nor can they impose structure when it is lacking in content (Richards, Sullivan and Gillespie, 1997). The field- dependent learners may prefer more direct instruction or definition of the material in situation that involve restructuring abilities (Kahtz and Kling, 1999).

Pithers (2002) reported that field dependent individuals were more strongly influenced by the immediate social context and more inclined to attend to and learn about social aspects of their environments. They seem to be incidental learners in social contexts and have difficulty in initiating a task. (Richardson and Turner, 2000). Incidental learning is unintentional or unplanned learning that results from other activities. It can happen through observation, repetition, social interaction, and problem solving from implicit meanings in classroom or workplace policies or expectations by watching or talking to colleagues or a teacher about tasks (Cahoon 1995; Rogers1997; Leroux and Lafleur 1995) This natural way of learning (Rogers 1997) has characteristics of what is considered most effective in formal learning situations: it is situated, contextual, and social. Initiation is the ability to begin a given task without undue procrastination, in a timely way. A student that has difficulty in using initiation does not easily know how to get started on a task and sustaining the attention and effort levels needed to complete the task. The student often 'just often sits there' when the other students have started working, often the student can complete the task successfully, once they get going. This finding is in agreement with that of Hall, 2000, Richardson and Turner, 2000.

Hypothesis

HO_1: Cognitive styles have no significance influence on the mean achievement scores of students in Technical Drawing.

To test this hypothesis a one-way Analysis of Variance was done.

Table 2: One-way Analysis of Variance (ANOVA) on Mean Achievement Scores of Students' Cognitive Styles in Technical Drawing

Source	Df	Sum of Squares	Mean Squares	F	Sig	Decision
Between Groups	2	1027.8763	513.9383	13.2188	.0000	S
Within Groups	85	10186.3878	38.8793			
Total	**87**	**11214.2642**				

The Data presented in table 2 reveals that the mean achievement scores of students' cognitive styles in Technical Drawing differed significantly from each other. This is shown by the calculated F-value of 13.2188, which is significant at .0000, but is not significant at 0.05 level of probability. Therefore, the null hypothesis of no significant influence of students' cognitive styles on mean achievement scores in Technical Drawing is rejected. This suggests that there is a significant influence of students' cognitive styles on mean achievement scores in Technical Drawing.

To find out the direction of difference a Scheffe post hoc multiple comparison test between two means, at 0.05 level of significance was carried out and presented in table 3.

Table 3: Scheffe Post-hoc multiple Comparison test between two mean scores of Students' Cognitive Styles at 0.05 Level of Significance.

The differences between two means is significant if Mean (1) — Mean (3) > = 2.3745 *RANGE *

Group	Mean	Mean Score comparison	Mean Score difference	Range	Decision
1	22.51	1 and 2	1.99		Not Significantly Different
2*	24.50	1 and 3	4.68	> = 2.3745	Significantly Different
3*	27.19	2 and 3	2.69		Significantly Different

(*) indicates group significant difference at 0.05 level of significance.

The result as shown in table 3 revealed that students' mean achievement scores in each cognitive style group differed significantly from each other. The field-independent (FI) group 3, performed better than field intermediate (FInt) group 2 with a mean score difference of 2.69, and the Field intermediate group 2, performed better than field dependent (FD) group 1 with a mean difference of 4.68 in Technical Drawing achievement test. Therefore, cognitive styles had a significant influence on students' mean achievement scores in Technical Drawing.

The finding that students' mean achievements scores in Technical Drawing were significantly influenced by students' cognitive styles is in agreement with the findings of Bahar and Hansel (2000), that field-independent students could readily sort "signal" (relevant) information from "noise" (incidental) information. Also, those field-independent students have a higher working memory capacity than those who are field-dependent. The result also agrees with Achor, (2001) and Anyigbo (2004) that the three groups of cognitive styles significantly differed in academic achievement in physics.

However, the finding does not support the study of Ahiakwo, (2000) that found no significant difference in the achievement of both field-dependent and field-independent on problem-solving ability in chemistry. The result is in agreement with Okwo and Iliya (2006) that the effect of modes of Pictorial adjusts and cognitive styles were significant with field- independent learners performing better in a Technical Drawing objective test than the field-dependent ones. Thus, the Busari (1998) study conforms with the finding that there is a moderate relationship between the performance of field independent and field-dependent learners in chemistry. As a result of the relationships in the findings of other studies which were used as support to the finding of this study, the finding that cognitive styles significantly influenced students' academic achievement in Technical Drawing is not misleading.

Conclusion

From the results of this study, it is clear that persistent poor students' achievement in Technical Drawing (WAEC, Chief examiner's reports 2015) and other researchers (Gambari, Yusufand & Balogun, 2014; Oviawe, Ezeji, & Uwameiye, 2015) could be attributed to teachers' inability to look at students' cognitive styles in classifying learners' ability. It is hoped that mass adoption of cognitive styles in classifying learners during teaching would bring about the much-desired improvement in achievement in Technical Drawing in Nigeria. It is a known fact that curriculum change is a gradual process which needs the input of experts in order to improve achievement in a given subject. After identifying the cognitive styles of the students, Technical Drawing teachers are encouraged to teach the students using teaching styles that will match their cognitive styles. This will enable students with poor achievement as a result of an inability of teachers to match the teaching styles with cognitive style to do better. As stated by Sternberg (1997), teachers must take into account that they teach according to a specific style. However, they should design their teaching style to takes into account the diversity of learning styles. This must be done to enrich and at the same time favour all the students. As we know, a compatible learning style with the teaching style of a course instructor enables the students to retain the information much longer, apply it more efficiently and effectively and have more positive post-course attitudes toward the subject than their counterparts who experience learning/teaching styles mismatches (Felder, 1993). If students can be enabled to be more aware of themselves and the ways in which they are likely to have better achievement in Technical Drawing, they can be encouraged to develop more effective and more flexible learning styles.

Recommendations

Based on the findings of this study, the following recommendations are made:

1. It is evident that since the adoption of cognitive styles was found to be effective in improving students' achievement in Technical Drawing, teachers should use classroom cognitive styles to facilitate their Technical Drawing teaching.
2. The curriculum of teacher education in the country should include the use of cognitive styles in identifying learners' learning problem in order to popularize their effectiveness in teaching Technical Drawing.
3. In-service training, workshops and symposia should be organized and made compulsory for practicing teachers to embrace the skills of cognitive styles for effective implementation in teaching and learning process.
4. Schools should organize workshops and seminars internally which will enable teachers and students to share ideas on the skills of cognitive styles.

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