



LEARNING STYLES AS PREDICTORS OF ACADEMIC PERFORMANCE OF PHYSICS STUDENTS IN SECONDARY SCHOOLS OF KATSINA ZONAL EDUCATION QUALITY ASSURANCE, KATSINA STATE, NIGERIA

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Abstract

This study investigated field dependence and field independence learning styles as predictors of students' academic performance in Physics in secondary schools of Katsina Zonal Education Quality Assurance, Katsina State, Nigeria. The study was guided by three objectives, one research question and two null hypotheses at 0.05 level of significance. The study employed Ex-Post Facto Research Design. The Population of the study comprised 5,445 SS II students from 23 Public Secondary Schools under Katsina Zonal Education Quality Assurance, out of which 357 were selected as the sample of the study using proportionate sampling technique. Data was collected using two instruments: Leuven's Embedded Figures test; with original reliability coefficients of 0.80 for the L-EFT and established coefficients of 0.89. The research question was answered using descriptive statistics (mean and standard deviation as well as frequency bar chart); while the null hypotheses were tested using linear regression analysis. Linear regression coefficients indicate low positive association between field dependence and field independence academic performance of students in physics. Hence, field dependence and field independence learning styles could not significantly predict physics performance. The researcher concludes that field dependence learning style is the most prevalent learning style whereas field independence and field dependence learning styles could not predict academic performance in Physics. Based on the findings of the study, it was recommended among others that field dependent learners should be allowed to pursue physics at secondary level of education just as field independent learners.

Keywords: Learning Styles, Predictors, Academic Performance, Physics

Introduction

Students' academic performance in sciences and physics in particular has been topic of major researches across the globe. This is because, many students were reported to have recorded poor academic performances for reasons such as phobia toward the subject, physics and many other teacher and student factors. Over the last two decades, the rise of different learning styles theories has led to the impression that

learning may take many forms; some students may rarely have a dominant learning style and utilize other learning styles, while others may choose to employ several learning styles in different contexts. Learning styles differ according to cognitive, emotional and environmental aspects. Every student is different (Nanaware & Bariskar, 2023). It is hence imperative for educators to understand the uniqueness of their students' learning styles



(Dennis & Ndege, 2024). Learning styles refer to the preferential way the students observe, process and comprehend as well as retain information (Leung & Sabiston, 2020).

Learning styles are preferred methods of individuals in knowledge acquisition, using the and preserving (retaining) knowledge, it could be an aspect of individual differences (Okonkwo, Egolum, Samuel & Okonkwo, 2023). Teachers are generally required to pay attention to individual differences as much as possible. Field-dependence or field-independence may also be seen as individual difference in perception dimension (Ozdemir, Alaybeyoglu, Mulayim & Uysal, 2018). Learning styles are preferences and a psychological theme that significantly affect academic performance in that, students learn better when their individual learning style is connected to favourable learning style (Ozdemir et al., 2018). Igwe and Iweka (2019) asserts that an important variable that should be attended to during the teaching and learning process is the issue of individual differences; which include differences in mental, physical, environmental, cultural, economic and emotional aspects. Cognitive styles, otherwise known as learning styles just like motivation, gender, thinking styles and attitudes are most widely researched individual differences (Okonkwo et al., 2023). Learning styles have been shown to be pivotal in the learning process (Alhassan & Abubakar, 2020). Every student has his/her preferred learning style which will in turn determine his/her tendency to grasp, perform and retain information (Dennis & Ndege, 2024).

Students' academic performance in Nigeria is witnessing downward slide. Poor academic performance of science students can be noticed in the rising rate of failures in external examinations of WAEC and NECO. Accordingly, Uchenna (2015)

opines that teacher should help the students by taking cognizance of the cognitive styles of the students with a view to matching their cognitive styles with the teaching styles. The teachers should understudy the cognitive styles of the students and adapt their teaching strategies to align with the cognitive styles of students.

Tailoring teaching in line with the students' learning styles is capable of bringing about the much-needed improvement in performance of the students. Okonkwo et al. (2023) assert that when teaching styles is matched with the learners' cognitive styles, teaching and learning becomes productive and rewarding. Dennis and Ndege (2024) defines cognitive styles as the relatively stable strategies, preferences and attitudes that determine an individual's typical modes of perceiving, remembering and problem solving. Accordingly, several studies were carried out on the relationship between cognitive (learning) style and academic performance or achievement. Empirical observations reveal that many Science Teachers do not appreciate matching of students' learning styles with their teaching strategies as well as content to be taught.

The most widely investigated learning styles in current studies include reflectivity-impulsivity, field dependence-field independence, wholist-serialist, and deep-level/surface level processing as well as logical learning style (Muchamad, Amiruddin, Siti, Marwia & Pipin, 2023; Syafitri, Putra & Noviana, 2020). Field-independent learners are more analytical, better separately details from the surrounding context, whereas field-dependent people tend to depend on cues and are easily confused in situations that are interwoven. According to Shaidullina et al. (2023), individuals who acquire information and are able to perceive by distinguishing that information from other surrounding information are known to be



“field-independent”; and hence exhibit more analytic abilities. Field-independent learners tend to have innate cues and are more autonomous in cognitive restructuring tasks. Likewise, Muchamad et al. (2023) asserts that, students with logical learning style could be more ready to pursue mathematics and mathematics dependent disciplines such as Physics.

Therefore, this study was prompted to be undertaken with the aim of ascertaining and establishing the whether or not students’ academic performance and retention are determined by the nature of learning (cognitive) styles possessed by the students; especially field dependence-field independence. This is because, teachers should pay attention to students’ learning styles as a way of fostering students’ academic performance and retention; and the fact that field dependent learners were widely reported to be good at group work (such as Physics practical experiments) whereas several other studies indicate that field independent learners perform better in sciences; what a confusion or problem. Ozdemir et al., (2018) opined that field dependent learners focus on whole while perceiving the outside world and see the big picture first, therefore do not easily identify components embedded in a whole. Owing to this, in order to get field-independent and field dependent learners; Group Embedded Figures Test (GEFT) by Witkin is normally administered. Along similar vein, students with Logical learning style prefer to use logic, reasoning, and systems (Muchamad et al., 2023). Kurniawan (2017) states that someone with logical learning style will prefer activities that involve the brain, usually, students will quickly become aware of a pattern, and see connections between one piece of information with other information that many people do not easily realize. The logical students do also understand something by connecting connections from various details and arranging them in an organized manner,

such as by playing puzzle. It was therefore, clear that students with logical learning styles preferred lessons that was problem-solving, and systemic; and did not rely on memorization.

Therefore, since learning styles of students according to empirical studies could influence academic performance, this present study examined whether or not field-independence and field-dependence as well as logical learning styles could determine academic performance of physics students. The study to addressed the problem of physics failure of students as affirmed by several reports and examination bodies; as this could emanate from the tendency of students enrolling into sciences (physics) without being selected for it or possessing of propriate learning styles for pursuing physics. It was against this background, that this study examined whether or not physics students’ academic performance was a function of (predicted by) field-dependence and field-independence learning styles.

Statement of the Problem

The problem of this study lies in the persistent poor academic performance and achievement of physics students in secondary schools particularly in external examinations. Academic performance by students has always been a subject of interest to scholars. Academic performance is essentially the outcome of education and the extent to which students has achieved educational objectives. The error of mismatching their teaching with the students’ preferred learning styles would no doubt stand a major factor that leads to students’ poor academic performance (Alhassan & Abubakar, 2020). Again, if students’ learning styles are not taken into cognizance in selecting students for a particular discipline or career (science or arts); then students’ desirable academic performance would not be guaranteed (Najafabadi, Imani, Beygi, Lopes & Silva,



2022). Therefore, teachers who do not understand the diversity of their learners in a typical classroom end up embracing the same traditional teaching methods in every context, using the same material of instruction for all categories of students in a classroom, regardless of their individual differences and learning style approach.

Students' academic performance in Nigeria is witnessing downward slide. Poor academic performance of science students can be noticed in the rising rate of failures in external examinations such as; WAEC and NECO. Again, Students need competencies and survival skills in facing life, as well as, 21st century skills namely critical thinking and problem solving, collaboration across networks and leading by influence, agility and adaptability, initiative and entrepreneurialism, effective and oral communication, accessing and analysing information as well as curiosity and imagination. The researcher therefore thought of logical learning style to be tried as independent variable in order to see if it will predict students' success in Physics. Logical thinking is a way that is reasonable, coherent and based on certain objective facts (Syafitri, Putra & Noviana 2020).

Results for West African examination council (WAEC) and the National

Examination Council (NECO) indicates a high failure rate in recent times. Notably, WAEC chief examiners report (2021) summarized candidates 'weaknesses as follows: Some candidates did not comprehend some of the theories of physics; Units were not carried out in S.I Unit by some candidates; most candidates had difficulty in solving problems set on mechanics, sound, heat and electricity; many candidates were not able to differentiate between concepts of motion and that of rest.; candidates could not differentiate between potential differences and electromotive force; many candidates failed to define the principal focus of a concave lens.

Coupled with the WAEC chief examiners' report (2021), the researcher having reviewed some articles came to understand that, learning styles could have relationship with students' academic performance. However, many teachers could not even assess their students' individual learning style, field-dependence/field-independence, reflectivity/ impulsivity, convergence/divergence or wholist /serialist as well as logical. The table below shows the trend of students in WAEC who got five credits including mathematics and English

Table 1 Trend of Academic Performance

S/N	YEAR	PERCENTAGE
1	2020	39.82
2	2021	81.7
3	2022	76.36

More also, this study is prompted in order to find out if field-dependence, field-independence and logical learning styles could determine students' academic performance in physics in secondary schools of Katsina Zonal Education Quality Assurance, Katsina state, Nigeria. This could help to establish either of which is

compatible with learning physics in order to avert the problem of students blindly going into sciences (physics) at SS1 without properly fitting in as either field-dependent, field-independent or logical.



Objectives of the Study

The following objectives were set to guide the study, to: -

- a) Identify most prevalent Learning style among Physics students in secondary schools of Katsina Zonal Education Quality Assurance.
- b) Determine to what extent does field-dependence learning style predict academic performance of students in Physics in secondary schools of Katsina Zonal Education Quality Assurance.
- c) Establish to what extent does field-independence learning style predict academic performance of students in Physics in secondary schools of Katsina Zonal Education Quality Assurance.

Research Questions

Based on the research objectives, the following questions were raised to guide the study:

1. Which of Field dependent, Field independent Learning styles is most prevalent among Physics students in secondary schools of Katsina Zonal Education Quality Assurance?

Research Hypotheses

The following hypotheses guided the study:

- H₀₁: Field-dependence learning style does not significantly predict academic performance of students in Physics in secondary schools of Katsina Zonal Education Quality Assurance.
- H₀₂: Field-independence learning style does not significantly predict academic performance of students in Physics in secondary schools of Katsina Zonal Education Quality Assurance.

Research Methodology

This study employed Ex-post facto research design. This was because, ex-post facto research design is non-experimental that

examines how an independent variable (in this case field dependence and field-independence as well as learning styles) present already prior to the study affects a dependent variable (in this case, academic performance). Ex-post facto correlational research design (also known as causal-comparative design) investigates the relationship between variables without the researcher controlling or manipulating any of them. The design hence describes how variable are naturally related in the real world without the researcher attempting to alter them or assign causation between them (Bikner-Ahsbahs, Knipping & Presmeg, 2015).

The design was contextually pertinent in this study, since, already the independent variables (field dependence and field independence, as well as logical learning styles) was present in the research subjects as definitely some were field dependent whereas others were field independent. These independent variables were also not subject to manipulation by the research however, was only examined via correlation as to how to they could affect or determine physics students' academic performance (dependent variable).

The population of the study covered all the senior secondary school year II (SS2) students offered Physics and who took Physics Qualifying Examinations, 2024/2025 in Katsina Zonal Education Quality Assurance. The population therefore comprised of five thousand, four hundred and forty five (5,445) SS 2 students in twenty-three 23 public senior secondary schools in Katsina Zonal Education Quality Assurance, with one (1) not offering Physics to students making the total number of schools in the population being twenty-two. The schools are public, operating as day schools and offer physics as a subject.

As for sample, the researcher first consulted Research Advisors table (2006) table of



sample size, and got advised to use three hundred and fifty-seven (357) subjects (participants) for a population, $N > 5,000$ but $< N 7,500$. Hence a sample size of 357 was deemed appropriate for this research endeavor. As for the sampling technique, the Researcher adopts multi-stage sampling approach. Accordingly, Purposive Sampling technique was initially employed to get the only secondary schools in Katsina Zonal Education Quality Assurance that offer Physics as a Science subject to students. Meanwhile, from the twenty-three secondary schools, only one (1) was isolated as non-sample as they do not offer Physics.

Thereafter, Proportionate Sampling technique was used to select correct and exact number of subjects from each of the twenty-two schools of the population, leading to the total sample size of three-hundred and fifty-seven (357). Meanwhile, due to the fact that the instruments were administered once, intact classrooms were used to make up the required sample size in each school and in some cases, convenience sampling was employed.

Three instruments were employed for the collection of data in this study namely adapted Leuven Embedded Figures Test (L-EFT) which was modified recent embedded Figures Test by Witkin, Raskin and Karp (1971) as well as Physics Qualifying Examination results, 2024/2025 academic session. The L-EFT is an adapted embedded figures test comprising of ten tasks or items and was used to classify (or find out) students with field dependence and students with field independence learning styles. The classification of the students was according to the decision rule established by Maghsudi (2007) and Adopted by Uchenna (2015), that students' performance in the embedded figures Test (EFT) be worked according to the relation, $\bar{X} \pm SD$. (where \bar{X} is the mean, and SD is the standard deviation). The Adapted

Leuven's Embedded Figures Test (L-EFT) consists of 10 tasks. The L-EFT Adapted for this study features in Huyglier, Vander Hallen, Wagemans, de-wit and chamberlain (2018).

The researcher ensured face validities of the instruments employed in the study. The Adapted Leuven's Embedded Figures Test (L-EFT) is ordinarily assumed valid since it been used widely and established by the experts. However, due to adaption, the researcher took it for validation before experts (experts one each from a university and one psychology expert from a university also).

Pilot test was carried out on thirty students from a senior secondary school that constituted part of the study population of Katsina state but from Rimi Zone and not Katsina Zonal Education Quality Assurance. Uchenna (2015) documents that the original GEFT by Witkin, Oltman, Raskin and Karp (1971), recorded reliability coefficient between 0.80-0.90 for about 3 years. Hence, the Leuven's embedded figures test (L-FT) and the subsequently adapted L-EFT for this study are reliable for research usage, especially in getting students with field dependence and field independence learning styles. The researcher also established reliability of stability using Pearson Product Moment Correlation and found the reliability coefficient to be 0.89. The reliability coefficients of the instruments are tabulated below: -

Descriptive statistics and inferential statistics were used to analyze the data to be collected. Research question of the study was answered using descriptive statistics whereas the null hypotheses were tested using inferential statistics. Specifically, research question was answered using simple frequency and pie chart.

As for research hypotheses, linear regression analysis was used to analyse the



two hypotheses. Overall, all analyses were performed using statistical package for social sciences (SPSS) version 27. The hypotheses testing was done at 5% (0.05) level of significance; since the research is educational (social science).

Results

The is presented according to research questions as follows:

Research Question 1:

Which of field-dependent, field-independent learning styles is most prevalent among physics students in secondary schools of Katsina Zonal Education Quality Assurance?

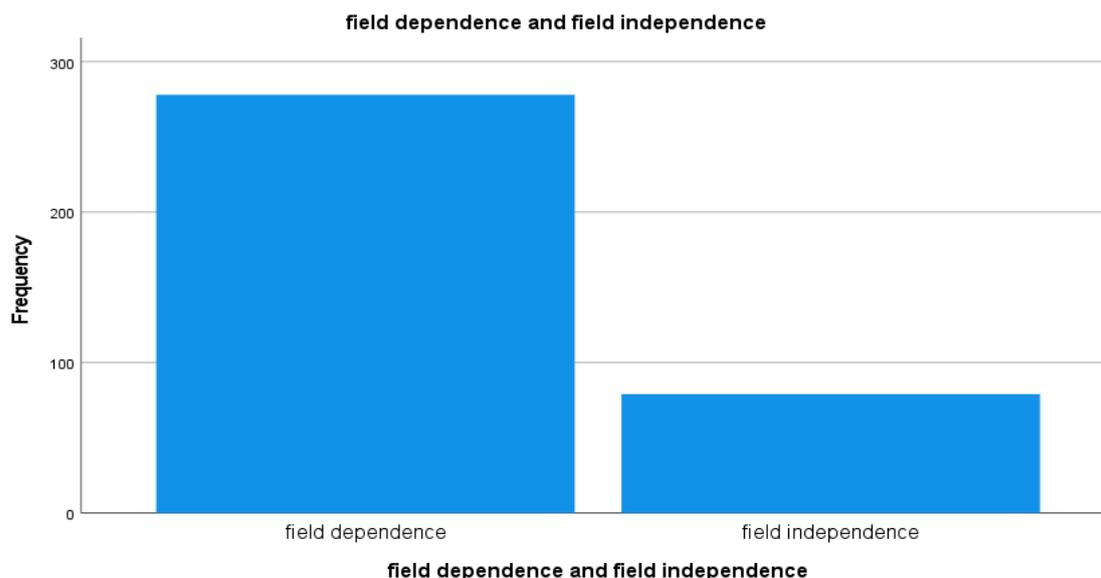


Fig. 1 Bar chart showing distribution of Physics students across Learning styles

From fig 1: the most prevalent learning style among physics students in secondary schools of Katsina Zonal Education Quality Assurance is field dependence learning style (278=77.9% and 280.34⁰).

Testing Research Hypotheses

Inferential statistics such as t-test (independent sample) and linear regression were employed; which are all parametric tools. All testing was carried out at 5% level

of significance; 95% confidence level and using SPSS V27.0.

H₀₁: Field-dependence learning style does not significantly predict academic performance of students in Physics in secondary schools of Katsina Zonal Education Quality Assurance.

To test this hypotheses, simple linear Regression was employed whose result is presented in tables below.

Table 2 Linear Regression coefficients for Ho1
Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.048 ^a	.002	-.001	21.29773

From table above, the observed unstandardized coefficient (b) of 0.045 indicates that Physics students' academic

performance increase by only 0.045 per unit increase in field dependence factor as expressed in term score obtained in L-EFT.



Finally, the R square (R^2) value denotes that only 0.2% of the variability observed in the scores spread of Physics students in

Qualifying Examinations is accounted for field dependence learning style

Table 3: ANOVA for Regression analysis for Ho₁

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	284.563	1	284.563	.627	.429 ^b
	Residual	125191.696	276	453.593		
	Total	125476.259	277			

From tables above, for field-dependence factor Standardized Coefficient, Beta = 0.048 denoting a negligible very low prediction ability of the independent variable (field dependence) for Physics Students' academic Performance, and the p-value ($p=0.429$; $F= 0.627$) is greater than alpha ($\alpha= 0.05$) hence, the hypothesis is retained and therefore, field-dependence

has no significant relationship or prediction power with/for physics students' academic performance in secondary schools of Katsina Zonal Education Quality Assurance.

Ho₂: Field-independence learning style does not significantly predict academic performance of students in Physics in secondary schools of Katsina Zonal Education Quality Assurance.

Table 4: Linear Regression coefficients for Ho₂
Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.109 ^a	.012	-.001	11.08373

From table for field-independence factor standardized coefficient is Beta = 0.109 denoting low prediction ability of the constant for Physics Students' academic Performance, and the p-value. Finally, the

R square (R^2) value denotes that only 1.2% of the variability observed in the scores spread of Physics students in Qualifying Examinations is accounted for field independence learning style.

Table 5: ANOVA for Regression analysis for Ho₂

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	112.768	1	112.768	.918	.341 ^b
	Residual	9459.384	77	122.849		
	Total	9572.152	78			

From table, ($p=0.341$; $F= 0.918$) is greater than alpha ($\alpha= 0.05$) hence, the hypothesis is retained and therefore, field-independence has no significant relationship with physics students' academic performance in secondary schools of Katsina Zonal Education Quality

Assurance; and the observed unstandardized coefficient (b) of 0.230 indicates that Physics students' academic performance increase by only 0.230 per unit increase in

From the results of data with respect to answering research questions and testing of



hypotheses; the followings were the major findings of the study:

1. Among the learning styles namely field-dependence; field-independence; field-dependence is the most prevalent learning style among physics students in secondary schools of Katsina Zonal Education Quality Assurance.
2. Field-dependence learning style has no significant prediction index on physics students' academic performance.
3. Field-independence learning style cannot significantly predict students' academic performance in Physics

Discussion of Findings

From the findings in this study, it is clear that field-dependence and field-independence learning styles could not significantly predict physics students' academic performance but logical learning style could significantly predict physics students' academic performance. This finding is in congruence with Okonkwo et al. (2023) who found out that there is no significant difference between learning styles and students' academic performance but reported that only kinesthetic learning style. However, the findings are in disagreement with Dennis and Ndege (2024) who found out that learning styles predict academic performance of students; Muhammad, Gananamalar and Amnah (2015); who found out that field-dependence and field-independence is a significant predictor of scientific achievement in male achievement and female achievements in biology and integrated science of Zamfara state college of education. Furthermore, Uchenna (2015) disagrees with this finding since it found out that field independent students had a higher mean achievement in sciences than the field-dependent students and that there was significant relationship between field-dependence-independence cognitive style

and career choice of students. Again, the finding is not in congruence with Alhassan and Abubakar (2020) who found out that the p-value (0.025) was less than alpha (0.05) leading to rejection of hypotheses in their study on the influence of field dependence and field independence learning styles on academic performance of secondary schools in Katsina Zonal Education. However, the subjects in their study were biology and English and not physics.

As for logical learning style prediction of academic performance in physics, the finding is in congruence with Siftiyari et al (2020) and Deborah, Sathiyaseelan, Audi than and Vijayakumar (2015) who carried out a study titled "fuzzy-logic based learning style prediction in e-learning using web-interface information" and found that e-learners' excellence can be improved by recommending suitable e-contents available in e-learners' servers that are based on investigating their learning style. However, their study acknowledges the fact, knowledge about the learners used for learning style prediction is uncertain in nature. Similarly, the findings of the study agree with Muchamad, Aminuddin, Siti, Marinia and Sumarni (2023) who got that average logical thinking ability of students with 61.9.

Thirdly, the present study established that, field-dependence is the most prevalent, abundant learning style among physics students in secondary schools of Katsina Zonal Education Quality Assurance. This study agrees with Alhassan and Abubakar (2020) who also found that most of the students in their study were field-dependent since out of 368 subjects, 206 were found to be field-dependent whereas 162 were field-independents. However, the finding disagrees with Muchamad, Aminuddin, Siti, Marhia and Sumarni (2023) who found that social learning style was the most prevalent with 12.5%.



Another major finding of the study was that, field-dependence has no significant effect on physics students' academic performance with b and beta value (standardized and unstandardized coefficients) being negligible. Similarly, Field-independence learning style has no significant relationship with students' academic performance in Physics and that the former could not significantly predict the latter. This study specifically disagrees with the works of Alhassan and Abubakar (2020); Uchenna (2015) and Muhammad, Gananamalar and Amnah (2015) who found that field-dependence-independence factor could predict academic performance of students in sciences. In the light of Witkins 1981, field dependence-independence theory as documented in Ozdemir et al. (2018); field independent individuals are markedly different from each other in perceiving information and have their own preferred way. By this ascertain, it could be believed that field-independent learners could do better in physics contrary to what the present study found that field-dependence-independence could not determine students' academic performance. In congruence, this study agrees or reinforces the assertions in Dunn and Dunn theory of learning styles as stated in Ozdemir et al. (2018) that, identifying and matching students' learning styles well as with instruction and consent is consequential for the students' attainment of learning objectives. This present study also believes that students' learning style if fiend-dependence or field-independence could not affect their success in physics.

Conclusion

Based on the analyses in chapter four, the researcher concludes that field-dependence learning style is the most prevalent learning styles amongst the duo of field-dependence, field-independence. Moreover, the researcher concludes that field-dependence-independence factor or learning style has no significant effect on

and could not therefore predict students' academic performance in Physics in secondary schools of Katsina Zonal Education Quality Assurance, Katsina state.

Recommendations

Based on the findings of the study, the following were recommended;

1. Both field-dependent and field-independent learners should be encouraged to learn physics in secondary schools.
2. Other researchers (future researchers) should carryout studies on effect of convergence/divergence, reflectivity/impulsivity with academic performance in physics.
3. Other researchers (future researchers) should carryout studies on effect of field dependence and field independence with academic performance in other science subjects.
4. Other researchers (future researchers) should carryout studies on effect of kinesthetic, auditory and visual learning styles on academic performance in physic

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