

Teachers' Non-Verbal Behavioral Instructional Practice and students' Achievement in Chemistry in Public Secondary Schools in Murang'a County, Kenya

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Abstract

Although teachers' non-verbal behavioral pedagogical technique may sound obvious to educational researchers and practitioners, there is insufficient information regarding its use during the instructional process. Additionally, research on non-verbal communication and self-efficacy has largely been conducted, with less focus directed towards teachers' non-verbal behavioral approach as an instructional practice. To address the gap, the present study sought to investigate if teachers' non-verbal behavior is an effective predictor variable of learners' academic achievement in chemistry. Using a sample size of 384 Form three chemistry learners and 32 chemistry teachers from 32 public secondary schools, in Murang'a County, Kenya, a descriptive survey design was adopted for this study. Three instruments were used to collect data: an Observation Checklist, Students' Questionnaire and Chemistry Achievement Test. Multiple observers were used to overcome the weakness or intrinsic biases and the problems emanating from a single-observer. A pilot study to validate the instruments, was conducted in three schools. Reliability of the instruments was calculated using Pearson Moment Correlation Coefficient. Data was coded using SPSS Version 20, and analyzed using one-way ANOVA, simple regression analysis, frequency tables, means and standard deviations. The study adhered to accepted ethical standards. From the findings, teachers' non-verbal behavior was found to be a strong predictor of learners' academic achievement in Chemistry and was found to offer support to other methods of instruction.

The results of the study will support policy efforts to improve and promote teachers' non-verbal behavior competencies. The study contributes to diversification of pedagogical practices and a support tool to the already existing conventional methods of teaching that is currently in use. Further studies should be carried out in several countries, using different designs, so that the results of the study can be broadly generalized.

Key words: Instructional practice; Predictor; non-verbal behavior; Observational schedule; Academic achievement.

I. INTRODUCTION

A recent study by [Inkinen, Klager, Juuti, Schneider, Katariina, Krajcik & Lavonen](#) (2020) revealed that only less than 25% of students in Organization for Economic Co-operation and Development (OECD) countries are engaged in post-secondary school science-related careers. Indeed, concern has been rising about the widespread low levels of learners' academic achievement in sciences in secondary schools ([Buari](#), 2017). This is supported by several studies which include DeSilver (2017), Education (n.d), Hulleman and Harackiewicz (2009), Kabunga and Mohamed (2016), Kihwele (2014), Osuolale (2014) and Uganda National Examination Board (2019), which have revealed that the sciences continue to be poorly performed in comparison to the arts based subjects. This is a critical issue that requires intervention because the rate at which the world is rapidly growing requires investment in science and technology.

The current study was concerned about the performance in Chemistry due to four reasons: One, Chemistry has continued to trail behind among the three science subjects in terms of students' academic achievement (Bernardine & Benedict, 2019). Secondly, Chemistry is the "mother" of nearly all professional science related courses offered in post-secondary institutions (Innovation (n.d). Thirdly, Chemistry subject is a prerequisite to the study of nearly all the scientific and technological courses required for the development of a nation such as Engineering, Food Science, Medicine and Agriculture (Musyoki, 2015). Fourthly, Chemistry is a practical subject that should be interesting to learners given that some of the day to day activities in life such as the air we breathe, the water we drink, the food we eat, the medicine prescribed by doctors and even the fuel we use revolve around Chemistry. Indeed, all these are examples of substances whose chemical composition involves Chemistry (Ashworth, 2014). Despite many of our daily activities being anchored in Chemistry, poor performance in the subject is evidenced in developed and developing countries. This poor performance was noted in Australia and the USA (Bernardine & Benedict, 2019), Germany (Wolfgang, 2011), and Israel (Raved & Assaraf, 2010). Others include Nigeria (Banu, 2006) and (Barineka, 2012), South Africa (Mji & Makgato, 2006) and Uganda and Zanzibar (Ahmed, Hassan, Abdallah, Kassim, Yussuf & Ali, 2015).

According to Kenya National Examinations Council (KNEC, 2020), candidates' performance in Chemistry continues to raise concern despite the Ministry of Education (MoE) interventions. For instance, the ministry has addressed the challenge through programmes such as Strengthening of Mathematics and Science in Secondary Education (SMASSE). SMASSE is a programme which was initiated by the Kenyan Government in collaboration with the government of Japan to offer in-service training programmes to Science and Mathematics teachers, on the best teaching approaches and methodologies.

Every Mathematics and Science teacher employed as a teacher after pre-service training undergoes a teachers' professional development course through the SMASSE in-service training, yet there are gaps hindering the performance in Chemistry. It is ironical that while the SMASSE programme has been in place for the last 30 years, it does not seem to be offering a solution to the problem (Republic of Kenya, 2015). Further, from the performance perspective, it seems that Chemistry is among the complex subjects disliked by learners. This is an educational gap that requires to be addressed through in-depth empirical studies.

Table 1 shows the national performance of Chemistry, Physics and Biology from 2012 to 2019.

Table 1: National Mean KCSE performance of Sciences (2012-2019) in percentages

Subject	2012	2013	2014	2015	2016	2017	2018	2019
Physics	29.67	33.78	37.01	35.66	38.43	39.10	38.87	23.18
Biology	26.15	27.76	31.95	23.14	32.03	31.34	30.06	20.08
Chemistry	18.54	23.32	21.86	24.55	23.76	25.81	23.79	16.16

Source: KNEC (2020)

From Table 1, the national performance in Chemistry was low compared to Physics and Biology, because the highest score in Chemistry in the eight years under study was 24.55% which translate to grade E. This is the lowest grade in KCSE grading system showing learners did not master the basic concepts in the subject. The implication of this performance is that only few students in the country took technological and science courses in institutions of higher learning in the eight years focused by the current study. This is a scenario that would make it difficult for the country to achieve the nation's development agenda by 2030. Apparently, the academic achievement in Chemistry is equally low in Murang'a County as shown in Table 2.

Table 2: Murang'a County Mean KCSE performance of Sciences (2012-2019) in percentages

Subject	2012	2013	2014	2015	2016	2017	2018	2019
Physics	27.81	34.61	37.99	36.14	37.38	41.37	43.39	28.96
Biology	24.12	26.98	32.33	22.96	30.06	36.78	33.78	25.71
Chemistry	17.23	24.25	20.79	23.82	24.56	29.51	28.45	19.86

Source: KNEC (2020)

This is a scenario that requires urgent intervention if the country is expected to achieve the 2030 vision. There is therefore need to carry out empirical studies to unearth the underlying issues so as to achieve the desired national goals. According to Parenting (2018), factors that cause poor academic achievement in Chemistry can either be external or internal. Internal factors include challenges at home and the learner's emotional state. External factors include the school environment, social interaction, teachers and teaching methodologies. The current study focused on one external factor: teaching methodologies. The study proposed that the poor performance may partly be attributed to gaps in teachers' pedagogical approaches in the classroom environment. In order to close the performance gap, there is need to explore effective pedagogical approaches to support the existing familiar conventional practices. Such new approaches should focus on attracting the attention and interests of learners during the teaching and learning process. One such method, suggested by the current study, is the teachers' non-verbal behavioral approach. Examples of nonverbal behavior used consciously or unconsciously by teachers include eye use and contact, and physical distance between the teacher and the learners. Others are gestures, touch, nodding, postures, thumbs up, gestures of appreciating the learner, pitch or tone of voice, patience, tolerance, facial expressions and body movements (Butt, 2011). Some previous studies have established that the impact of a lesson depends on how a teacher's behavioral approach is perceived by the learners.

For instance, a study by Heyder, Weidinger, Cimpian and Steinmayr (2020) on teachers' belief that success in Mathematics requires innate ability among learners revealed that such beliefs resulted in lowering the intrinsic motivation of the lower achieving students. Although the study did not directly address the issue of behavioral approach and quality learning, such teachers' beliefs are normally accompanied by certain non-verbal behavior which might impact on learning.

For instance, if the teacher pays little attention to the lower achievers, these learners may "switch off" "from the lesson, thereby affecting their learning.

The current study examined some previous studies that focused on non-verbal related behaviors. Studies by Akinola (2014) and Haneef, Faisal, Alvi and Zulfiqa (2014) carried out in Nigeria and Pakistan respectively revealed that non-verbal communication can be an effective tool for enhancing learners' academic achievement and engagement in English during the instructional process. The two studies further revealed that learners actively participate in lessons when teachers use gestures, postures and eye contact and recommended that teachers should be engaged in workshops that train them on utilization of non-verbal behavior. Two weaknesses identified in the Haneef, Faisal, Alvi and Zulfiqa's study were: the study was purely qualitative and data was collected using interviews from only one focus group hence only thematic analysis was used to analyse the data creating an in-depth research gap. Akinola's study used questionnaires and Focus Group Discussion. The current study took cognizance of the weaknesses listed by utilizing multiple data collection methods and quantifying the academic achievement that resulted from teachers' non-verbal behavior.

While one expects verbal communication to be more effective than non-verbal communication, Bambaeroo and Shokrpour (2017) noted that non-verbal communication was more effective during teaching and learning compared to verbal communication.

The study revealed that even when someone tries to hide some feelings, they are still manifested in their facial expression. The implication is that one cannot conceal something that is unseen because it will be evident in one's thoughtless words or face. This seem to suggest that teachers' non-verbal behavior is likely to have significant influence on learners' academic outcomes contrary to what many teachers are unlikely to believe. However, Bambaeroo and Shokrpour's study failed to address the aspect of academic achievement which is the focus of the current study.

Similar findings were revealed in Chaudhry and Arif's (2012) correlational study which indicated a strong relationship between non-verbal communication of teachers and learners' academic achievement in English. Bambaeroo and Shokrpour (2017) and Chaudhry and Arif (2012) studies suggested that the true feelings between the learner and the teacher, portrayed on their faces, effectively transfer subject matter to the students. While the current study may concur with the two studies, the suggestions were not supported by empirical data.

A quasi-experimental study by Butt (2012) showed that the learning environment was made active when teachers' use non-verbal communication with learners who are alert, thus enabling them participate during the learning process. The practice improved learners' level of retention and understanding of the concepts, evidenced by the outcome of a post-test assessment, as compared to learners from a control group. The current study used an observational schedule as the main instrument for data collection and respondents were not aware of what was being observed. Hence, the phenomenon under study was observed under a natural environment. Moreover, Butt (2012), and Chaudhry and Arif (2012) studies involved teaching of English.

Other related studies reviewed by the current study focused on teachers' non-verbal, immediacy behavior and students' self-efficacy.

Lisa's (2006) study for instance revealed a positive and significant relationship between teachers' non-verbal immediacy behavior and learners' motivation for learning English. In the same study, findings from multiple regression analyses revealed that non-verbal immediacy was a significant predictor of students' motivation for learning English. Lisa's results were contradicted by a study by Velez and Cano (2008) that revealed no association between teacher immediacy and student self-efficacy. However, Velez and Cano's (2012) study on the relationship between student self-efficacy and non-verbal immediacy in Agriculture revealed that 4% variance in self-confidence was explained by non-verbal immediacy. The study further established a positive relationship ($r = 0.209$) between students' self-confidence and teachers' non-verbal immediacy. Lisa (2006), Velez and Cano (2008) and Velez and Cano's (2012) studies lacked consistency in their findings and differed with the current study on two aspects: Firstly, the three studies focused on nonverbal immediacy and students' motivation or self-efficacy. Secondly, they targeted post-secondary school students.

The related previous studies, reviewed in the current study, point at significant learning benefits associated with non-verbal communication or self-efficacy. However, not only were all the reviewed studies inconsistent with their findings, but they also did not attempt to quantify the learning emanating from non-verbal communication or self-efficacy. Moreover, nearly all the reviewed studies seem to be limited, more inclined and focused towards the teaching of English language. The current study proposed that generalizing the results based on one subject can create a gap because the teaching techniques of different subjects are unique. Based on the literature review and despite the identified gaps, it is evident that a lot has been done on non-verbal communication and self-efficacy.

However, effect of non-verbal behavioral approach instructional practice which is the focus of the current study seems to be inadequately explored - a gap that the current study intended to fill.

The distinction between non-verbal behavior and non-verbal communication may not have a very clear boundary. However, according to Nonverbal Cues (n.d), non-verbal behavior involves behavior displayed without the awareness of the teacher (the one conveying the information), whereas non-verbal communication involves a more active process whereby the teacher and learner display and interpret behavior according to a shared meaning code. Foley and Gentile (2010) asserted that most non-verbal behavior is unconscious. For the purpose of the current study, the respondents were not informed what the researcher was investigating. Therefore, the researcher observed non-verbal behavior of the teacher during instruction without the teacher’s awareness of what the researcher was observing. The current study therefore shifted the focus from non-verbal communication and self-efficacy to teachers’ non-verbal behavioral concept which is linked to Affiliative Conflict Theory also referred to as Equilibrium Theory Model (Miles, 2006) and advanced by Argyle and Dean (1965). Argyle and Dean postulated a state of intimacy equilibrium where intimacy is a function of non-verbal behavior portrayed by a teacher such as smiling, physical proximity, eye-contact, intimacy of topic and patience. Any change in one variable produces a change in the others until equilibrium is achieved.

The main focus of the Affiliative Conflict Theory is how individuals maintain friendly and attractive levels of behavioral relationships. The equilibrium theorists proposed that some non-verbal behavior such as gestures, nodding, postures and thumbs up determine the overall level of involvement in an interaction (Carr & Dabbs, 1974). The level of relationship increases as individuals get acquainted with one another. For instance, one is likely to avoid eye contact with a stranger who approaches them and comes to stand close to

them. The theory explains the momentary behavioral adjustments that people make in the course of an interaction. Early empirical research that supported the theory increased the range of relevant behaviors. For instance, Argyle and Dean (1965) suggested that body orientation, touch, leaning and expressiveness also contributed to the overall involvement between interacting partners. The theory was found relevant to the current study because teachers can use non-verbal behavioral approach during the teaching process to create an intimacy equilibrium with learners. This may lower the mental and psychological distance between the teacher and learner.

Therefore, a balanced equilibrium is established when the teacher and the learner maintain comfortable levels of intimacy through nonverbal behavior and ultimately maintain a friendly and attractive learning environment. The current study developed a conceptual framework from the Equilibrium Theory model, as follows:

Figure 1: Conceptual Framework

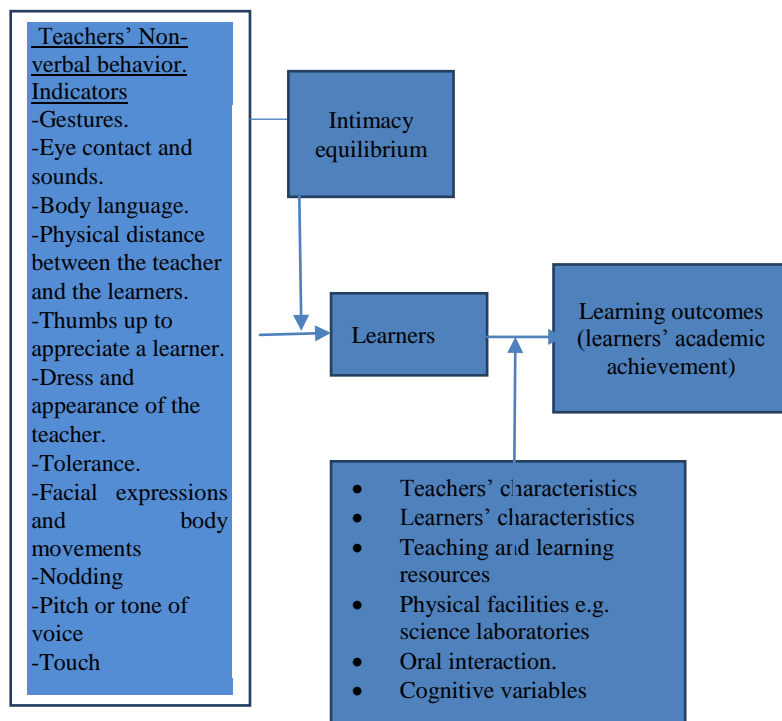


Figure 1: Conceptual Framework

Source: Author (2020)

From the conceptual framework, the behavioral relationships (teachers’ non-verbal behavior) are indicated as the independent variables.

Therefore, a teacher who develops friendly, attractive and non-verbal levels of behavioral relationships creates an intimacy equilibrium during the learning process. This attracts the attention of the learners and creates interest in learning. The teacher's non-verbal behavioral approach is intended to improve the learning environment such that teacher-learner friendliness reduces the psychological barrier between the learner and the student.

In summary, based on the reviewed literature, little is known about the effectiveness of teachers' non-verbal behavioral approach as an instructional technique and therefore its benefits on learning remain unclear.

Further, by the time of carrying out the current study, few or none of non-verbal behavioral approach studies had based their studies on Affiliative Conflict Theory.

The study used 'Gas laws' as the sub-topic of interest because it is taught through several pedagogical techniques and covered in Form three, the target class in the current study.

II. RESEARCH QUESTIONS

The study was guided by three research questions:

- a) What is the extent of teachers' usage of non-verbal behavioral approach as an instructional practice during the teaching of Chemistry in public secondary schools in Murang'a County, Kenya?
- b) What is the learners' behavior emanating from teachers' non-verbal behavior during the teaching of Chemistry in public secondary schools in Murang'a County, Kenya?
- c) What is the effect of teachers' non-verbal behavioral approach as an instructional practice on learners' academic achievement in Chemistry in public secondary schools in Murang'a County, Kenya?

III. METHOD

This study employed a descriptive survey research design. Mugenda and Mugenda (2008) asserts that the design is used to collect data concerning the current situation. The target population was 10,200 Form 3 students drawn from 123 public secondary schools in Murang'a County which have been scoring average mean scores in the Kenya Certificate of Secondary Education (KCSE) examinations. The KCSE mean scores in the national examinations range from 1.0, which is the lowest, to 12.0, which is the highest. Therefore, the schools with mean scores of 4.0 - 6.0 were purposively selected. Schools whose mean scores were below 4.0 were found unsuitable because the learners in such schools were considered low achievers.

Learners with mean scores above 6.0 were considered high achievers and assumed to have the ability to study on their own or ahead of the teacher and to understand the concepts very fast. Using Yamane's formulae (1967), a sample size of 384 Form 3 students and 32 Chemistry teachers drawn from 32 public secondary schools were selected to form the sample size. The 32 schools provided 384 learners; each school provided $384/32 = 12$ Form 3 students.

An observation schedule, students' questionnaire and a Chemistry Achievement Test (CAT) were used as data collection instruments. The main instrument, an observation schedule, was designed to capture the non-verbal behavior of the teachers and students during Chemistry lessons. The study did not utilise video cameras because the researchers preferred a natural environment which is more familiar to teachers and learners. The observation schedule was modified from a similar instrument used in a study carried out by Noureen, Chaudhry and Manzoor (2012).

The schedule design included a Likert scale of 1-5, indicating use, where 5 indicated Excellent, 4= Good, 3= Moderate, 2=Poor and 1= Not used at all. The last item in the observation schedule required the researcher to observe any striking learners' behavior emanating from teachers' non-verbal behavior during the teaching.

The second instrument, a students' questionnaire, also included a Likert scale to capture the opinion of learners regarding the teacher's use of non-verbal behavior, where SA meant Strongly Agree, A=Agree, NS= Not Sure, D=Disagree and SD=Strongly Disagree. The third instrument, using the six levels of Bloom's taxonomy, was a CAT set by teachers from high performing schools who have been examiners with the KNEC for at least five years and whose schools were not part of this study.

To address the issues of credibility and dependability of data, prior to piloting of the instruments, the lead study person trained four research assistants who were graduates in Master in education.

The three instruments were piloted in three schools that did not participate in this study but were covering 'Gas laws'.

The research assistants visited the first school and sat in different positions during the Chemistry lesson in order to avoid influencing each other. They were provided with an outline of schemes of work which was also availed to the Chemistry teachers from the target schools for use during the data collection. The scheme of work was prepared by the authors from the Chemistry syllabus provided by the Ministry of Education. Table 1 shows the order, objectives and activities that were used during the teaching of 'Gas laws'.

Table 1: Scheme of work used by Chemistry teachers in this study.

Week	Lesson	Topic	Objectives: By the end of the lesson learners should be able to:	Activities
1	1 & 2	Boyle's law	a. State Boyle's law	a. Introduction of the

	(80min)		e's law.	subtopic with learner's involvement.
			b. Carry out an experiment to investigate Boyle's law.	b. Class experiment in small groups.
			c. Carry out calculation on Boyle's law.	c. Group reporting.
			d. Carry out calculation on Boyle's law.	d. Teacher-learner class discussion.
3 & 4	Charle's law (80min)	a. State Charles's law.	e. Introduction of the subtopic with learner's involvement.	
		b. Carry out an experiment to investigate Charles's law.	f. Class experiment in small groups.	
		c. Carry out calculation on Charles's law.	g. Group reporting.	
			h. Teacher-learner class discussion.	
5	Combined Boyle's and Charles's law (40min)	Use the combined laws to carry out calculations.	Calculations involving the combined laws. (Teacher to involve the learners).	
2	6 & 7 (80min)	Move on to Diffusion of liquids	a. Explain diffusion of liquids in terms of kinetic theory.	a. Introduction of the subtopic with learner's involvement.
			b. Explain diffusion of liquids in terms of kinetic theory.	b. Class experiment in small groups on

8 & 9 (80min)	Diffusion of gases	<p>a. Explain diffusion of gases in terms of kinetic theory.</p> <p>b. Define Graham's law of diffusion and relate it to movement of particles.</p>	<p>c. Group reporting</p> <p>d. Introduction of the subtopic with learner's involvement.</p> <p>e. Class demonstration on diffusion of gases.</p>
10 (40min)	Graham's law	Carry out calculations on Graham's law of diffusion	f. Calculations involving teacher-learner interaction.

Cooper, Heron and Heward further noted that the most common characteristic observed is frequency or how often a behavior occurs, magnitude or how intense a behavior is and duration or how long a behavior lasts. The research assistants also observed striking learners' behavior emanating from teachers' non-verbal behavior during the teaching.

After the lesson, the four research assistants discussed the challenges encountered with a view of an improvement in the next lesson. Average mean for the four assigned numerical values in all the behavior were calculated. For instance: suppose in a given non-verbal behavior the four research assistants independently assigned, 2, 3, 2 and 4. Average = $(2+3+2+4) \div 4 = 2.75$. Then 2.75 was rounded to 3.0 which was considered a moderate behavior. The same procedure was followed up to week 2, lesson 10. The final average numerical value for each non-verbal behavior was calculated and recorded. Immediately after observation of the tenth lesson, the students' questionnaire was administered to 12 sampled students. The CAT was administered after one week of the lesson observation and marked out of 100 marks.

The research assistants discussed the three research instruments with a view of improving the reliability of the instruments in the other two pilot schools and to reduce individual bias and obtain more objective data as possible. The same process was repeated in the second and third pilot schools. To increase the trustworthiness of the data collected, the practice was done for two weeks covering ten lessons that involved lecture, class experiments, demonstration, and group reporting and teacher-learner discussion. The third school was revisited after two weeks for the purpose of working out the reliability coefficients of the instruments. Test-retest method using Pearson Moment Correlation Coefficient was used to test the reliability coefficients. All the instruments had a reliability coefficient above $r = 0.78$ which was considered adequate.

Source: Authors (2020)

Guided by the observational schedule, the research assistants independently observed teachers' and learners' non-verbal behavior during the teaching and learning of the whole class in lesson 1 and 2 of week 1. Each research assistant assigned a numerical value (1-5) to each behavior under investigation depending on one's judgement regarding the intensity of use. Cooper, Heron and Heward (2007) asserted that, behavioral observation provide quantitative and objective data that can be used to determine current levels of behavior.

Validation of the instruments was also carried out during piloting, with items that appeared ambiguous either being replaced, removed or modified. During the pilot study, no extreme deviations were noted in the scoring of numerical values in the observational schedule from the three research assistants which confirmed the reliability of instruments.

Prior to data collection, the lead study person visited the sampled schools and interacted with the principals, learners and the Chemistry teachers with the aim of creating a rapport. The lead study person explained the purpose of the study and dates were set on when the study team would visit the schools to collect data. During the actual data collection, lesson observation was carried out within the school master time table. After finishing with each lesson, the research assistants took the average Likert scale numerical value in order to reduce individual bias and obtain objective data as much as possible. Striking learners' behavior emanating from teachers' non-verbal behavior during the teaching were also discussed. After every lesson, a discussion on the challenges encountered during the lesson observation was done until all the 32 schools were observed.

Between 4.30 pm and 5.00 pm on the day of the tenth lesson observation in each of the different 32 schools, the twelve sampled students from each class sampled were given the questionnaires and guided on how to fill them.

For the purpose of the current study, the researcher did not disclose what was being observed. Thus, the respondents were unlikely to deviate from the normal non-verbal behavior they are used to because they did not know the interest of the researcher. The researchers therefore found it easy to observe the non-verbal behavior of the respondents in a natural environment. The study used multiple observers because it was cognisant that rating observation behavior may be challenging to different observers who are likely to give diverse rating which would render the instrument irrelevant to the study.

Therefore, trustworthiness of data was also enhanced through involving multiple observers and carrying out the research in a natural environment. To ensure some students did not have an advantage of recent memory of the teaching than others, the CATs were administered to each group after one week of lesson observation of each particular group. The CAT for each learner was marked out of 100 and the mean score of the 12 students from each school was calculated to form the dependent variable for this study. During the lesson observation, each Chemistry teacher was observed teaching the whole class of between 45-50 learners. According to the Ministry of Education in Kenya, public secondary schools have class sizes of 40-45 students.

Data from the questionnaires was checked for completeness, then edited for accuracy, uniformity and consistency, and eventually coded and entered using the Statistical Package for Social Sciences (SPSS). Descriptive data was analysed and presented in form of means, standard deviations and percentages. Simple regression model at 95% confidence level was employed in inferential statistics. Striking learners' behavior emanating from teachers' non-verbal behavior were recorded. The lead study person observed ethical considerations by providing consent forms to the respondents as appropriate. To uphold ethical issues, informed consent was sought from teachers, learners and from the principals who were considered by the researchers as the care-givers of students involved in this study because they were all below 18 years of age. Other ethical issues involved privacy, conflict of interest and confidentiality, and respondents informed that they were allowed to withdraw whenever they wished to.

IV. FINDINGS

This section reported the findings of the three research questions as outlined below.

3.1 Findings of the first research question

To answer the first research question, the researchers sought the opinions of students on teachers' use of non-verbal behavioral approach as an instructional practice. Secondly, from an observation schedule, the study rated the extent to which teachers used non-verbal behavioral approach as an instructional practice during the teaching of Chemistry.

3.1.1. Students' responses on teachers' use of non-verbal behavioral approach as an instructional practice

The students were asked to rate their Chemistry teachers on the extent to which they utilize non-verbal behavior during Chemistry lessons. Table 2 indicates the responses in percentages, mean score and standard deviations.

Table 2: Students' responses on teachers' use of non-verbal behavioral approach as an instructional practice during the teaching of Chemistry (N=384)

Statement	SD %	D %	NS %	A %	SA %	Me an	Std. dev
1 I enjoy Chemistry lessons because the teacher is friendly	0.4	1.8	2.7	41.3	53.6	4.49	0.675
2 My concentration in class is affected by the teacher's mood	28.2	18.7	10.0	24.3	18.8	2.43	1.509
3 I enjoy answering questions in class because whether wrong or correct, the teacher encourages us through a	4.0	3.9	4.4	39.3	48.4	4.41	1.061

smile.

4 I like the Chemistry subject because the teacher is always smart and confident.	2.7	6.0	5.7	41.9	43.7	4.09	1.032
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SA=Strongly Agree, A=Agree, NS= Not Sure, D=Disagree, SD=Strongly Disagree

The high means of statements 1, 3 and 4 and the high percentages shown in bolded responses, seem to answer the research question of students' perception on teacher's use of non-verbal interaction behavior. The researcher rated it as above average.

3.1.2 Observational rating of teachers' use of non-verbal behavioral approach during instructions

The research assistants observed each of the 32 Chemistry teachers who represented 32 classes in the 32 sampled schools. The percentage of teachers rated under each numerical value (1-5) in each non-verbal behavior was calculated and presented in Table 3. For instance, one teacher did not vary the tone throughout the two weeks of teaching. Therefore, percentage of teachers in that behavior was $1 \div 32 \times 100 = 3.125$, which was rounded to 3.1%.

Table 3: Percentage of teachers rated under each numerical value (1-5) in each Non-Verbal Behavior during Teaching and learning of Gas Laws (N=32)

	Non-verbal cues	Ratings (%)				
		1	2	3	4	5
1	Tone variation	3.1	28.1	53.1	15.6	0.0
2	Physical distance between the teacher and the learners	15.6	37.5	28.1	15.6	3.1
3	Different facial expressions	6.3	50.0	25.0	15.6	3.1
4	Use of gestures	0.0	15.6	40.6	43.8	0.0
5	Grooming/dressing	3.1	15.6	31.3	50.0	0.0
6	Eye use and contact with the	0.0	15.6	18.8	53.1	12.5

	students when asking or answering questions.					
7	Nodding	9.4	40.6	37.5	12.5	0.0
8	Different postures	9.4	18.8	40.6	28.1	3.1
9	Body movements	6.3	15.6	43.7	25.0	9.4
1	Tolerance and	6.3	31.3	46.9	9.4	6.3
0	patience					
	Mean rating	5.9	26.9	36.7	26.9	3.8

Modified from: Noureen, Chaudhry and Manzoor (2012).

5=Excellent usage, 4= Good, 3= Moderate, 2=Poor, 1= Not used at all.

The bold figures shows a breakdown of which behaviors were classified as excellent, moderate, poor or not used at all, while the mean rating findings revealed that 5.9% of teachers did not exhibit any non-verbal behavior during teaching, 3.8% exhibited excellent non-verbal behavior, 26.9% exhibited poor behavior, 26.9% exhibited good behavior and 36.7% exhibited moderate behavior. Therefore, teachers' usage of non-verbal interaction during the teaching process in the sampled schools can be rated as moderate.

3.2 Findings of the second research question

The researchers identified four schools that had striking learners' behavior resulting from teachers' non-verbal behavior.

School 1: a female teacher with excessive use of strong perfume. Students were seen reacting to the strong perfume by holding their noses.

School 2: a female teacher in a mini-skirt. There was a significant noticeable learners' attention towards the teacher. The learning atmosphere was not conducive and learners appeared uncomfortable during the lesson.

School 3: a male teacher who appeared shy and had little control of the class. Some students were conversing among themselves, hence class control was negatively affected.

School 4: a male teacher who appeared unsettled, unfriendly and irritated by petty issues from learners like giving the wrong answer. Learners appeared relaxed when the bell to end the lesson was rang.

In all the four schools, learners' attention seemed distracted by the teachers' non-verbal behavior. Interestingly, the four schools were among the last eight schools that had low mean scores in the administered CAT.

3.4 Findings of the third research question

To answer the question, simple regression analysis was carried out and findings presented in Table 4.

Table 4: Statistical analysis on effect of teachers' non-verbal behavioral approach as an instructional practice on learners' academic achievement in Chemistry

Model summary				
Model	R	R ²	Adj. R ²	Std. Error
1	0.707 ^a	0.4999	0.5130	8.5324
ANOVA				
Model	Model	Sum of Squares	Df	Mean Square
1	Regression	3465.349	1	3465.349
	Residual	2587.681	31	83.474
	Total	6053.03	32	
Coefficients				
Model	Unstandardized Coefficients	Std. Error	Standardized Coefficients	
	B		Beta	
(Constant)	-0.679	8.689		
Non-verbal	21.001	3.011	0.707	

Source: Researcher (2020)

a. Dependent Variable: Academic Performance (Student mean score)

b. Predictors: (Constant): Non-verbal interaction

Table 4 summarizes the results of the regression analysis and revealed the prediction level caused by the independent variable. The regression had a standardized coefficients of (B= 0.707, $p < 0.001$), indicating the estimate resulting from the regression analysis or the strength of the effect of the independent variable to the dependent variable. The higher the absolute value of the beta coefficient, the stronger the effect. The implication is that if non-verbal behavior is increased by a single unit, the resultant effect is an increase in the dependent variable (learners' mean score) by 0.707 units.

Further, the value of R² also referred to as the statistical coefficient or coefficient of determination, was equal to 0.4999. The ratio, which translates to 49.99%, shows the percentage of the response variable variation that is explained by the linear model.

Therefore, non-verbal behavior in the model was estimated to have contributed 49.99% of the academic achievement. This implies that, 50.01% of the academic achievement was contributed by other variables that were not part of the model which include the intervening variables. The results further revealed that non-verbal interaction had statistical and significant effect on learners' academic performance in gas laws, [$F = 41.514, P < 0.001$].

From the findings, the equation model was; $Y = -0.679 + 0.707X_2$, where Y is academic performance and X_2 is non-verbal interaction. Therefore, the findings of the current study suggest that, teachers' non-verbal behavior is a powerful instrument of instruction during teaching and learning of Chemistry.

V. DISCUSSIONS

In this section, the results from the data analysis were presented and examined in detail. Most likely, teachers might take the teachers' non-verbal behavioral approach as a technique of teaching for granted yet in the current study, the regression analysis of teachers' non-verbal behavioral approach in the model predicted that non-verbal behavior variable contributed 49.99% to academic achievement in Chemistry. This study therefore quantified the dependent variable resulting from the independent variable. The findings suggest that teachers' non-verbal behavior seem to support other teachers' teaching methodologies during teaching and learning. From the findings, it is very probable that use of teachers' non-verbal behavioral approach could significantly improve the widespread poor academic achievement in Chemistry and other subjects. Therefore, the findings suggest that teachers' non-verbal behavioral approach is an effective pedagogical practice that can promote student learning and enhance quality delivery of learning. The findings from the regression analysis conform to results emanating from the students and study rating concerning teachers' use of non-verbal behavior. The average rating,

supported by the regression analysis model, can be perceived as a true reflection of what actually happened on the ground. This is supported by the fact that the respondents had no prior information about what the researchers were interested in observing and identifying. Therefore, the 49.99% academic achievement contribution by the non-verbal behavioral approach that resulted from the regression analysis confirms the overall average ratings that emanated from the analysis of the first research question.

The implication of these findings is that behavior such as a smile, gesture, mode of dressing, eye contact and teacher's friendliness to students seems to narrow the psychological and emotional gaps between the teacher and the student during teaching and learning. Barati (2015), Goodall and Kachur (2005) and McIntyre, Mulder and Mainhard (2020) for instance asserted that learners who exchanged consistent eye contact with their teachers seemed to have higher concentration in learning compared to those who did not engage in this manner. Further, eye contact makes the learner not only feel part of learning, but also encourages and raises the learners desire to learn. This conforms to the Affiliative Conflict Theory that guided the current study because the intimacy equilibrium determine the overall level of involvement in non-verbal interaction. This study suggests that despite an impressive lesson plan and lesson notes with detailed content, a teacher may not achieve the desired objectives of the lesson if the aspect of the teacher's non-verbal behavior is not part of the lesson plan. What is emerging from this study is that non-verbal behavior of a teacher attract the learners to the context of learning and improve the learning environment.

As such, all the other methods of teaching are supported by teachers' use of non-verbal behavior resulting to improved quality learning.

Table 2 mean of 4.09 with 41.9% and 43.7% agree and strongly agree confirmed the students' responses that their teachers of Chemistry were always smart.

However, the researcher's observation slightly differed because 31.3% were moderate in grooming and 50.0% good. This discrepancy can be attributed to the fact that the research assistant's way of judging the mode of dressing may be different from that of the learners. Nevertheless, the effect of dressing may not be out rightly observed, but the impression created in learners have some influence on learning (Kashem, 2019) and if one considers the adage "cleanliness is next to Godliness", the value can influence students' respect for the teacher. Normally, respected teachers are performers in terms of curriculum delivery and learning outcomes. Indeed, well-groomed teachers command a lot of respect in learners which in turn works as a motivating interest and learning of the subject because the psychology works at student's mind that by a smart outlook smart presentation is possible (Kashem, 2019). The implication here is that the mental image of a teacher that a student holds plays a big role in the attitude of a student towards the subject taught by that teacher. Supporting the argument, a study by Musyoki (2015) that was done in Machakos County, Kenya, established that positive attitude towards the subject teacher had a positive influence on performance of Chemistry. It is likely that effective use of teacher's non-verbal behavior like dressing can develop students' positive attitude towards their teachers which is likely to improve the performance.

Another example of a mental image of the teacher being a motivation for students is the characteristic of patience and tolerance by a teacher. From the findings, a significant number (37.6%) of Chemistry teachers lacked patience.

Teachers who do not exhibit patience and tolerance may create a big barrier between them and the students such that irrespective of how knowledgeable they are, they may not be able to disseminate the knowledge to learners effectively. Tolerance and patience are two values that need to be inculcated in teachers because slow learners

require tolerant and patient teachers. Supporting the current study, Alan (2017) in a study titled "*Fostering Patience in the Classroom*" revealed that noncognitive skills like tolerance and patience are strongly associated with predictive power on outcomes including educational attainment. Teachers did not score well on body movement which is a non-verbal behavior that can be perceived differently by learners. Indeed, when well utilized, it may attract the attention of learners. Some researchers suggest that, teachers' positive body movement can be applied successfully as a motivational strategy to enhance learners' motivation (Bauernfeind, Marie, 2016; Benes, Finn & Sullivan, 2016 and Meriem, 2017). Such motivated learners are high achievers in academics.

The findings of the current study reveal that teacher's use of non-verbal behavior plays a significant influence on learners; determining the outcome of a lesson. This was evidenced by the low mean scores from the four schools that had negative striking learners' responses emanating from teachers' non-verbal behavior (Results of the second research question). This seems to suggest that some teacher's nonverbal behavior found in classrooms inhibits learning. Supporting the findings Lisa (2006) and Wahyuni (2018) asserted that teachers' style of non-verbal behavior determines the level of learners' understanding of concepts and is a key factor if effective teaching in any subject matter is to be achieved. Thus, non-verbal behavior create an effective supportive learning environment where learners do not feel threatened or intimidated resulting to a fundamental psychological need. One implication here is that a Chemistry teacher needs to create a warm and safe atmosphere which conforms to the Affiliative Conflict Theory. This warm safe atmosphere would seem to raise students' self-esteem so that in turn, students are self-motivated, confident and above all experience reduced anxiety during the learning process. In such a situation, the teacher will create an intimacy equilibrium with learners. Chemistry teachers are likely to achieve such an environment if they

skillfully use non-verbal behavior, impacting positively on students' attitude towards learning. The issue of attitude is supported by Barineka (2012) and Vilia, Candeias, Neto, Franco and Melo (2017) whose findings revealed a significant positive association between the learners' attitude towards Chemistry and learners' achievement in Chemistry. Vilia et al asserted that both attitudinal attitude and cognitive variables are critical in science education and learning interventions. This is supported by several studies that include Abdullahi (2017), Khaombi (2016) and Makato (2016) that established that students have negative attitude towards Chemistry since they perceived Chemistry as a difficult subject. Student's dislike of chemistry can be attributed to such negative attitude. If skillfully utilized, non-verbal instructional behavior is likely to significantly change the students' attitude towards Chemistry resulting to higher academic achievement. This can be interpreted to mean that the type of non-verbal behavior displayed by the teacher has an impact on learners' emotional and social development. According to psychologists, the intellectual growth of a learner requires emotional stability which can only be facilitated by a teacher who creates an intimacy equilibrium with learners (Weeks, 2000).

VI. CONCLUSIONS

The current study reveals that effective teachers' non-verbal behavior is a noncognitive predictor variable of learners' academic achievement in Chemistry. In line with the Equilibrium Theory approach model, teachers need to embrace non-verbal behavior to create more interest and attention to learners.

Therefore, the conventional techniques of teaching can be reinforced with non-verbal behavioral approach as an effective pedagogical support tool for teaching. Further, the current study reveals that teachers' non-verbal behavioral approach is a pedagogical approach that can be utilized to provoke learners' interest in Chemistry lessons. It indeed enhances the cognitive ability of a learner.

Based on the conclusion of the current study, teachers' non-verbal behavioral approach can be used as an intervention measure to improve the widespread poor academic achievement in Chemistry. Therefore, the theory behind the current study yielded the predictions that effective teachers' non-verbal behavioral approach is a key component to achievement of higher learners' academic achievements and hence such teachers' competencies are of paramount importance.

5.1 Contribution to new knowledge

The study can thus be used to improve the educational intimacy equilibrium in Affiliative Conflict Theory and consequently improve students' learning and pedagogical practices in Chemistry and other disciplines of learning. The study possibly will contribute a new insight of teachers' non-verbal behavioral approach as a support and intervention tool to the already existing conventional methods of teaching that are currently in use. The results of the present study will support policy efforts to improve student academic achievement by promoting teachers' non-verbal behavioral approach during the teaching process. Given the number of limited but related studies available, the study findings will form the basis for further studies and also help in building more literature for the subject matter. These results build on existing evidence of the importance of non-verbal communication in learning.

5.2 Suggestions

The study recommends widespread studies with use of different subjects, a bigger sample size, level of learners and learners from different cultural background for comparative results.

Additional information

Conflict of interest

The authors declare that they have no conflict of interest.

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