

Learner-teacher non-verbal interaction effect on academic achievement of learners in chemistry

Mwangi Newton Irungu*, Grace Nyagah and Mercy Mugambi

School of Education, Department of Educational Administration and Planning, University of Nairobi, Kenya.

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ABSTRACT

This study aimed at establishing the learner-teacher nonverbal interaction effect on academic achievement of learners in Chemistry. Two null hypotheses were generated for the study: H_{01} : There is no statistically significant effect of learner-teacher nonverbal interaction on learners' academic achievement in Chemistry. H_{02} : There is no statistically significant relationship between learner-teacher nonverbal interactions on learners' academic achievement in Chemistry. Descriptive survey design was adopted for the study while the study was based on Vygotsky social development theory. Data was analyzed using descriptive and inferential statistics. The results of simple regression analysis revealed that, non-verbal interaction had statistically significant effect on learners' academic achievement [$F=37.959$, $P<0.001$]. The regression had a standardized coefficient of ($B=0.759$, $p<0.001$) indicating that increasing use of non-verbal interaction by a single unit would lead to an increase in students' performance by 0.759 units. Results of Pearson Product-Moment Correlation Coefficient revealed a strong positive relationship ($r = 0.7586$) between the independent and the dependent variables. From the results of this study effective use of nonverbal interaction during teaching and learning enhances quality learning leading to high academic achievement. The new knowledge arising from this study indicates that, teachers should adopt nonverbal interaction as a teaching method to enhance higher academic achievements.

Keywords: Lesson observation, learners' academic achievement, nonverbal interaction, curriculum.

*Corresponding author. E-mail: mwanginewton61@yahoo.com.

INTRODUCTION

Luu and Nguyen (2010) defines interaction as the collaborative exchange of ideas, feelings or thoughts between two or more learners, where the participants benefit from one another. Through interaction, learners can gain knowledge as they listen to one another through dialogue, discussions and joint problem-solving tasks. It is through the process of interaction that learners are actively involved, contribute in the process of learning and build knowledge from what they already have, leading to meaningful learning. Teachers should always give a chance to learners to contribute and never assume that learners know nothing. Teachers should shift from the old tradition beliefs that learners are blank vessels and came to school to be fed with knowledge. Constructivist views show that learning involves building

on what the learner knows so that, the learner brings it to the current situation, restructure it and create new knowledge (Roberts and Billings, 2008). Therefore, interactive or social learning becomes very effective because it involves sharing of experiences from different background knowledge and interests of different learners. This is supported by Page (2010) who noted that for learners to learn creative methods to solve complex problems, social interaction among learners is one of the most effective ways that need to be incorporated in curriculum delivery methodologies. Therefore effective teachers ensure there is social interaction practice among the learners and the teacher for meaningful learning to take place. Non-verbal interaction is a behavioral response style of interaction where the

learners and teacher engage each other through non-verbal means such as eye contact, nodding of the head, raising hands and gestures.

Fabri et al. (2015) describe the term "nonverbal" as human interaction events that transcend the spoken or written word, while Fatemeh et al. (2014) described nonverbal interaction as the process of one person using cues such as gestures and facial expressions to stimulate meaning in the mind of another person by means of non-linguistic. Non-verbal interaction may take place primarily through several ways like non-verbal vocalization, types of clothes, bodily contact, how a teacher express the face, gaze, types of gesture, one's body posture. Therefore, non-verbal interaction can be equal to or more effective than oral interaction.

According to Okon (2011) widely used types of nonverbal interaction in both humans and other primates are emotions through facial expressions. Cross-cultural studies have revealed a similarity of physiological reactions to universal facial expressions, from people of different cultures across the world (Manusov and Patterson, 2008, as cited by Okon, 2011). For example, when one smiles, this is universally taken as a sign of happiness, while furrowing the brows and tensing and hardening the facial muscles is taken as a sign of being annoyed. A competent teacher pays attention to learners, listens with signs of interest, notes the learners with interest and those not interested and creates interest through nonverbal means so as to raise the learners' desire to learn.

When a teacher appears happy, smartly dressed, displays admirable behaviour like the way the teacher walks, learners are likely to be interested in the lesson compared to a teacher who appears annoyed, angry, scaring face and intimidating. Therefore the way teachers portray themselves during instruction is likely to have a positive or negative effect on the academic achievement of learners. For instance, Miller (2005) observed that a genuine smile can result in a warm environment that can raise the learners' desire to concentrate during the teaching and learning process. If learners are intimidated by the facial expressions of the teachers, they will not be free to interact with the teacher during teaching and learning process which affects acquiring of knowledge transmitted by the teacher. The nonverbal impression a teacher creates to learners during teaching and learning determines the extent of learner's concentration and desire to learn.

Therefore, teachers should set a continuous mood of learning through nonverbal interaction even before the lesson commences so as to create interest in learning among the learners. Results from a study by Julia (2014) revealed a strong positive relationship between teachers' higher ratings of nonverbal behaviors and higher ratings of effectiveness while participants equated teacher expressiveness with teacher enthusiasm. If this can be

achieved by a teacher, the outcome will probably be improved academic achievements.

Findings from a study by Noreen et al. (2012) in Pakistan on teachers' nonverbal behavior and its effect on learners' academic performance found that, the nonverbal conduct of the instructors was reliable with their verbal conduct and influenced learners' academic achievement. The study was on physics, biology and chemistry and observation schedule and video recording were used as the instruments to measure the non-verbal teaching behavior. The current study used observation schedule to authenticate the results in the Kenyan context and narrowed down to chemistry subject while data collection was enriched through focused groups and interview schedule to measure the non-verbal teaching behavior. A study by Sukris (2018) revealed that nonverbal interaction significantly and positively affects learners' English academic performance. Questionnaire was the main data collection tool and the end of year English examination provided the scores while regression analysis was used to analyze the data. The current study enriched collection of data using observational schedules and analyzed the data through regression, descriptive analysis, Pearson Moment Correlation and ANOVA while chemistry subject was the focus of this study. Another study by Lisa (2006) on the impact of perceived teachers' nonverbal immediacy on students' motivation for learning English in Taiwan revealed that, learners' morale for learning English is likely augmented when the instructor uses behaviors such as: smile, signal, relaxed body position, vocal articulation, and utilizations of a monotone voice during learning. From the correlation analysis, it was found that educator's nonverbal immediacy practices significantly and positively related to students' motivation during teaching and learning of English. The study under review focused on motivation of learners in English as the dependent variable while the current study focused on academic achievement in chemistry as the dependent variable.

A study by Bambaeroo and Shokrpour (2017) on the effect of the teachers' non-verbal interaction on success in teaching revealed that, non-verbal interaction by teachers during the learners' speech shows that they accept and avoid self-centeredness, while attention by educators' to the learners' nonverbal behaviors during instructions like eye to eye contact, signs of fatigue, humor shows the teachers' concern with the learners' mental and physical status. In addition, the study further revealed that amount, quality and technique of utilization of non-verbal interaction by educators' while teaching was strongly and positively related. From the results it can be argued that the outcome is improved quality learning that is likely to improve the learners' performance which is the focus of the current study as the dependent variable. Some of the suggestions made by Bambaeroo and Shokrpour (2017) were that,

attempts should be made to attract and guide the attention of students' through non-verbal interactions while teaching. Additionally, humor, coordination of sound and fun are perceived as effective in promoting process of teaching and learning. One of the suggestions was that educational programs and workshops be held on efficacious association among students and their educators so that learners can get familiarized with skills on non-verbal interaction to improve the process of effective teaching and learning.

A study by York (2015) on nonverbal immediacy role on student learning revealed a positive impact of nonverbal interaction on learners' academic achievements. The study sought to establish the correlation between teachers' nonverbal interaction and learners' achievement academically. The study revealed existence of a relationship between nonverbal interaction and learners' academic achievement. The study targeted post-secondary learners while the current study targeted secondary school learners. The results of Pearson Moment Correlation coefficient from a study by Lisa (2006) revealed that teachers' nonverbal immediacy behaviors and learners' motivation for learning English were positively and significantly correlated. Further analysis using multiple regression revealed that five nonverbal behaviors were significant predictors to learners' motivation for learning English. The researcher further suggested that, the following behaviors: gesture, uses a variety of vocal expression, a relaxed body position, smile and uses a monotone voice while teaching enhances learners' motivation for learning English. The study noted that a smile is a link to interaction with learners. Learners are likely to be more receptive, attentive and relaxed when teachers carry a smile on their face in the process of teaching and learning. Though the aspect of a smile might be underrated, the findings give teachers an insight to relate facial expression and how it influences learners' motivation during learning of English. This study focused on motivation of learners in learning English while academic achievement in Chemistry was the focus of the current study.

Results of a study by Fatemeh et al. (2014) revealed that teachers' facial expressions and eye contact played a fundamental role in students' learning of language. Through eye contact, teachers can make the learning environment in the classrooms active by making the learners alert through teachers' eye contact. This results in active participation environment during the learning process, enhancing the level of learners' retention and understanding of concepts taught. Teachers' body movements like during the teaching of stories also provide a strong basis for the teacher to be effective in their teaching and if they use them properly, they supply students with additional information. When the head, shoulders, and hands are skillfully used, the learners are in a better position to understand difficult learning

concepts. The major source of the data collection in this study was a questionnaire. The current study used observation schedule as the main instrument and was based on academic achievement in chemistry in the Kenyan context. A study by Lisa and Calvin (2006) showed a strong positive correlation between teachers' nonverbal immediacy behaviors and the willingness of learners to speak in English at a statistically significant level. The current study will investigate the effect of teachers' and learners' nonverbal interaction on academic achievement in Chemistry.

A study by Mehdipour and Balaramulu (2013) revealed that teacher's friendliness and attitude toward the learners had a positive significant impact on suitable behavior in educational environments leading to high motivation towards learning and enhanced discipline of students. Friendly behaviour was enhanced by non-verbal behaviour. This study focused on students' change of behaviour and motivation while the current study focused on nonverbal interaction and academic achievement. One of the gaps identified by this study was that, the area of effect of nonverbal behaviour on learners' academic achievement has not been well explored, hence limited access to recent studies. This was the focus of the current study and it was based on chemistry as a subject matter.

Objectives of the study

The following objectives guided the study:

- a) To establish learners' perceptions on the use of non-verbal interaction by teachers of Chemistry.
- b) To determine the extent at which non-verbal behaviour were used by teachers of Chemistry during teaching and learning.

Research hypotheses

Two null hypotheses were generated for the study:

Ho₁: There is no statistically significant effect of learner-teacher nonverbal interaction on academic achievement of learners in Chemistry.

Ho₂: There is no statistically significant relationship between learner-teacher nonverbal interactions on academic achievement of learners in Chemistry.

METHODOLOGY

The following research method was adopted for the study. Descriptive survey design was used for this study while mixed methods approach involving quantitative and

qualitative methodologies were used. Data in dependent variable was provided in scores. The higher the scores, the higher the dependent variable and the lower the scores, the lower the variable. Therefore this study was mainly quantitative because the focus of the dependent variable was the learners' academic achievement in Chemistry. The quantitative measure of learners' level of academic achievement was the scores they attained in the administered Chemistry achievement test.

The targeted group for this study was purposively selected and consisted of academically average public secondary schools with average mean grades of D+ to C in Chemistry in the last eight years. The researcher used Yamane (1967) formula to calculate the sample size which was three hundred and eighty four Form three Chemistry students, thirty two teachers of Chemistry from thirty two public secondary schools in Murang'a County.

The main data collection instrument was a Structured Lesson Observational Checklist. The researcher sat at the back of the classroom during teaching and learning of Chemistry and recorded the interaction behaviour of teachers and learners. A Chemistry Achievement Test (CAT) was administered to the students so as to get scores which formed the dependent variable for this study. To supplement the study with more data, the researcher used Student's Questionnaire, Document Analysis Guide, Interview Guide for the County Quality Assurance and standard officer (CQASO) and Student Focus Group Discussion Guide. The data collection instruments were piloted in two public secondary schools that were not used in the actual study.

To ensure content and construct validity of the CAT, questions were picked from Kenya National Examinations Council (KNEC) past papers and three teachers of Chemistry with more than five years of marking national examinations in Chemistry developed the marking scheme, which was used by the researcher to mark the learners' work. The content validity of the other instruments was enhanced through use of remarks and recommendations from the supervisor and the academic proposal defense panels at departmental and school levels. Pearson's Product-Moment Coefficient of correlation (r) was used to test the reliability of the instruments using test-retest method. Any instrument that had a reliability coefficient of 0.8 and above was accepted while any instrument with reliability coefficient of less than 0.8 was reviewed with an aim of improving it. The researcher attended Chemistry lessons in 30 sampled secondary schools during teaching and learning and collected observational data. Students were then given the questionnaires and guided on how to fill them. A CAT was administered at the end of the topic after which the researcher collected qualitative data through group discussion and from the QUASO.

Data from the lesson observation checklist was analyzed using simple regression analysis and analysis

of variance (ANOVA). Descriptive statistics were used in analyzing data that was collected using questionnaires and data presentation was done in frequency tables, percentages, mean and standard deviations. Qualitative data was thematically analyzed using content analysis as per objective.

DATA ANALYSIS, INTERPRETATION AND DISCUSSION

Computer package SPSS (Statistical package for social sciences) was used to analyze the data. The first null hypothesis was analyzed using Simple regression analysis, analysis of variance (ANOVA), the second null hypothesis was analyzed through Pearson Product-Moment Correlation Coefficient, while the quantitative data was presented in frequency tables, percentages, mean and standard deviations. Qualitative data was thematically analyzed using content analysis as per objective. Generated data was analyzed, interpreted and discussed under the following sub-themes:

Testing of hypothesis (H_{01})

To analyze the first hypothesis, simple regression analysis was used to establish the effect of non-verbal interaction on academic achievement of learners. The hypothesis stated that, "There is no statistically significant effect of learner-teacher nonverbal interaction on academic achievement of learners in Chemistry." To test this hypothesis, the model $Y = B_0 + B_2X_2 + \epsilon$ was used. Table 1 shows the regression analysis results on the effect of non-verbal interaction on students' academic achievement.

The results indicate that non-verbal interaction had statistically and significant effect on academic performance of learners, [$F = 37.959, P < 0.001$]. The regression had a standardized coefficient of ($B=0.759$ $p < 0.001$) indicating that increasing use of non-verbal interaction by a single unit would lead to an increase in students' performance by 0.759 units. The statistic coefficient (R^2) provides the amount of variation that can be accounted for by the independent variable which is the non-verbal interaction. With $R^2 = 0.58$ in the model, this implies non-verbal interaction explained 58% of the variation in academic achievement which is the dependent variable in this study. Therefore, the model explained only 58% of change in academic performance, meaning that the remaining 48% can be explained by other factors that were not part of the model. From the findings, the equation model was;

$$Y = -0.664 + 0.759X_2$$

Table 1. Regression analysis results on the effect of non-verbal interaction on academic achievement of learners.

Model summary						
Model	R	R²	Adj. R²	Std. error		
1	0.759 ^a	0.575	0.560	9.4468		

ANOVA						
Model	Model	Sum of squares	Df	Mean Square	F	Sig.
1	Regression	3387.538	1	3387.538	37.959	<0.001 ^b
	Residual	2498.793	28	89.243		
	Total	5886.331	29			

Coefficients						
Model	Unstandardized coefficients		Standardized coefficients		t	Sig.
	B	Std. Error	Beta			
(Constant)	-0.664	8.595			-0.077	0.939
Non-verbal	20.478	3.324	0.759		6.161	<0.001

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

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

Where Y is academic performance and X_2 is non-verbal interaction.

Because the p-value was less than 0.05, the null hypothesis was rejected and the study concluded that: There is a statistically significant effect of learner-teacher nonverbal interaction on academic achievement of learners in Chemistry. Therefore, from the results of this study, teachers of Chemistry should use nonverbal interactions as a method of curriculum delivery to supplement other teaching methodologies.

Testing of hypothesis (H_0)

The second hypothesis stated "There is no statistically significant relationship between learner-teacher nonverbal interactions on academic achievement of learners in Chemistry". To determine the relationship, Pearson Moment Correlation Coefficient was carried out. Table 2 below shows the outcome of the analysis.

Table 2 shows results of Pearson Moment Correlation Coefficient which revealed a strong positive relationship (r) between teacher-learner nonverbal interactions and academic achievement of learners in Chemistry. $r = 0.7586$ is close to 1 meaning a strong and positive relationship between the dependent (academic achievement) and independent variable (Nonverbal interaction). Therefore, the null hypothesis was rejected, implying, there is a statistically significant relationship between learner-teacher nonverbal interactions on academic achievement of learners in Chemistry. This is

in conformity with the results in Table 1, confirming the recommendation, that, teachers of Chemistry should incorporate nonverbal interactions in their teaching methods.

The empirical results of this study indicated that use of non-verbal interaction was a crucial factor for teaching and learning among secondary schools and it creates impacts in the environment of a classroom. The findings are in agreement with conclusion reached by Noureen et al. (2012) in their study on teachers' nonverbal behaviour and its effects on learners achievements in Pakistan which found strong and significant associations between use of nonverbal aspects of teaching such as tone of voice, face expressions, eye contact, gestures and posture of the teacher with learners' academic achievement. The results are also in conformity with a study by Fatima et al. (2016) who conducted a study on non-verbal interaction and its effect on students at secondary level in Pakistan and found that the use of non-verbal interaction enhances quality learning during teaching and learning process hence improving students' academic achievement. Therefore, the use of effective non-verbal interaction improves quality delivery of the curriculum implementation leading to improved academic achievements in Chemistry.

Bunglowala and Bunglowala (2015) had similar observations in that teachers can make learners to be alert and participate, enhance their retention and comprehending levels by making the learning environment active through their non-verbal interaction. Nonverbal cues like eye contact, body movements,

Table 2. Relationship between learner-teacher nonverbal interactions on academic achievement of learners in Chemistry.

Variables	Academic achievement	Non-verbal interaction
Academic achievement	1	
Non-verbal Interaction	0.7586**	1

proper use of facial expressions, pitch of voice, and spatial distance helps the teachers to facilitate better understanding of concepts leading to high attainment of students learning outcomes. Bambaerero and Shokrpour (2017) identified some non-verbal interaction, as imaginative, supportive, team work, purposive, emotive, and balanced communication and all were found to effectively influence learning and academic success of students. The study suggested that the teachers' should be conscious of learners' moods of learning in different seasons of the year and arrange topics according to learners' moods and readiness to learn. The study concluded that practicing of these skills by educators will positively and profoundly affect the mood of the learners' and consequently raise the academic achievement.

Perceptions of learners on the use of non-verbal interaction by teachers of Chemistry

The first objective stated: "To establish learners' Perceptions on the use of non-verbal interaction by teachers of Chemistry."

To achieve this objective, the researcher sought to establish the students' attitude towards various teachers' non-verbal interactions on their learning in class. Learners were provided with questionnaires and guided by the researcher on how to fill them depending on the extent to which each agreed with the statement. The ratings were done using a Likert scale and presentation done in Table 3.

The results indicated that 95% of the respondents agreed that their teacher of Chemistry look very friendly while teaching, while 48.9% of the students disagreed that different moods like anger, happiness in their teacher of Chemistry affect learning. Learners are likely to do well in subjects where teachers are friendly. In other words, when learners like a teacher they are likely to associate the teacher with the subject, hence enjoy learning leading to higher academic achievement. Unfriendly teachers are unattractive to learners and learners may suffer psychologically, hate the teacher and consequently hate the subject, leading to low quality learning and low academic achievement.

The issue of different moods like anger or happiness in a teacher affecting the learner requires more research, since different learners are likely to behave differently.

Furthermore, 87.7% of the students agreed that their teacher of chemistry always appreciates any answer that they give through nodding and facial expression while 85.6% agreed that their teacher of Chemistry encourages them to appreciate others when they participate in class. The reaction of a teacher and classmates towards a learner can have a big impact on learners' motivation. For instance, when the learner is appreciated through nodding, facial expression, thumb up, it shows approval by the teacher. This raises the motivation level towards learning leading to high academic achievements. These results are in conformity with results of several studies. For instance, Babelan (2012) found that the majority of teachers' one on one conversations were gestures, sign language and non-verbal interaction and teacher's appropriate and timely non-verbal behaviors and students' academic achievement and good behavior were significantly correlated. Gholipour (2007) found that when the learner is appreciated through nonverbal means, motivation level towards learning is high leading towards high academic achievements. Therefore, if a teacher portrays behaviour that encourages the learner, the learner will respond by being more attentive leading to effective learning whose outcome is likely to be high academic achievement. Therefore, from the students' perception, teachers were using non-verbal interaction effectively to encourage the learners. This is also evidenced by the high mean rating from learner's responses. The researcher further used students' group discussion to find out more on non-verbal interaction in the classroom during teaching and learning. The general view was that, teachers were using nonverbal interactions during teaching and learning. However, the researcher could not verify whether teachers' were using the interaction deliberately.

CQASO was interviewed by the researcher regarding nonverbal interaction and the study revealed that the common nonverbal interactions were the way a teacher walks, talks and facial expression. Therefore, from the results of this study, non-verbal interaction is practiced by teachers of Chemistry during teaching and learning which may lead to higher academic achievement in Chemistry. This enhances a conducive learning environment that makes learners attentive and develops a liking for the teacher that leads to liking of the subject, hence creating interest for learning and improving the quality of learning that may lead to higher academic achievement. This is in

Table 3. Students' perceptions on the use of non-verbal interaction by teachers.

Statement	SD%	D%	NS%	A%	SA%	Mean	Std. dev
Our teacher of chemistry look very friendly while teaching	0.3	1.9	2.8	41.1	53.9	4.46	0.675
Different moods like anger, happiness in our teacher of chemistry affect learning	29.2	19.7	10.0	23.3	17.8	2.81	1.509
Our teacher of chemistry always appreciates any answer that you give such as through nodding and facial expression.	5.0	3.9	3.3	28.3	59.4	4.33	1.061
Our teacher of chemistry encourage us to appreciate others when they participate like clapping	3.9	5.0	5.6	33.9	51.7	4.24	1.032

SA = Strongly Agree, A = Agree, NS = Not Sure, D = Disagree, SD = Strongly Disagree.

conformity with Najafi and Rahmazade (2013) who found that non-verbal interaction is often subtler and very effective compared to verbal interaction and has the ability of conveying meaning in a better way compared to words. They further stated that through using this skill, teachers have the ability of playing critical roles in enhancing the concentration of learners during the teaching and learning process. This is because, using non-verbal interaction, allow teacher to draw the attention of students to understand better and motivate them and excite learners with low concentration (Najafi and Rahmazade, 2013). The whole class is therefore, likely to be attentive to the teacher and active enhancing meaningful learning.

Teachers' rating on use of various non-verbal interactions in teaching

The second objective stated that: "To determine the extent at which non-verbal behaviour were used by teachers of Chemistry during teaching and learning."

The study sought details on the rating of various non-verbal characteristics exhibited by teachers while teaching the students. This was administered using the lesson observation checklist and the following non-verbal features were put under consideration: use of eye contact, gestures, body language and tone variation. Rating of responses was done using a 5-point Likert scale where 1 = Highly Inconsistent, 2 = Moderately Inconsistent, 3 = Partially Consistent, 4 = Moderately Consistent and 5 = Highly Consistent. Table 4 presents the findings of the study.

The results indicated in Table 4 show the ratings of various non-verbal interactions used by the teachers of Chemistry while teaching. The findings indicate that the majority of teachers (60.0%) were moderately consistent while maintaining eye contact with the students. While a teacher is looking at the learner this provokes the student to think because this is a non-verbal way of what the

teacher is expecting from the learner, hence the student participate or interact within the learning environment. When asking questions, 63.3% of the teachers were moderately inconsistent in showing different variety of gestures. Gestures are a means of interaction and have an impact on the learner. Gestures like nodding are a sign of approval or appreciation and they encourage learners to be interactive and generate knowledge. This is supported by Khabaz (2013) whose study revealed that, when a teacher shows no interest to a learner through gestures, the learner becomes disinterested in learning, leading to low academic achievement. Therefore teachers need to be more active in displaying gestures to enhance effective learning. Furthermore, 40.0% of the teachers were partially consistent, 16.7% highly inconsistent and 26.7% moderately inconsistent while using nonverbal behavior to motivate the students.

Therefore, the results revealed that the majority of teachers were poor in using interactive body language to learners. The way the teacher walk, hands movements may influence the interaction of learners. Indeed, learners are always alert observing the interactive body language which influences learning. In the study, 43.3% of the teachers were partially consistent, 36.7% moderately consistent and 6.7% highly inconsistent in using non-verbal behaviour while accepting students' ideas. The study revealed that teachers were not very good in accepting students' ideas. Whether correct or wrong, student's ideas need to be appreciated, accepted and improved. This encourages learners to bring out and share what they know. Quality learning requires that students build on what they already know (Salimi, 2014). Additionally, 26.7% of the teachers were highly inconsistent, 33.3% were moderately inconsistent and 26.7% partially consistent in use of tone variation.

Teachers should interact with learners through different tones depending on circumstances or vary tone to avoid monotony. For instance, teachers gifted with loud voice need to vary. The findings show that majority of teachers were partially consistent in the use of non-verbal

Table 4. Teachers' use of non-verbal interaction while teaching.

Statement	HI%	MI%	PC%	MC%	HC%
Teacher maintenance of eye contact with the students when asking questions	3.3	10.0	26.7	60.0	0.0
Teacher shows a variety in gestures	23.3	63.3	10.0	0.0	3.3
When guiding learners, teachers' nonverbal behavior motivates the participation of students	16.7	26.7	40.0	13.3	3.3
Teachers nonverbal encourages when they accept ideas of learners	6.7	36.7	43.3	13.3	0.0
Teacher ensures variety in tone and variation	26.7	33.3	26.7	13.3	0.0

Adapted from: Noureen et al. (2012).

HI = Highly Consistent, MC = Moderately Consistent, PC = Partially Consistent, MI = Moderately Inconsistent, HI = Highly Inconsistent.

interactions in class. This implies that teachers should be encouraged to use non-verbal interactions during the teaching of Chemistry to improve students' motivation which is likely to improve their academic achievement. These results are in conformity with Mortazavi (2013) who carried out a meta-analysis of patterns of interaction in a journal article in Mathematics. The results of the study established that effective learning of Mathematics can be enhanced through body interaction by use of collaborative, supportive, and emotive methods. Therefore, from the current study teachers of Chemistry in Murang'a County were moderately using nonverbal interaction during teaching and learning. For effective and meaningful learning, learners should also be encouraged to use nonverbal interaction in the classroom during teaching and learning. For instance, while teaching, a nod, or paying attention encourages the teacher or peer teacher leading to more desire to continue teaching. This is because even teachers need to be encouraged. Therefore, both teachers and learners should use the nonverbal interactions to encourage one another, which will improve the learning environment, leading to quality teaching and learning and consequently higher academic achievements.

CONCLUSION

Through the statistical analysis of data the conclusion arising from this study revealed that non-verbal interaction positively and statistically influences the academic achievement of learners in Chemistry. Descriptive analysis also reveals that the majority of teachers are using this pedagogical practice either deliberately or unknowingly. Learners also seem to enjoy the learning process when nonverbal cues are practiced in class. This is probably due to the fact that, a concept can be easily conveyed or expressed through the use of non-verbal interaction. Another conclusion arising from this study, is that, if teachers of all subjects use non-verbal interaction effectively, quality teaching and learning is likely to be enhanced, which will ultimately

raise the learners' academic achievement.

RECOMMENDATIONS

- i. Non-verbal interaction skills should be incorporated in teachers' in-service programs to enhance teachers' teaching competence and their pedagogical skills.
- ii. The Ministry of Education needs to organize intensive capacity building workshops targeting practicing teachers of Chemistry to improve their pedagogical skills in effective nonverbal interaction to improve their teaching skills.
- iii. The Ministry of Education should bring the results of this study to the attention of all education stakeholders to update them on the new knowledge arising from this study.

Suggestions for further research

The following suggestion was made for further research: Given that this study focused only in Murang'a County, similar study should be conducted in other parts of the country for comparative purposes. A nationwide study would be indeed useful to compare the findings from other counties in the country.

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