PHYSICS CLASSROOM DISCOURSE FAVORS BOYS MORE THAN GIRLS: A MYTH OR REALITY?

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Mode of instruction used in teaching is key to the understanding of the concepts and skills to be learned. Instruction in classrooms is controlled to a larger extend by the interaction patterns involving teachers, learners and resources. Some interaction patterns seem to promote learning especially science subjects. In Kenya, enrolment and performance of girls in Physics has been comparatively low for a long period of time when compared to their male counterparts. This concern was one of the objectives that prompted a study on interactions in Physics lessons with the aim of determining the common patterns that can aid in drawing possible inferences on the effects of instruction in Physics. The study was descriptive in nature and five schools in Matungulu district (Kenya) were used. The main instrument was modified Flanders' Interaction Analysis Categories (FIAC) that was used in Physics lessons. Data was analyzed using ratios, percentages and chi-square. It was observed that there exists a significant difference in the teachers' verbal behavior patterns in the boys' and girls' schools. Teachers in girls' schools used patterns related to 'direct' methods that created autocratic climate in class and hence limited participation in girls during lessons. On the other hand, patterns in the boys' schools related to 'indirect' methods which encouraged boys to ask questions and interact with resources more, thus creating a more democratic learning climate. It is therefore important for teachers to give equal attention during classroom discourse in Physics to both boys and girls.

List of Acronyms and Abbreviations Used

ICT - Information Communication and Technology
IT - Information Technology
K.C.P.E - Kenya Certificate of Primary Education
K.C.S.E - Kenya Certificate of Secondary Education
K.N.E.C - Kenya National Examinations Council
MoE - Ministry of Education
NEPAD - New Partnerships for Africa's Development
PDSI - Plan, Do, See Improve
SMASSE - Strengthening Mathematics and Science in secondary education
F.I.A.C - Flanders' Interaction Analysis Categories

Definitions of Terms Used

Active Participation: Overt or observable involvement in a learning activity
Communication: The sharing of thoughts and feelings through words or symbols that have approximately the same meaning for all involved
Classroom Climate: The atmosphere and environment in which students and teachers work and relate to one another
Direct teaching: A direct instructional strategy best suitable for method memorizing basic information and mastering of well-defined performance skills. It emphasizes systematic organization using small steps, checking for understanding and ensuring active learner participation and learner success
E-learning: Electronic learning

Gender: Social construction of roles, responsibilities and behavior patterns assigned to men and women, boys and girls in a given society in time

Indirect teaching: A learner centered 'open approach' to method education that facilitates practice of a range of skills and encourages learners to take responsibility for the enquiry process

Instructional behavior: These are acts by the teacher, which occur in the context of classroom interaction. They are basically teaching behaviors

I/D Ratio: The ratio of in-direct instructional behavior to direct instructional behavior

Learning: Acquisition of knowledge, skills and attitudes that results in observable change in behavior or capability

Learning Strategies: These are the instrumental strategies; specific methods of promoting learners achievement of planned learning goals

Rhetoric questions: Questions asked for rhetorical effect, and not to elicit a response

Sex: Biological differentiation between women and men

Verbal interaction: What teachers and pupils say to each other, who does the talking and about what, who asks questions and who responds

Background

In most African communities and Kenya in particular, division of labour is determined by the society. Performance of different roles in the society is assigned to members of different sex by the community. The roles to be played by either sex vary from one community to another though anything related to technology is seen as a preserve of men. Due to this, men are perceived to be better placed to study science related careers and women are left to study art – related courses. This has gone a long way and it has affected the choice of subjects to study at high school level. It has also led to dismal performance and low enrolment for girls in science related subjects and in particular Physics. This is supported by the data in table 1.

Table 1: K.C.S.E Physics Performance and its National Candidature (Boys and Girls) in Kenya From 2001-2005

Year	Girls entry	Girls Mean	Boys Entry	Boys Mean	Total Entry	% of Girls	% of Boys
2001	16,210	38.36	38,388	38.62	54,598	29.7	70.3
2002	15,283	42.18	38,793	44.51	54,076	28.3	71.7
2003	16,094	42.69	40,386	44.39	56,480	28.5	71.5
2004	16,975	46.95	43,107	51.50	60,082	28.3	71.7
2005	19,290	48.64	50,145	54.77	69,435	27.8	72.2

Source: Kenya National Examinations Council (KNEC)

Introduction

Kenya aspires to be industrialized by the year 2030. Use of proper teaching methods might be one of the ways of helping Kenyans to achieve this goal. These proper methods of teaching (indirect methods) should are characterized by a move from the 'traditional methods of teaching' like the formal lecture method to the modern ways of teaching like role playing which ensure almost total involvement of the learner in the teaching- learning process for both boys and girls.

It is worth noting that development cannot be attained without engaging women at all levels of governance. For women to be involved, they have to be empowered. One of the most

appropriate tools for empowering them is education. Industrialization is attained faster when the human resource is well endowed with scientific skills. Most of these scientific skills are acquired through proper teaching of Science subjects at all levels of education. Physics is one of the vital subjects which industrialization heavily relies on. With this in mind, women in Kenya ought to be taught the same way as their male counterparts to ensure that they are equally endowed with the required scientific skills relevant for the job market.

Purpose of the Study

The purpose of this study was to determine the verbal interaction patterns which exist in Physics classrooms. The study was also to establish whether there exists any significant difference in verbal interaction patterns in mixed, girls and boys schools.

Objectives of the Study

This study was guided by the following objectives:

1. To find out the kind of classroom atmosphere created by the teacher's verbal interaction patterns
2. To find out which between the direct and the indirect methods of teaching elicits most responses from the learner
3. To find out whether there is any significant difference in classroom verbal interaction patterns among mixed, girls' and boys' schools.

Research Questions

The research was guided by the following pertinent questions:

1. What type of teacher-pupil interaction patterns exists in a Physics classroom?
2. Are there any significant differences in classroom interaction patterns in the teaching of Physics in mixed, girls' and boys' schools?

Studies Done on Classroom Discourse

According to Sotto (1995) the way the teacher communicates is an important issue. As a result, one of the topics commonly taught in teacher training courses is classroom communication and more so the verbal communication. Verbal behaviour has some advantages when used in analyzing classroom interaction in that it is easy to observe and note whatever is happening. An observation checklist is required for this purpose.

Pollard (2005) suggests that classroom interaction which involves communication helps us to make best use of time and also to answer some pertinent questions to teaching and learning. Some of the questions include; how effective is teaching by telling and can it be done better? How good are we at asking questions? How can we make class discussions better?

Innovations have been done worldwide in an attempt to increase verbal interactions in the classroom. According to Draper (2002) electronic equipment for interaction in lecture halls has been designed in the United Kingdom. Using this device, classroom interaction is electronically enhanced. Verbal interaction takes a greater percentage as compared to other forms of interaction while the teaching- learning process is in progress. Verbal interaction here refers to what the teachers and the pupils say to each other, who does the talking and about what, who asks questions and who responds.

Pollard (2005) observes that verbal communication is and will always be at the heart of teaching. Researchers have shown that teachers do much of the speaking that takes place in the classroom (ibid: 262). Flanders (1970) carried out a research in America and found out that in the teaching sessions observed, two-thirds of the time was spent in a talk and the teacher did two-thirds of that talking. The picture was a predominantly teacher dominated situation.

Muthwii (1981) researched on verbal interactions in Chemistry classrooms and found out that in Kenyan classes eighty percent (80%) of the total time is spent on lecturing by the

teacher. Learner-centered and interactive methods of teaching lead to effective teaching and learning. He recommended that there is need to involve the learners fully while teaching.

Njuguna (2000) studied verbal interaction patterns in some selected secondary school Home-science teachers with their students in Nairobi province and found out that there exists a significant difference in the direct teaching behaviour patterns of Home-science teachers in girls', boys' and mixed schools.

Methodology Used

The descriptive survey research design was used for this study since observations on verbal interactions taking place in Physics classrooms were to be made. The nineteen public secondary schools in the district were categorized into three strata namely; girls' schools, boys' schools and mixed schools. Boys' schools are only two and both were picked using purposive sampling. There are four girls' schools and the names of these four were written on small pieces of paper; each school on its own piece of paper. Later, each piece was folded keenly to hide the identity of the school. The four pieces were shuffled and the researcher then picked two papers and included the schools written on them in his sample. For the thirteen mixed schools, which are all district schools, the procedure similar to the one followed in choosing the two girls' schools was followed and the researcher got two more schools, which were included in the sample. By the end of this process, the researcher had obtained a total of six schools for the sample. Piloting was done to validate and ensure that the instruments were reliable. When carrying out the main study, one of the sampled schools declined and this left the researcher with five schools where the study was carried out. Data was collected using observation schedules and interview guides. The collected data was analyzed and discussed. The chi-square was used in making comparisons of the verbal interactions, which took place among mixed, girls' and boys' schools. I/d ratios were used to determine the extent to which the teacher was using the indirect and the direct methods of teaching. Out of the discussions, conclusions and recommendations were made.

Findings

On the use of direct methods of teaching and the indirect methods, the i/d ratios revealed that teachers in the sampled girls' schools use mostly direct methods of teaching. The i/d ratio for boys and mixed schools in this sample are comparatively higher showing that teachers in these types of schools use the indirect methods relatively more compared to the teachers in girls' schools.

The researcher also found that there was a relatively higher use of categories 5a, 5b and 5c as compared to the other categories. This observation was cutting across all categories of schools (boys', girls' and mixed schools). Physics is a practical subject and instead of using lecture method while teaching, heuristic methods should be used because they foster creativity and discovery of new theories, laws and principles. By doing this, the students will get ample time to participate in the lesson and increase their initiation during the lesson.

Generally, there was a relatively low use of categories 1, 2, 3 and 4. Girls' schools were the most affected by this. This may mean that, teachers teaching in girls' schools rarely reinforce their learners. They also appear to be weak in building on the learner's ideas. This de-motivates the learners and reduces their participation in the lesson and hence reducing their initiation. Teachers in boys' and mixed schools made a relatively higher use of these four categories.

High use of categories 6, 7, 5a, 5b and 5c is more likely to create an autocratic climate in the classroom. With this kind of climate in classroom, students are not free to participate in the teaching- learning process. This hinders their creativity and reduces the chances of discovering new things. High use of categories 1, 2, 3 and 4 leads to the creation of a

democratic climate in the classroom where students are free to participate during the teaching-learning process.

Discussion and Analysis of Data

This section discusses the findings and does some analysis of the data obtained from the study.

General comments on verbal classroom interaction of physics teachers in girls', boys' and mixed schools. In all categories of schools, category 5a was the most dominant. Teachers whether males or females were using lecture method most of the time. This means that the teachers were teaching physics theoretically. In most cases, category 9 (student talk initiation) was having a high percentage when there was a high percentage in category 2 (reinforcing). Students participated more when the teachers were reinforcing them. From the tables 4.05, 4.06 and 4.07, the bar graph below shows that category 9 has a high percentage when category 2 has a high percentage and vice- versa. Figure 1 shows the comparison between categories 2 and 9.

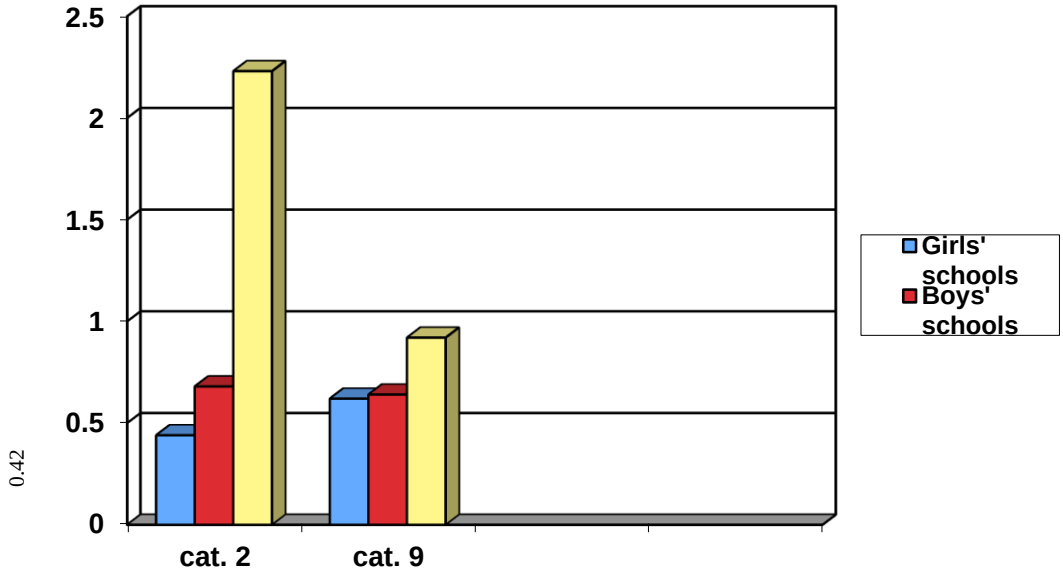
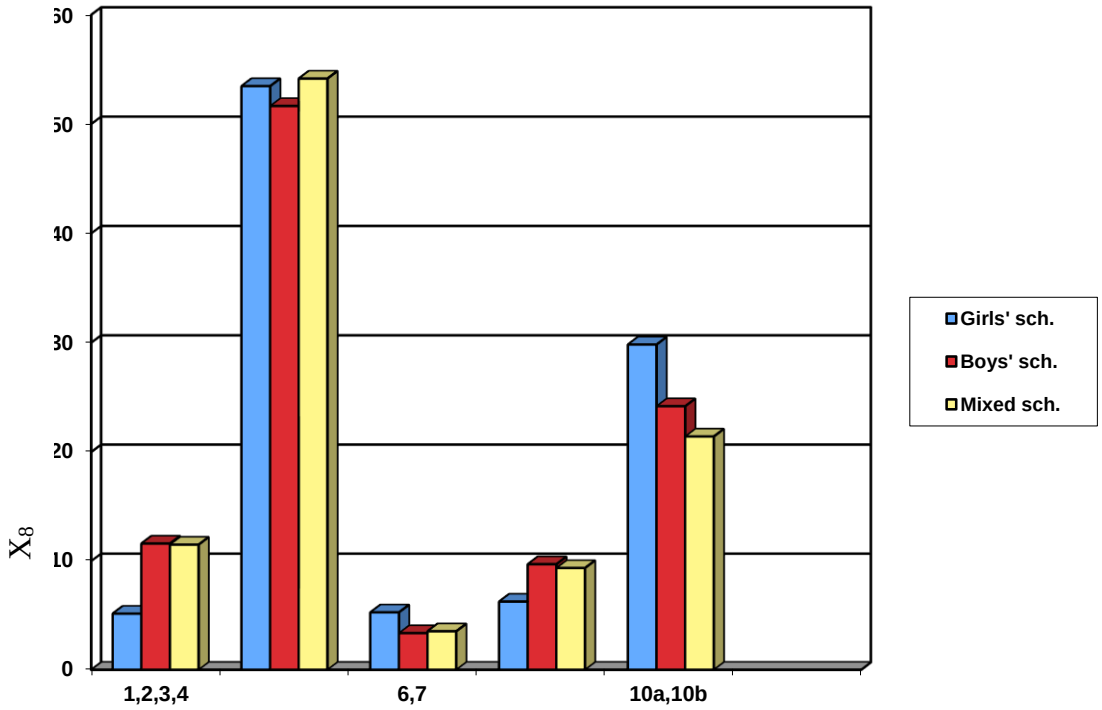


Figure 1: A bar graph giving a comparison in percentages between categories 2 and 9
(Refer to Appendix I on Modified FIAC)

From the bar graph above, the data represented shows that reinforcement is proportional to the level of students'- talk-initiation.

In Girls' schools, reinforcement is at the minimum level followed by Boys' schools and lastly mixed schools. Teachers teaching in Girls' schools do not motivate their learners as teachers teaching in mixed schools.

Figure 2 shows comparison of the percentages of tallies of the teachers and students verbal interactions for different categories across the three categories of schools.



Modified FIAC categories

Figure 2: A Bar Graph Showing the Verbal Classroom Interaction Patterns of Teachers in Boys', Girls and Mixed Schools Expressed in Percentages

The bar graph above is used to show the general outlook of the verbal classroom interaction patterns. The categories which fall under the indirect influence by the teacher while teaching the students that is categories 1, 2, 3 and 4 have been grouped together for easier comparison of indirect and direct methods of teaching.

Percentages of categories 5a, 5b, and 5c have been summed up together to show the extent to which lecture method has been used. Categories 6 and 7 have been added up for matters of plotting since their percentages are relatively small. They also show the use of directions given to the learner from the teacher. Categories 8 and 9 have been combined to show the extent of student- talk- initiation during the lessons. Categories 10a and 10b which happen to be periods when the students are writing notes, doing experiments, drawing graphs and in short periods of silence or confusion have been grouped together since there is no much interaction between the teacher and the students.

From the bar graph, teachers in boys' and mixed schools used categories 1, 2, 3 and 4 relatively more than the teachers teaching in girls' schools. This implies that teachers in girls' schools did not praise their students like their counterparts in boys' and mixed schools. They also did not consider students' personal feelings and neither did they use students' ideas or modify them like their counterparts in boys' and mixed schools.

Teachers in girls' and mixed schools spent relatively more time lecturing as compared to teachers in boys' schools. Generally, in all school categories, there is high use of the lecture method. It should also be noted that there is a relatively low use of category 5c (lecture with demonstrations). In girls' schools, teachers used more commands and criticisms than in the boys' and mixed schools. This discouraged girls from participating in the lesson. The students' initiative was relatively low in girls' schools (6.27 %) as compared to mixed schools (9.36%) and the boys' schools (9.71 %).

Category 10a and 10b are also highly used as compared to the other categories with the teachers teaching in girls' schools having the highest percentage in the two categories

combined. Categories 10a and 10b recorded highest values when the teachers used the lecture method relatively more.

Calculation and interpretation of I/D ratios. Teacher's teaching behaviour can be determined after knowing the kind of classroom climate, which prevails in the classroom. According to Njuguna (2000) there are three types of classroom teachers categorized according to the classroom climate they create. First, there is an autocratic teacher; this teacher does not consider the students' feelings. He/ she dominates the classroom talk. The work of the students in the classroom is to listen and obey orders. Secondly, there is a democratic teacher. This one allows the students to share and contribute in the classroom freely. Lastly, there is the Laissez- faire teacher who allows the students to do as they wish. This teacher is not in control of the class at all.

Calculation of the i/d ratio of the different teachers teaching in the three categories of schools is one way of knowing the kind of classroom climate the teacher creates while teaching. The i/d ratio is calculated by adding the sum total of indirect behaviour (represented by categories 1,2,3 and 4) divided by the sum total of direct behaviour (represented by categories 6 and 7). The type of classroom behaviour set by the teacher affects students' participation either positively or negatively. A democratic climate enhances learning because it encourages the students to be actively involved in the lesson. An autocratic teacher creates an environment full of tension where the learners are not free to participate. This hinders the learning process. Inamullah et al (2008) argue that the ratio between indirect influence and direct influence is given by: the sum of categories 1, 2, 3, 4, divided by the sum of categories 5, 6, 7. The ratio between positive reinforcement and negative reinforcement is given by dividing the sum of categories 1, 2, 3 by the sum of categories 6 and 7. On the other hand, student participation ratio is given by dividing the sum of categories 8 and 9 by total sum.

Table 2: I/D Ratios of Physics Teachers in Boys', Girls' and Mixed Schools

Type of School	**FIAC categories**		
	Categories 1,2,3 &4 (I)	**Categories 6 & 7 (D)**	**I/D ratios**
Boys'	92	163	0.56
Girls'	24	230	0.10
Mixed	79	235	0.34

Key:
I – Indirect teaching methods
D – Direct teaching methods

The table above shows that I/D ratios in all categories of schools are below 1. Comparing the I/D ratios in the three categories, it can be seen that teachers in boys' school are creating a relatively more democratic classroom climate. The students are free to participate during lesson time. The I/D ratio in this category (boys' schools) can be increased if the students are engaged in group discussions, debates and role plays in the classroom as the teacher teaches. Mixed schools are a little bit more democratic than girls' schools. Teachers teaching physics in girls' schools did not allow a lot of freedom for the girls to be able to participate freely. The teachers were somehow autocratic as compared to boys and mixed schools. It can be said that they created an autocratic climate in the classroom.

Calculation and interpretation of chi- square results for different categories of schools. One of the aims of this study was to find out whether there exists any significant

difference in verbal interaction patterns among mixed, girls' and boys' schools. The chi-square was the most convenient tool to use to determine this. The chi- square results helped to determine whether the observed difference in teaching patterns among teachers in girls', boys' and mixed schools were statistically significant or not. The researcher used 0.05 level of significance obtained from the chi- square tables to determine this. If the results were giving values that were above this level, then the difference would be statistically significant.

For the purposes of analysis, the different types of direct and indirect teaching behaviour patterns were extracted from the collected data and the formula below was used to calculate the chi square values.

$$\chi^2 = \sum \left(\frac{(f_o - f_e)^2}{f_e} \right)$$

Where f_o is the observed frequency and f_e is the expected frequency.

In the calculation of chi- square, the test was administered to the direct and the indirect influence of the teacher while teaching and also to the students' talk initiation. Table 3 shows the values of the observed frequencies (f_o) and their calculated expected frequencies (f_e). The expected frequencies were calculated by multiplying the number of frequencies contained in the entire row, R_T by the number of frequencies contained in the entire column, C_T. The product of these two was then divided by the total number of observed frequencies (G_T).

$$f_e = \frac{R_T \times C_T}{G_T}$$

Table 3: Observed and Expected Frequencies for Categories 1, 2, 3 and 4 in Boys', Girls', and Mixed Schools

Observed and expected frequencies for categories 1, 2, 3 and 4 in boys', girls', and mixed schools; or, Modified FIAC categories	**Type of school**							
	Boys'	**Girls'**	**Mixed**			**Totals of f_o**		
	f_o		**f_e**	**f_o**	**f_e**	**f_o**	**f_e**	
1 (accepts feelings)	3		4.0	2	2	3	2	8
2 (praises/encourages)	33		55	19	23	56	30	108
3 (accepts or uses student's ideas)	56		40	3	17	20	22	79
4 (asks questions)	444		437	200	182	210	235	854
Total	536		536	224	224	289	289	**1049**

Table 4: Nature of the Indirect Teaching Behavior Patterns of Teachers in Boys', Girls', and Mixed schools

Type of school	**Modified FIAC categories**								
	1(accepts Feelings)		**2 (**praises/encourages)		**3** (accepts or uses student's ideas)		**4** (asks questions)		Total χ^2 of 1, 2, 3 & 4 **(i)**
	f_o	f_e	f_o	f_e	f_o	f_e	f_o	f_e	
Boys'	3	4	33	55	56	40	444	436	
Girls'	2	2	19	23	3	17	200	182	
Mixed	3	2	56	30	20	22	210	235	
$\sum \frac{(f_o-f_e)^2}{f_e}$	**0.75**		**31.99**		**18.11**		**4.59**		**55.44**

At 6 degrees of freedom (df) the χ^2 results for i is 55.35. The critical value of χ^2 at the 0.05 level of significance is 12.59. This means that the χ^2 value at 6 df is statistically significant because it is more than the critical value. This means that there exists a significant difference in the indirect teaching behavior patterns of physics teachers in boys', girls' and mixed schools. This difference can be clearly seen in the I/D ratio for categories 1, 2, 3 and 4 of the girls' schools, which is 0.1 while the I/D ratio for the boys' and mixed schools are above 0.3. Teachers in boys' and mixed schools made a relatively higher use of the indirect methods of teaching compared to their counterparts in girls' schools.

Table 5: Calculation of the Expected Frequencies for Categories 6, 7, 5a, 5b, and 5c

Typeofschool	**Modified FIAC Categories**										
	6 (gives directions)		**7** (Criticizes)		**5a** (lecture with neither aids nor demonstrations)		**5b** (lecture with teaching aids)		**5c (**lecture with demonstrations)		Total f_o
	f_o	f_e	f_o	f_e	f_o	f_e	f_o	f_e	f_o	f_e	
Boys'	122	151	41	41	1520	1538	856	740	124	192	2663
Girls'	203	146	27	40	1206	1477	785	710	336	185	2557
Mixed	54	82	35	22	1126	837	212	503	22	105	1449
Total	379	379	103	103	3852	3852	1853	1853	482	482	**6669**

To determine whether there exists any significant difference in the direct teaching behaviour pattern of the teachers in the three categories, χ^2 values were again calculated for category 6,7,5a, 5b and 5c in the table 6 below.

Table 6: Calculation of χ^2 Values for Categories 6, 7, 5a, 5b, & 5c

Type of school	**Modified FIAC Categories**										
	6 (gives directions)		7(criticizes)		5a (lecture with neither aids nor demonstrations)		5b (lecture with teaching aids)		5c (lecture with demonstrations)		Total χ^2 for 6,7,5a, 5b & 5c
	f_o	**f_e**	**f_o**	**f_e**	**f_o**	**f_e**	**f_o**	**f_e**	**f_o**	**f_e**	
Boys'	122	151	41	41	1520	1538	856	740	124	192	
Girls'	203	146	27	40	1206	1477	785	710	336	185	
Mixed	54	82	35	22	1126	837	212	403	22	105	
$\sum\frac{(f_o f_e)^2}{f_e}$	**37.38**		**11.9**		**149.7**		**116.6**		**212.9**		**52.5**

The chi- square results obtained from table 6 can be used to test if direct teaching patterns of the teachers in boys', girls' and mixed schools differ significantly. From the table, the chi-square results at 8 df is 528.5. The critical value of chi- square at the 0.05 level of significance is 15.5. This shows that there exists significant difference in the direct teaching patterns of teachers in boys', girls' and mixed schools. Teachers in boys' and mixed schools made a relatively lower use of the direct methods of teaching compared to their counterparts in girls' schools. Again, this can be confirmed from the results in table 2, which gives the I/D ratios for the three school categories.

It was considered important to determine the nature of Students Talk (ST) in boys', girls' and mixed schools. Categories 8 and 9 have been used to determine this.

Table 7: Chi- square Values for the Nature of Students' Talk in Boys', Girls' and Mixed Schools

Type of School	**Modified FIAC Categories**				
	8 (student talk response)		**9**(student talk initiation)		Total of χ^2 categories 8 & 9
	f_o	**f_e**	**f_o**	**f_e**	
Boys'	439	431	31	39	
Girls'	246	250	27	23	
Mixed	212	216	23	19	
$\sum\frac{(f_o-f_e)^2}{f_e}$	**0.28**		**3.1**		**3.38**

At 2 df, the χ^2 results for categories 8 and 9 (students' talk) is 3.38. The critical value at the 0.05 level of significance is 5.59. This means that there was no significant difference in the patterns displayed by the students in their talk during the Physics lessons.

The students are not given ample time to ask questions or to participate in the lesson. This further implies that the teachers mostly used the lecture method. Inquiry methods of teaching were rarely being used. This is further proved by the fact that categories 1, 2, 3 and 4 are having very low percentages. This observation was cutting across all categories of schools. In general, the chi- square results have shown that teachers display significantly different teaching behaviour patterns with their students while teaching. Inamullah et al (2008) indicate

that majority of teachers of English at college level generally use direct methods of teaching and this leads to low student's participation level during the teaching and learning process.

Conclusions

The researcher sought to determine whether there exists any significant difference in verbal interaction patterns in mixed, girls' and boys' schools. To achieve the objectives of the study, tools to gather information on classroom discourse were designed. In designing the tools, the following aspects were considered:

1. The kind of classroom atmosphere created by the teacher's verbal interaction patterns.
2. The type of teaching methods that elicit most responses from the learner.
3. The differences in verbal interaction patterns as displayed by teachers and their students while in the classroom.

The data collected from the chosen sample was used to achieve the objectives and answer the research questions stated to guide the study.

It was revealed that there was much use of direct methods of teaching across the different school categories. This was more dominant in girls' schools than in boys' and mixed schools. Teacher's talk dominated most of the lessons. The direct methods create an autocratic climate in the classroom. It also emerged that teachers in all categories of schools rarely used the in-direct methods of teaching rarely while teaching Physics. Teachers in girls' schools used direct methods the most. Students were rarely praised during Physics lessons. It should be noted that praising of students motivates them and helps them develop a positive attitude towards the subject. According to Rao & Undai (2006) teacher's influence motivates the learner to take initiative, contribute ideas, recognize, express and share feelings, develop meaningful relations, gain independence, interpersonal trust and harmony with the main social systems like family, school, peer group, teachers among others.

In addition, from the results obtained, there exists a significant difference in the verbal interaction patterns in boys', girls and mixed schools. Teachers display different interaction patterns while teaching depending on the gender of the students they are teaching and the sex of the teacher. For example, male teachers appeared to be more comfortable while teaching boys. The female teacher observed was not very comfortable while teaching boys. It is also worth-noting that female physics teachers are very few compared to their male counterparts.

The study has also revealed that categories 1, 2, 3 and 4 elicited the most responses from the students as compared to the use of categories 6 and 7, which discouraged the students. This means that teachers who used categories 1, 2, 3 and 4 mostly while teaching motivated their learners during the lesson.

Recommendations

The following recommendations have been made based on the findings of the study for future implementation:

1. There is need to avoid much use of the lecture method while teaching physics. Trainers of teachers need to emphasize this during their training sessions. The trainers should emphasize on the importance of using in-direct methods of teaching.
2. Teachers need to try as much as possible to boost creativity in their learners by using the discovery methods of teaching. In doing so, they will give the learners room to discover Physics laws, theories and principles on their own. This practice should be extended to in-service training programmes.
3. There is need for the policy makers to look for ways and means of campaigning for attitude change towards Physics in students. This will probably lead to an increased number of girls taking Physics up to Form Four. This will possibly lead to an increased number of ladies who will be willing to train as Physics teachers.

4. There is need for teachers to avoid criticizing their learners' answers or giving them a lot of directions (steps to follow) while teaching because this hinders learner participation in the lesson and hinders creativity.
5. Universities and colleges should look for ways to encourage female students to train as Physics teachers. One way can be by reducing the cluster points for ladies joining the teaching profession as Physics teachers.
6. Teachers should try as much as possible to use the indirect methods of teaching so as to maximize the freedom of the learners to participate during the teaching- learning process.

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Appendix I

A Modified Flanders' Interaction Analysis Categories Used During the Study

TEACHER TALK	INDIRECT INFLUENCE	1. ACCEPTS FEELING. Accepts and clarifies the feeling tone of the students in a non-threatening manner. Feelings may be positive or negative. Predicting or recalling feelings are included 2. PRAISES OR ENCOURAGES. Praises or encourages student action or behaviour. Jokes that release tension, not at the expense of another individual; nodding head or saying "um hm?" or "go on" are included 3. ACCEPTS OR USES IDEAS OF STUDENTS. Clarifying, building, or developing ideas suggested by a student. As a teacher brings more of his own ideas into play, shift to category five. 4. ASKS QUESTIONS. Asking a question about content or procedure, based on teacher ideas, with the intent that a pupil will answer.
	DIRECT INFLUENCE	5. LECTURES: This category is divided into: (a) Lecture by involving only talk by the teacher without any aids to enhance the ideas. (b) Lecture with illustrations or

		aids. The lecture here uses charts, diagrams, real objects and chalkboard illustrations. (c) Lecture with demonstrations where the teacher performs an experiment or a practical to enhance the lesson. 6. GIVES DIRECTIONS. Directions, commands, or orders to which a student is expected to comply. 7. CRITICIZES OR JUSTIFIES AUTHORITY. statements intended to change student behaviour from non-acceptable to acceptable pattern; bawling someone out; stating why the teacher is doing what he is doing; extreme self-reference.
		8. STUDENT TALK-RESPONSE: a student makes a predictable response to teacher. Teacher initiates the contact or solicits student statement or structures the situation. Freedom to express own ideas is limited. 9. STUDENT TALK-INITIATION: Talk by students that they initiate. Expressing own ideas; initiating a new topic; freedom to develop opinions and a line of thought, like asking thoughtful questions; going beyond the existing structure.
		10. SILENCE OR CONFUSION: This category is divided into: (a) Students performing experiments, making observations, recording measurements and drawing graphs. (b) Short periods of silence and confusion when communication cannot be understood by the observer.

NOTE: There is no scale implied by these numbers. Each number is classificatory; it designates a particular kind of communication event. To write these numbers down during observation is to enumerate, not to judge a position on a scale.