



Investigating teacher-learner classroom interaction and its effect on learners' ability to solve word-problems in secondary schools, Nakuru County, Kenya

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Abstract: *The teaching and learning process in Mathematics classrooms requires teachers to use different strategies which motivate learners and develop analytical and critical thinking skills. Research findings have presented factors that influence learners' performance and suggestions for possible solutions. In spite of the findings, learners' performance in Mathematics remains a global concern. This study was aimed at investigating teacher-learner classroom interaction and its effect on learners' ability to solve word-problems in secondary schools. The objective was: to establish the effect of teacher-learner classroom interaction on learners' ability to solve word-problems. The researchers employed the descriptive survey design with quantitative and qualitative methods. A sample of 358 participants were selected through stratified random sampling technique, comprising 10 Mathematics teachers, 338 Form II learners, and 10 Mathematics Heads of Department from secondary schools in Naivasha sub-County, Nakuru County, Kenya. The data collection tools for the study were: Mathematics teachers' questionnaire, learners' questionnaire, classroom observational checklist, and Mathematics Heads of Department schedule interview. The researchers reported the data in frequency tables and charts. The findings show that the teachers and Mathematics Heads of Department recognized the effect of teacher-learner classroom interaction on learners' ability to solve word-problems. Thus, the study suggests that teacher-learner interaction is crucial to word-problem-solving teaching. The data also show that most schools in Naivasha sub-County had overcrowded classrooms. The researchers propose further study of how classroom overcrowding affects learners' ability to solve word-problems.*

Key Words: *Classroom interaction, Word-problems, Interpersonal, Teacher-learner*

1. INTRODUCTION:

Teacher-learner classroom interaction is considered one of the important aspects to fostering learning in the 21st century contemporary education. According to Hamre et al. (2012), this interaction may be characterized as the everyday exchanges that take place in a back-and-forth way between the teachers and the learners. In the context of these exchanges, offering feedback on the learners' work, helping learners through the process of problem-solving, and teaching learners to comprehend real-life mathematics are all examples of activities that may be carried out. According to Pennings (2017) and Pennings et al. (2018), many scholars believe that the interaction between teachers and learners helps to reduce behavioural issues in the classroom and fosters good teaching and learning results. Pennings et al. (2018) added social order can be established and maintained through interactions between teachers and the behaviour of learners in the classroom. According to Gasser et al. (2018), this interaction may be divided into three categories: educational support, emotional support, and classroom organization support. These supports from the interaction can help foster learners' ability to solve word-problem, especially the educational and emotional supports. Researchers globally have described one of the critical issues in contemporary education to be teacher-learner classroom interaction. Zhang (2019) asserted that the quality of teacher-learner bond has a profound effect on the ability of learners to solve problems. There have been a great number of studies that have investigated the factors that influence the performance of learners;



however, little or no consideration has been given to the teacher-learner interaction in the classroom in terms of how it affects the learners' ability to solve word-problems. Global researchers believe that the creation of teacher-learner interaction in the teaching and learning process promotes learners' attention level, stimulates learners' learning attitude, and guides learners' problem-solving ability (L. Li & Yang, 2021; Xie et al., 2022). Dobrotina and Erokhina (2016) describe the interaction between a teacher and their learners as both the teacher displaying respect and care to the learners, as well as the learners expressing respect and care to both one another and to the teacher. Effective classroom interaction is of the utmost importance for ensuring effective communication, which in turn encourages the learners' participation in collaborative learning and facilitates an atmosphere conducive to learning for all learners (Pratolo, 2019). The government of Kenya and educational stakeholders have exerted efforts in improving the performance of learners in Mathematics. These include the introduction of Strengthening Mathematics and Science in Secondary Education (SMASSE), In-service Education and Training (INSET), and Secondary Education Quality Improvement Project (SEQIP), (Kiruja et al., 2019; Komen, & Nyandoro, 2023; Miller & Elman, 2013; Wafubwa, & Obuba, 2015), yet learners' performance in Mathematics is still a concern. The Kenya National Examinations Council (KNEC) Kenya Certificate of Secondary Education (KCSE) 2021 report shows that learners are still performing below the standard scores in Mathematics. The data in Table 1 shows the mean scores of learners in Nakuru for the past five years. The data shows that learners in Nakuru are still having challenges in attaining the standard score in Mathematics as though nothing is happening to improve the situations.

Table 1: Mathematics Mean scores at KCSE for Secondary Schools in Nakuru County

Sub-County	Year				
	2017	2018	2019	2020	2021
Bahati	3.04	3.14	3.42	2.79	2.73
Gilgil	2.46	2.97	2.65	2.08	2.25
Nakuru West	0.00	0.00	2.33	1.87	1.53
Nakuru East	3.03	3.88	4.15	3.67	3.44
Molo	2.49	2.60	3.09	2.82	2.15
Njoro	2.40	2.57	2.61	2.08	2.18
Kuresoi North	2.43	2.57	2.30	2.62	2.25
Kuresoi South	2.36	2.54	2.55	2.18	2.30
Naivasha	2.54	2.33	2.00	2.22	2.23
Rongai	2.75	2.43	2.36	2.32	2.26
Subukia	2.80	2.90	2.89	2.19	2.05

This study investigated the teacher-learner classroom interaction and its effect on learners' ability to solve word-problems. The objective of the study was to establish the effect of teacher-learner classroom interaction on learners' ability to solve word-problems.

2. LITERATURE REVIEW:

2.1. Teacher-learner Classroom Interaction

Li and Yang (2021) found that teacher-learners interaction brings about positive productivity in problem-solving. The study addressed teacher-learners interaction and learners' self-efficacy and preference for the flipped classroom. The authors used qualitative design with a target population of undergraduate learners in Chinese universities and sampled 649 undergraduate learners. Benny and Blonder (2018), in a study, reported that teachers should be aware of the knowledge of the academic curriculum require for teaching and things that gifted learners will need in the classroom in the Israelites school system. The study perceives interaction that is positive with gifted learners to keep them encouraged and engaged in classroom activities. The study further noted that gifted learners would soon lose interest if there were a disconnection of interaction between the lesson and the teacher.

Majanga et al. (2011) affirm that classroom interaction is an importance indicator, specifically the teacher-learner interaction in Kenya education but identified factors that affect it. The study reported classroom congestion, shortage of teachers, and high teacher workload as factors affecting classroom interaction in Kenya. According to the researchers, these factors could not allow teachers in Nakuru Municipality to have a personalised interaction with learners. The researchers employed the ex-post facto research design with descriptive and inferential analysis. Despite challenges outlined in the previous research, assessing classroom interactions and its effect on learners word-problem-



solving ability is still imperative using different research methods. Sen (2021) affirms the importance of this interaction by saying that teachers who interact positively with their learners create more conducive learning environments and meet their developmental, emotional, and academic needs.

2.2. Interpersonal Social Knowledge and Classroom interaction

The teacher and learners' interpersonal skills are critical components of Mathematics classroom interactions. Learning how to connect socially and create friends is one of the most crucial life skills that children acquire. Building relationships with others is so vital that many teachers might not even be aware of their role. This social connection supports learning outcomes and improves teachers' instruction (R. Li, 2021). Xie and Derakhshan (2021) emphasized that in order to promote every aspect of teaching and learning processes, teachers must create a strong interpersonal social network between themselves and learners, as well as between learners and their peers.

According to Münte et al. (2019), interpersonal relationships are social connections between two or more people. Teachers can help to develop this interpersonal social connection in the classroom by activating teamwork through group work and collaborative learning. Building and keeping a solid bond between the teacher and learners must involve a mutual give-and-take, encouragement, emotional support, effective communication and listening skills, and understanding what the learners need to learn (Gasser et al., 2018). Researchers have posited that teachers need to build a solid positive interpersonal and social network between learners and themselves by understanding the learning needs of the learners (Che Ahmad et al., 2017; Lans et al., 2020). This aspect is the knowledge for learners' learning needs that teachers must have in teaching Mathematics (Opic, 2016; Pennings et al., 2018). A positive interpersonal communication between the teacher and the learner has been shown to have a significant impact on both the quality of the lesson and the learner's learning outcomes.

In a study by Pennings and Hollenstein (2020) in Netherland, teachers' interpersonal relationships were figured out by learners as being positive. The researchers used the interpersonal theory and said that teacher-learner interaction follows some interpersonal patterns and relationship in the classroom. For instance, a deviant learner when being responded to in a moderate tone by the teacher will change the negative interaction to a positive interaction which will positively influence the learner's ability to solve problems. The study pointed out two critical positive interpersonal relationship levels, directing and helping in the Netherland education system. The study was longitudinal for three years, with a sample of 36 teachers as the sample size.

2.3. Factors that influence teacher-learner classroom interaction

The teachers in the classroom are very important to fostering classroom interaction between themselves and the learners. According to (Vanner et al., 2022), many teachers in the classroom lack the ability to create awareness of the important of classroom interaction among learners and also with they and the learners which is one of the factors that hindered teacher-learner classroom interaction. Some researchers believe that teachers need to be aware of the learners' ability to interact, the personality of learners, their learning styles, cultural background, mental processes, and academic ambition in order to maintain good classroom interaction (Akpeli, 2019; Pennings et al., 2014). This implies that a teacher who will not show concern about these characteristics in the learners will not build a good teacher-learner relationship. Akpeli (2019) outlined some key factors that affect teacher-learner classroom interaction: teachers' being insensitive to the learning needs of learners, always bullying learners, and having a troublesome behaviour towards the learners.

3. METHOD:

The researchers adopted the descriptive research survey design with quantitative and qualitative methods. The purpose for this study design was to describe how teacher-learner classroom interaction effect learners' ability to solve word-problems. According to (Manjunatha, 2019; Mugenda, & Mugenda, 2019), the purpose of descriptive research survey design is to determine, identify, and describe the characteristics or phenomenon of the research participants. This study design is significant to this study because the researchers want to establish and describe how teacher-learner classroom interaction effect learners' ability to solve word-problems. The researchers conducted this study in Naivasha sub-County, Nakuru County, Kenya. This location was chosen because the performance of learners for the past five years was low. A sample 338 learners in Form II and 10 teachers of Mathematics as well as 10 Mathematics Heads of Department were selected through stratified sampling techniques. The analysis of the data is based on 318 learners in Form II who took part in the research, 10 teachers of Mathematics, and the Mathematics Heads of Department. This is because 20 learners did not return their data collecting instruments after the research instrument was administered. Mathematics teachers and learners' questionnaires, classroom observational checklist, and Mathematics Heads of Department schedule interview guided the researchers in collecting the necessary data. The study was piloted by



randomly selecting 10% of the total sample. Cohen et al. (2018); Creswell and Creswell (2018); Mugenda and Mugenda (2019) all agree that doing a pilot study aids in the development and refinement of the data collecting instrument. They also mentioned that for piloting purposes, a percentage of the research sample somewhere between one percent (1%) and 10% is ideal.

3.2. Data Analysis:

The data gathering instruments yielded quantitative and qualitative data, which were analysed with the Statistical Package for Social Sciences (SPSS) version 26 and Microsoft Excel 365. The findings were presented in tables with frequency and the percent counts, graphs as well as narration.

3.2. Ethical considerations:

The researchers obtained all relevant legitimate documents before embarking on the study. A letter of introduction from Graduate school was obtained, a Permit from the National Commission of Science, Technology, and Innovation (NACOSTI) was also obtained. The County and sub-County educational offices issued separate letters to the researchers granting them permission to access the schools.

4. FINDINGS:

This section presents the study's findings in tables and graphs, followed by a narrative of those results about learners' and teachers' perspectives on the teacher-learner classroom interaction and its effect on learners' ability to solve word-problems. There were four (4) male and six (6) female Mathematics teachers, 10 male Mathematics Heads of Department, 137 male learners and 181 female learners that participants in the research.

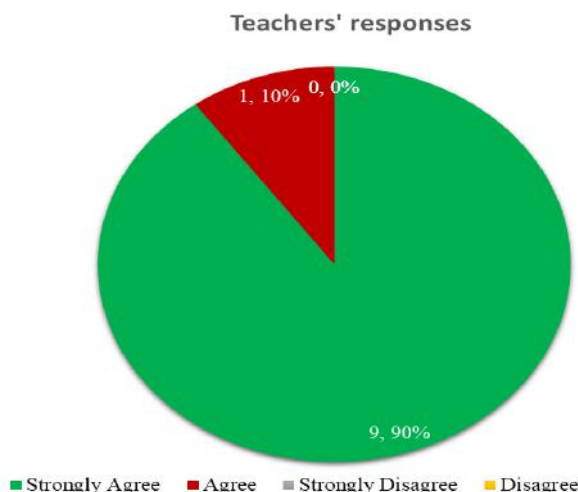


Figure 1: Mathematics Teachers’ responses to *“Learners' word problem-solving skills correlate with the amount of class discussion we have.”*

All the teachers, 100%, agree that learners’ word-problems solving skills correlate with the amount of class discussion they have concerning the lesson. There was no contrary view on this.

Table 2: Mathematics Teachers’ responses to *“My learners and I usually interact during lesson presentation.”*

Responses	Frequency	% of Frequency
Strongly Agree	8	80.0
Agree	2	20.0
Strongly Disagree	0	0.0
Disagree	0	0.0
Not Sure	0	0.0
Total	10	100.0

The findings presented in Table 2 show that 80% of the teachers strongly agree that there is a usual interaction during the lesson presentation, whereas 20% agree.



Table 3: Mathematics Teachers' response to *“My interpersonal social knowledge help to support learners in word problem-solving.”*

Responses	Frequency	% of Frequency
Strongly Agree	6	60.0
Agree	4	40.0
Strongly Disagree	0	0.0
Disagree	0	0.0
Not Sure	0	0.0
Total	10	100.0

Data in Table 3 shows that 60% of the participants strongly agree of have a strong interpersonal social knowledge which help learners in solving word-problems.

Table 4: Mathematics Teachers responses to *“I allow a free space interaction of my learners during classroom lecture, wherein I post questions and by term, they give response(s).”*

Responses	Frequency	% of Frequency
Strongly Agree	6	60.0
Agree	4	40.0
Strongly Disagree	0	0.0
Disagree	0	0.0
Not Sure	0	0.0
Total	10	100.0

The data in Table 4 shows that 80% of the teachers agree that they allowed a free space for interaction during the class time which allows learners to response to questions in one after the other.

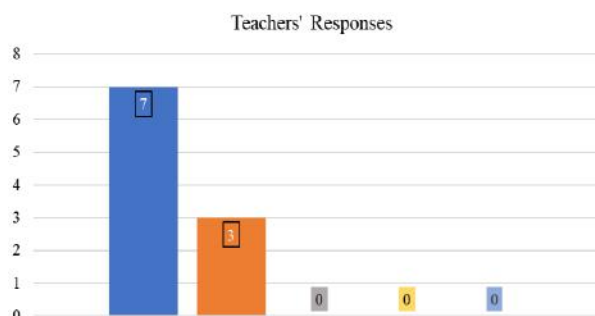


Figure 2: Mathematics Teachers’ Responses to *“The learners and I have a strong bond of social connection, which supports learning.”*

Data in Figure 2 demonstrates that all the Mathematics teachers, 100%, agree that the close relationships they have built with their learners have helped the learners succeed in class.

Table 5: Mathematics Teachers’ Responses to *“The class time is minimal; therefore, it is not necessary for classroom interaction.”*

Responses	Frequency	% of Frequency
Strongly Agree	0	0.0
Agree	0	0.0
Strongly Disagree	5	50.0
Disagree	5	50.0
Not Sure	0	0.0
Total	10	100.0

Findings in Table 5 show that 100% of the teachers disagree *“The class time is minimal; therefore, it is not necessary for classroom interaction.”* There was no teacher who found this classroom interaction unnecessary.



Table 6: Mathematics Teachers’ responses to *“I give a class exercise wherein immediate feedback is given to learners as reinforcement to the lesson.”*

Responses	Frequency	% of Frequency
Strongly Agree	2	20.0
Agree	5	50.0
Strongly Disagree	0	0.0
Disagree	3	30.0
Not Sure	0	0.0
Total	10	100.0

Table 6 shows that 70% of the teachers agree that they give class exercises with immediate feedback to the learners, while 30% did not agree of giving class exercises.

Table 7: Mathematics Teachers responses to *“I sometimes appear unfriendly and do not allow learners’ question during the lesson.”*

Responses	Frequency	% of Frequency
Strongly Agree	0	0.0
Agree	3	30.0
Strongly Disagree	7	70.0
Disagree	0	0.0
Not Sure	0	0.0
Total	10	100.0

The data presented in Table 7 shows that 30% of the teachers agree of being unfriendly and do not allow learners’ question during the lesson presentation, however, 70% of the teachers disagree that they sometimes appeared unfriendly and do not allow learners’ questioning them during the lesson presentation.

Table 8: Mathematics Teachers’ Responses to *“I do not see teacher-learners’ classroom interaction benefiting to learners’ learning needs.”*

Responses	Frequency	% of Frequency
Strongly Agree	3	30.0
Agree	0	0.0
Strongly Disagree	4	40.0
Disagree	3	30.0
Not Sure	0	0.0
Total	10	100.0

Table 8 shows that 30% of the teachers agree that they do not see teacher-learner classroom interaction as benefiting to learners’ learning needs, whereas 70% perceive this teacher-learner classroom interaction as a significant factor which benefit learners’ learning needs.

Table 9: Learners’ responses to *“My teacher shows me attention during the teaching time.”*

Responses	Frequency	% of Frequency
Strongly Agree	99	31.1
Agree	89	28.0
Strongly Disagree	105	33.0
Disagree	17	5.4
Not Sure	8	2.5
Total	318	100.0



The data presented in Table 9 shows that 59.1% of the learners agree that their teachers show them attention during the teaching period, whereas 38.4% did not agree to the statement. Some learners, 2.5% were not sure of the statement.

Table 10: Learners' Responses to "*My teacher allows friendly classroom interaction during the lesson presentation.*"

Responses	Frequency	% of Frequency
Strongly Agree	108	34.0
Agree	77	24.2
Strongly Disagree	100	31.4
Disagree	27	8.5
Not Sure	6	1.9
Total	318	100.0

The responses of learners presented in Table 10 show that 58.2% agree that their teachers allow a friendly classroom interaction during the lesson presentation, while 39.9% perceive their teachers as unfriendly during lesson presentation. A small number of the learners, 1.9%, were unsure as to whether their teachers show friendly classroom interaction or not.

Table 11: Learners' Responses to "*We have the freedom to talk to our teacher concerning the lesson.*"

Responses	Frequency	% of Frequency
Strongly Agree	110	34.6
Agree	78	24.5
Strongly Disagree	96	30.2
Disagree	24	7.5
Not Sure	10	3.1
Total	318	100.0

The findings presented in Table 11 shows that 59.1% Of the learners agree of having freedom to talk to their teachers concerning the lesson, with 37.7% of the learners showing disagreement, saying that there is no freedom of having a talk with their teachers concerning the lesson. As for some of the learners, 3.1% were not sure as to whether there was freedom in the classroom in talking with their teachers.

Table 12: Learners' Responses to "*My teachers cannot allow any student to come close to them or post a question during the lesson.*"

Responses	Frequency	% of Frequency
Strongly Agree	89	28.0
Agree	24	7.5
Strongly Disagree	124	39.0
Disagree	74	23.3
Not Sure	7	2.2
Total	318	100.0

Data presented in Table 12 shows that 35.5% of the learners agree that their teachers cannot allow them to come close them or post a question during lesson delivery, whereas 62.3% did not agree, they believe that their allow them to come close to them with any issue relating to the lesson as well post questions during the lesson in the class. The number of learners that were not sure was represented by 2.2% of the total learners who participated in the study.

Table 13: Learners' Responses to "*My teacher always complains about teaching time, so we cannot ask or talk during teaching.*"

Responses	Frequency	% of Frequency
Strongly Agree	109	34.3



Agree	24	7.5
Strongly Disagree	127	40.0
Disagree	48	15.1
Not Sure	10	3.1
Total	318	100.0

It was found that learners responses as presented in Table 13 show that 41.8% agree that their teachers always complained of having limit teaching time, so there was no opportunity for learners to ask or talk during the lesson presentation, but 55.1% of the learners did not agree, for them, teachers allow question posting and have never complained about the teaching time.

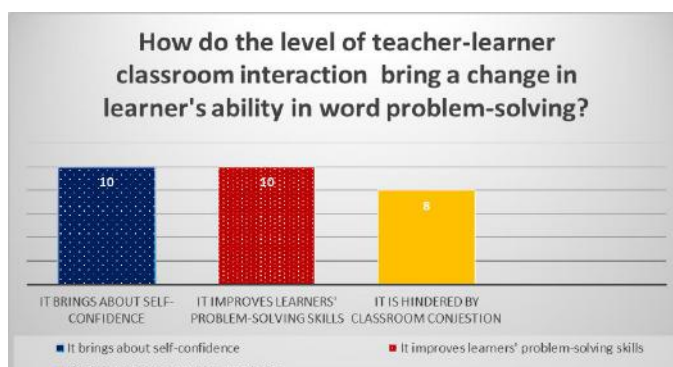


Figure 3: Mathematics Heads of Department Responses
 N = 10

Data presented in Figure 3 from the responses of the Mathematics Heads of Department about teacher-learner interaction, 100% of the respondents said that the level of teacher-learner classroom interaction brings about self-confidence and improves learners' problem-solving skills. The data also shows that 80% of the Mathematics Heads of Department pointed out some challenges which made teacher-learner interaction impossible, classroom congestion.

Table 14: Classroom Observational Checklist

Observed Activity	Yes	No	Total
High level of motivation from the teacher to the learners	8	2	10
Learners are freely participating in the classroom discussion	4	6	10
Learners engage in the teaching process as the teacher teaches the lesson	3	7	10
Learners learn in groups and at some point, in time, they do some independent work	1	9	10
The classroom lively between the teacher and learners	5	5	10
The teacher can call out the name of the learners as a means of maintaining classroom order	2	8	10
The teacher shows a high level of confidence and passion for the topic and learners' learning needs	7	3	10
The word problem-solving in the classroom is like fun	5	5	10

N = 10

The researcher presented the findings from the classroom observational checklist in Table 14. The data shows that 80% of the Mathematics teachers were showing high level of motivation to the learners, whereas 20% were not motivative in their teaching. Learners were able to talk in the class lesson at a point with 40% of the teachers allowing so, but 60% of the teachers did not give learners the time. For engagement in the lesson, 30% of the teachers allowed learners' engagement and participation, whereas 70% did not allow learners engagement. The findings in Table 14 further show that the teachers tried their best to employ group learning strategies with 10% of the teachers succeeding, while 90% of the teachers could not succeed because of the class size. The teachers made the classroom very lively, 50% of the teachers were excellence in this, but 50% were not following along. The researcher found that 80% of the



teachers could not call out the name of the learners for either input or attention, but 20% of the teachers were able to call out their learners' names and pointed out a learner by name during the lesson. A good number of the teachers, 70%, show high level of confidence and passion for the topic they were teaching as well as the learning needs of the learners. Making the teaching a fun, 50% of the teachers responded well, whereas 50% were focussing on the lesson.

5. DISCUSSION:

The findings in Figure 6 show that all the Mathematics teachers, 100%, agree that learners' ability to solve word-problems correlate with the classroom interaction through discussion. In Table 2, Table 3, and Table 4, the data shows that every teacher that participated in the study, 100%, agree that their learners including themselves have an interaction during the lesson, that their interpersonal social knowledge had helped their learners in word-problem-solving, and that they allow and create free space of interaction for the learners in the classroom by posing questions and learners responding to the questions. The Mathematics Heads of Department (MHOD) responses in Figure 3 show that 100% of them agree that teacher-learners' interaction brings about self-confidence and improves learners' problem-solving skills. The findings support Pennings *et al.* (2018) findings, that classroom interaction brings about social order and maintain good behaviour of learners. Li and Yang (2021) reported that the teacher-learner classroom interaction brings a positive productivity in learners' ability to solve problems. The data presented in Table 11 shows that 59.1% of the learners agree that they have freedom to talk in the class concerning the lesson. These positive productivities were acknowledged by majority of the respondents. The data in Figure 3 shows that 80% of the MHOD pointed out some challenges which hindered classroom interaction; classroom congestion as one of the common problems that do not favour the need for classroom interaction. The study found that 90% of the classes visited, learners could not work in group for collaborative learning. The findings also show that 60% of the teachers did not allow learners to participate in the classroom discussions. The researchers, from a classroom observation, observed that 80% of the teachers showed high level of motivation to the learners as presented in Table 14. Xie and Derakhshan (2021) stressed the importance of teachers and learners building a solid interpersonal social network in the classroom as a support to all teaching and learning activities. The activation of interpersonal social network among learners was not observed maybe because of the class time, the size of the class, or other factors. According to Münte *et al.* (2019) and Gasser *et al.* (2018), interpersonal social network in the classroom is built through teamwork and collaborative learning which boost a mutual give-and-take, encouragement, emotional support, effective communication, and good listening skills. Learners in this study affirmed the interpersonal relationship of their teachers to them in the classroom wherein the learners responses as presented in Table 10 show that 58.2% agree that their teachers allow a friendly interaction in the classroom. This is in support to Pennings and Hollenstein (2020) study in Netherland, that learners figured out their teachers' interpersonal relationship as positive. The findings show that the participants and respondents acknowledged the importance of teacher-learners classroom interaction, but from the observation and with the responses of the Mathematics Heads of Department, one common observed challenge to the classroom interaction for building teams or going through collaborative teaching and learning was class size. This was one of the factors highlighted by Majanga *et al.* (2019) in Nakuru Municipality.

6. CONCLUSION:

The findings of this study show that participants acknowledged that teacher-learner classroom interaction plays a significant role in the teaching and learning processes of the learners. Most of the teachers expressed of having a strong interpersonal social knowledge which support the teacher-learner classroom interaction. On the other hand, the learners acknowledged a friendly verbal interaction among they and the teachers. However, from the classroom observation, it was found that the teacher-learner classroom interaction met up with some challenges which could not allow the teacher to teach in a collaborative way. The Mathematics Heads of Department (MHOD) acknowledged that teacher-learner classroom brings about self-confidence and improves learners' ability in problem-solving. Activities that could have incorporated the teacher-learner interaction meant with some challenges as was observed and also mentioned by the MHOD. Most of the classes have more than 45 learners which could not allow the teachers to do group learning in the classroom. The Mathematics Heads of Department (MHOD) acknowledged that classroom congestion has hindered the teacher-learner interaction, especially the interaction that could encourage learners to work in pairs or collaboratively. Therefore, the findings of study suggest that teacher-learner classroom interaction is very important to the teaching and learning processes of word-problem-solving. The researchers suggest further study on the effect of classroom congestion on learners' ability to solve word-problems.



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