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Senior high school chemistry teachers' knowledge and use of group work as a teaching strategy

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ABSTRACT

The study investigated the knowledge of chemistry teachers in using group work as a teaching strategy in teaching chemistry at the senior high schools (SHSs) in Ahafo and Bono Regions of Ghana. The sequential explanatory mixed method design was adopted for the study. All 58 chemistry teachers in the 20 purposively sampled SHSs participated in the study. A structured questionnaire, interview guide and an observation checklist were the research instruments. The descriptive techniques used for the analysis of data were percentages, means and standard deviation while Chi-square used for inferential analysis. The results revealed that a statistically significant number of chemistry teachers were knowledgeable in the use of the cooperative teaching strategies but adopted it occasionally based on unavailability of time and resources. The study recommended in-service training and workshops be organized on the impact of group work as a teaching strategy to enhance chemistry teachers understanding and motivation to use group work more frequently in their teachings. This promotes active learning among students through debates, questioning and discussions.

Keywords: chemistry teachers, group work, senior high school, teaching strategy

INTRODUCTION

Growing interest in the use of group work as a teaching method in science education has been observed during the past several years (Abell, 2013; Cohen & Lotan, 2014). It has been discovered that group work provides many advantages for students, including higher communication and collaborative abilities, better learning results, and increased engagement (Barkley et al., 2014; Jensen et al., 2015). Despite these advantages, group work is still rarely used as a teaching method in science classrooms, especially in many sub-Saharan African countries of which Ghana is one (Tabulawa, 2013). Recent studies on learner-centered teaching upholds the long held view that it actively engages students, promotes peer cooperation, and enables them to be socially aware and focused on group success rather than individual success (Klees & Qargha, 2014; Metto & Ndiku Makewa, 2014; Sanjana, 2018).

Group work is a student-centered teaching and learning approach, where the student has more accountability as a learning partner. Working in small groups, or collaborative working as it is often known, is simply a group of two to six students organized to study a specific subject or do a specific assignment (Center for Academic Development [CAD], 2013). Association for specialists in group work classifies work groups to include discussion groups, study circles, and learning groups that serve to accomplish identified work goals (Waldo & Bauman, 1998).

In educational practice, the ultimate goal of group work is to motivate students to learn. For example, it is expected that students participating in a group activity "learn something" (Hammar Chiriac, 2014). In this era of pedagogical transformation, active learning has become a major focus (Burke, 2011). Burke (2011) went on to add that while the phrase "group work" covers a wide range of activities, collaborative learning, or group work, is still an important part of active learning theory and practice. In group work, students usually work with their classmates and teachers while also seeking support, practical guidance, feedback, and reinforcement (Badache,2011; Weimer, 2002). This paradigm shift is absent from the teacher-centered approach, where students are treated as passive learners (Cheong, 2010; O'Neill & McMahon, 2005). Students' cross-cultural capability and sense of belonging can be enhanced by group work in culturally varied groups. These outcomes, however, are neither inevitable nor easy to obtain; they rely on the pedagogic interventions of teachers (Montgomery, 2009). According to Hammar Chiriac (2014), the growing interest stems from the realization by both researchers and instructors of the good benefits that teamwork can have on student's ability to learn. Students who participate in collaborative learning and educational activities outside of the classroom

and interact more with faculty members get better marks, are more satisfied with their education, and are more likely to stay in school (Wasley, 2006).

The premise behind group work, according to Kasim (2015) and Laal and Laal (2012), is that much of learning takes place in environments, where learners argue constructively and debate with others rather than just listening to the voice of the teacher in their minds. With the help of the group work technique, students can collaborate or learn in small groups of three up to six peers with a range of abilities to complete projects (Brame & Biel, 2015; Csernica et al., 2002; Davidson & Major, 2014; Davis, 1993).

In terms of student group learning, Hammar Chiriac (2011) proposed two approaches: cooperative and collaborative learning. Collaboration is a more exclusive idea that may be included in the much broader concept of cooperation, whereas cooperative group work is commonly considered a complete umbrella concept encompassing numerous types of student active working modes (Hammar Chiriac, 2011; 2014; Jacobs, 2015). Collaborative learning always incorporates interaction, teamwork, and the use of the group's competencies, whereas cooperative learning may describe group work without any interaction between the students (Jacobs, 2015; Laal & Laal, 2012).

Singh and Agrawal (2011) are of the view that as students learn, they can interact with one another in three different ways, they can work independently towards a goal without considering other students, compete to see who is "better," or work collaboratively with a stake in both their own and one another's development. Although competition is currently the most prevalent of the three interaction styles, where the vast majority of pupils see school as a place, where they compete to do better than their peers, research has shown that working collaboratively as learners produces holistic learners than the other two (Davidson & Major, 2014; Laal & Laal, 2012).

Group size dynamics are a key aspect of group work. Researchers agree that for cooperative learning to be successful, students should be divided up into small, face-to-face groups, but there are differences of opinion as to the best size for a group (Corrégé & Michinov, 2021). The suggested sizes proposed by researchers range from two (i.e., pairs) (Williams, 2010) to seven (Singh & Agrawal, 2011). Three or more persons are usually considered a small group (Beebe & Masterson, 2003). Dyads are two-person groups that are not recommended for group work since there are not enough people to produce innovation and a diverse range of ideas (Csernica et al., 2002). However, Levine and Moreland (2004) argued in their study that individuals working in dyads perform better than those in larger groups and those working individually (Kim et al., 2020; Schultze et al., 2012). In general, it's thought that groups of four to five people operate best (Abuseileek, 2012; Davis, 1993; Shimazoe & Aldrich, 2010). Csernica et al. (2002) and Jacobs (2015), on the other hand, believe that three or four members are more acceptable. Larger groups limit each member's ability to engage, and some individuals may not actively contribute to the group. Smaller groups are recommended in instances where there is a limited amount of time available to accomplish a group assignment, such as an in-class collaborative learning exercise. The group should be smaller if there is a limited amount of time available (Burke, 2011; Morice et al., 2015). For big classrooms, group work might be extremely effective. According to Wright and Lawson (2005), group work made students feel that the class was smaller; this encouraged them to attend to class more frequently. They felt more involved in the course and the topic in class, which encouraged active learning in a large group setting.

The members of the group must be assigned to ensure the group's success. Some instructors prefer to allocate students to groups at random. This has the benefit of increasing group heterogeneity (Davis, 1993) and it is a good technique to distribute group members in big courses. If the class is small and the teacher knows most of the students, the instructor can choose group members based on the class's recognized characteristics. The instructor, for example, can divide the students into groups based on their performance levels, academic strengths and weaknesses, ethnicity, and gender (Connery, 1988; Jacobs, 2015). In addition, some teachers enable students to choose their own group; nevertheless, this has significant drawbacks. Friends and roommates are frequently drawn to self-selected groupings (Csernica et al., 2002). As a result, students may isolate themselves and spend more time socializing than focusing on the group assignment (Taqi & Al-Nouh, 2014). According to research findings by Felder and Brent (2001), instructor-assigned groups tend to do better than self-selected groups.

Working in a group has benefits and drawbacks (Beebe & Masterson, 2003; Benson et al., 2019). A group can maximise the benefits of group work while minimising the obstacles that obstruct achievement by knowing the benefits and potential hazards. Working in a group has six benefits (Burke, 2011). A group of people has more information than a single person. Because of the diversity of backgrounds and experiences, groups have a larger pool of resources to draw from and more information to share. Group work also helps students to be more creative. When it comes to problem solving, the old adage "two heads are better than one" can be used. Another important benefit of group work pedagogy is that discussions by group members are easily remembered. When students work in small groups, they are more likely to learn and remember more of what is taught than when the same content is provided in other instructional styles (Barkley et al., 2005; Taqi & Al-Nouh, 2014). Students who engage in the process of decision-making tend to exhibit a higher degree of satisfaction. They may be able to better examine their interpersonal behaviour as a result of the feedback they receive. Employers place a high priority on teamwork. Employers ranked interpersonal skills as one of the top ten abilities they search for in university graduates (Graduate Outlook Survey, 2010 cited in Burke, 2011). CAD (2013) identified some of the benefits of using group work instructional approach to include: encouraging questioning, discussion and debate and can advance motivation to learn by raising interest levels.

Notwithstanding the enormous benefits that could be derived from usage of group work instructional method, research has proven that if it is not properly handled, it may put pressure on the group members to follow the majority's views (Laal & Laal, 2012). In addition, the division of work among group members limit their interdependence and opportunities for them to collaborate and enhance their social skills (Utha & Tshering, 2021). Also, majority of individuals in a group dislike confrontation and try to avoid it whenever feasible. Individuals may consent to a terrible solution only to avoid controversy by quickly assenting to the majority opinion. A single person may be able to control the conversation. As a result, members may be dissatisfied with the organisation because they may feel too isolated from the decision-making process (Taqi & Al-Nouh, 2014). Again, some members

in a group may place an undue reliance on others to complete tasks. This is a highly significant predicament that science educators and organisations are currently facing (Freeman & Greenacre, 2011). Despite the fact that group work is currently favoured over other types of techniques owing to its great advantages, CAD (2013) identified requirement that satisfies the use of group work to include:

1. Where the goal is to educate pupils how to collaborate, cooperate, and work in groups.
2. When a task can only be completed by a team (e.g., where students work as a management team, or are required to assign specific roles to group members).
3. When the work is too big or complicated for a single individual to do.
4. When a group's abilities are exactly what is needed for the work or study.
5. When pupils are asked to think creatively and independently, to listen compassionately and critically to others' ideas, and to build on the work of others.
6. When resource constraints warrant group work (equipment, time, project duration, and a small number of "genuine" clients, for example).

In Ghana, the academic performance of Senior High School (SHS) students in chemistry in general has been found to be poor (Hanson, 2017). In-depth investigations conducted by educational researchers and the West African Examinations Council have identified approximately five primary factors contributing to the poor performances of students in chemistry (Hanson, 2017). Among all the factors identified as the root course of learners' poor performance in chemistry, teaching approach seems to stand out. The rest of the factors that contribute to students' poor performance in chemistry, that is, their inability to answer questions based on organic chemistry coherently and from a conceptual basis; non-performance of practical activities in organic chemistry; non-connectivity between science and one's personal life; and students' own attitudes can be addressed through the adoption of appropriate teaching approaches. The traditional way of teaching, where teacher decides on what goes on in the classroom has a limited space in the 21st century science classrooms (Buabeng et al., 2014; Nkansah, 2021). Unfortunately, as alluded to, research seem to suggest that the most predominant pedagogical approach in most Ghanaian chemistry classrooms is the expository or traditional teaching methods (Ayittey et al., 2023).

Again, SHS chemistry teaching syllabus authored by the Ministry of Education, emphasizes on the adoption of participatory teaching approaches, which inarguably will include all the cooperative and inquiry-based learning strategies: group work, problem-based learning, and project-based learning, to mention but a few. There seems to be little or no literature on chemistry teachers' knowledge and use of this important teaching approach. This paper therefore seeks to examine chemistry teachers' knowledge level and practice of group work in teaching the subject in classrooms.

The following research questions were formulated to guide the study:

1. What knowledge do the chemistry teachers have on the use of group work in teaching chemistry?
2. To what extent do chemistry teachers use group work teaching approaches in teaching chemistry?
3. What are the factors that inhibit chemistry teachers' use of group work to teach chemistry in SHSs?

METHODOLOGY

Research Design

The study's primary focus is on instructors and their pedagogical approach preferences, thus theories that address how those traits may influence students' learning are relevant because they relate to the study's central question. The authors hold the opinion that students should be in charge of their own education since they do not think that teachers can exert any control over what they learn. However, the facilitatory and supervisory roles of the teacher are inevitable to the learners' learning. This assertion backs with the constructivist theory that students actively create concepts and work to make sense of the world. This study is thus hinged on the sociocultural constructivist theory propounded by Vygotsky.

The study employed the sequential explanatory mixed method research design (Ivankova et al., 2006). The research design was adopted in two stages. The first stage dealt with the collection of quantitative data using questionnaire. The second stage included the use of interviews and classroom observations to obtain qualitative data from the teachers, which helped the researchers to obtain deeper understanding of the chemistry teachers' use of group work teaching strategies and to capture participants' practices on the field. The questionnaire consisted of items that required straightforward answers with or without options.

Sampling Procedure

The target population comprised of 218 chemistry teachers from 60 public and private SHSs in Ahafo and Bono Regions of Ghana. The accessible population for the study was the chemistry teachers from 20 purposively selected public SHSs in the study area.

All 58 chemistry teachers in the 20 public SHSs agreed to participate in the study. Census sampling was used to sample the research participants due to the small number of chemistry teachers. A sub-sample of 15 respondents were observed and interviewed to have in-depth understanding of the issues involved in the use of group work teaching approach in chemistry lessons delivery in the schools.

Research Instruments

A structured questionnaire, a semi-structured interview guide and an observation guide were the instruments used to gather data for the study. The purpose for the selection of instruments was for methodological triangulation (Creswell, 2014). The items on the questionnaire were a 5-point Likert- scale type items, which were collapsed into 3-point Likert scale type during the analysis. The questionnaire composed of four main sections. The first section was concerned with the bio data of the respondents (i.e., sex, age, professional, and academic experiences). The second section had 16 statements focused on the knowledge of teachers on the use of group work in teaching chemistry while the third section had 10 statements on the extent to which teachers used group work in teaching chemistry. The final section with nine statements covered the factors that inhibit the practice of group work teaching approach in SHSs.

A Semi-structured interview guide, which captured the themes and constructs of the study, was developed by the researchers to obtain an in-depth understanding of the problem under study. The first section was more structured and focused on eliciting straightforward answers from the participants on the four cardinal research questions of the study. The second section, which was subjective and focused on what drive teachers to use group work in terms of advantages and disadvantages as well as the extent to which it is used.

To streamline and put the observation in the context of the study, a checklist was designed based on the research questions of the study. The checklist comprised direct observation of use of group work teaching strategies used by selected chemistry teachers. It also comprised appropriate steps in the selection of groups, group size and procedures of discussions by students.

The content and face validity of the research instruments were done by three experienced senior Lectures in the department of science education, University of Education, Winneba. Their comments and suggestions made for review were effected before the administration of the instruments.

The research instruments were pilot tested in order to improve the instrument's reliability. Using data from the pilot test on the instruments administered to a small sample of chemistry teachers with chemistry minors who were not participating in the study, the Cronbach Alpha reliability statistic coefficient of 0.76 was obtained, which was judged significant for the study (Baidoo, 2015). The interpretations of the participants' responses to each interview questions were carefully examined to ensure that the items measured what they were intended to measure.

Data Collection Procedure

The researchers obtained permission from the district directors of education in the study area to carry out the research in the selected schools. Permission letters obtained from the district directorates were copied to all the chemistry teachers to seek their consent to conduct the study. Participants were briefed on the purpose of the study to engage their maximum support and cooperation. The questionnaires were administered by the researchers within a period of three weeks to all chemistry teachers in 20 selected schools. All questionnaires were completed by chemistry teachers within three weeks and returned.

Subsequently, interview sessions, which lasted between 45-60 minutes were conducted with the 15 selected chemistry teachers to ascertain their in-depth knowledge of the use of group work as a teaching strategy by chemistry teachers. Checklist of direct observation was also used by the researchers to obtain data from the chemistry teachers in the classroom settings.

Data Analysis

Statistical package for social sciences version 25 was used to analyze the data. Descriptive statistics such as frequency and percentages were used to analyze data. The frequencies were used to determine the number of chemistry teachers who agreed (A), not sure (NS), or disagreed (D) to statements. In addition, the interview data was analyzed using content analysis. Inferential statistics such as Chi-square statistic was further used to analyze the responses. Chi-square statistic was used to determine whether a response was significant or not. A critical value of 7.82 with three degrees of freedom (df) at a significance level of 5% was used in this analysis. A response is significance when the Chi-square statistic is greater than the critical value.

RESULTS & DISCUSSION

Demographic Characteristics of the Respondents

The study investigated the demographic characteristics of the respondents who participated in the research. The sample was comprised of individuals possessing educational backgrounds such as Bachelor of Science (BSc), Bachelor of Education (BEd), Master of Science (MSc), and Master of Education (MEd) in the field of chemistry. These educational backgrounds corresponded to proportions of 10.30%, 44.80%, 32.80%, and 12.10%, respectively. Additionally, 58.60% of the chemistry teachers held a first degree while 41.40% possessed masters' degrees. In terms of teaching experience, only one teacher had less than a year of experience, whereas 31 teachers had been teaching for two-five years, 24 teachers had been teaching for six-10 years, and two teachers had been teaching for 11-15 years. These years of experience corresponded to proportions of 1.70%, 53.50%, 41.40%, and 3.40%, respectively.

Knowledge of Teachers on Use of Group Work in Teaching Chemistry

To ascertain the knowledge of chemistry teachers in the use of group work as a pedagogical approach, analysis of the data collected through survey is presented in **Table 1**.

Table 1. Responses of chemistry teachers' knowledge of group work (Researcher's Data, 2019)

Knowledge of use group work	A	%	NS	%	D	%	X^2
1. Group work is small group	39	67.24	14	24.14	5	8.62	32.11
2. Consist of at most six students	45	77.59	13	22.41	0	0.00	55.49
3. Serve as incentive	43	74.14	13	22.41	2	3.45	46.59
4. Encompasses a broad array of practice	44	75.86	12	20.69	2	3.45	49.80
5. Group is culturally diverse	42	72.41	14	24.14	2	3.45	43.59
6. Increase the sense of belonging	44	75.86	11	18.97	3	5.17	48.87
7. Depends on teaching pedagogy	39	67.24	15	25.86	4	6.90	33.14
8. It's a collaborative learning activity	38	65.52	15	25.86	5	8.62	29.63
9. Collaborative learning more likely to understand complex concept	42	72.41	12	20.69	4	6.90	41.52
10. Well of resources for group to tap	41	70.69	14	24.14	3	5.17	39.56
11. Remember group discussion better	43	74.15	13	22.41	2	3.45	46.59
12. Encourages questioning, discussion and debate	40	68.97	13	22.41	5	8.62	34.80
13. Engage students as active participants	37	63.79	21	36.21	0	0.00	35.62
14. Safeguard against students being isolated	39	67.24	14	24.14	5	8.62	32.11
15. Develops student's transferable skills	43	74.15	15	25.86	0	0.00	49.28
16. Stimulate creative ideas	39	67.24	15	25.86	4	6.90	33.14

Note. n=54 & χ^2 tabulated=7.820 at 5% level of significance

Table 2. Responses of teachers on when they use group work (Researcher's Data, 2019)

When teachers use group work	A	%	NS	%	D	%	X^2
1. Inadequate teaching and learning materials s for chemistry	39	67.24	17	29.31	2	3.45	35.83
2. Large number of students in class	40	68.96	14	24.14	4	6.90	35.73
3. Diversity in level of understanding among student	38	65.51	16	27.59	4	6.90	30.76
4. Impossibility for chemistry teacher to attend individually to students	45	77.58	11	18.97	2	3.45	53.22
5. Unavailability of time	43	74.14	12	20.69	3	5.17	45.56
6. Balanced number of good and weak students	29	50.00	20	34.48	9	15.52	10.38
7. Objectives are best achieved	36	62.07	20	17.24	2	3.45	29.94
8. When we want students to collaborate, cooperate and do teamwork	46	79.31	10	25.86	2	3.45	56.84
9. When task is too large and complex	41	70.69	15	22.41	2	3.45	40.80
10. Required to think creatively and originally	42	72.42	13	17.24	3	5.17	42.46

Note. n=54 & χ^2 tabulated=7.815 at 5% level of significance

As indicated in **Table 1**, all the chemistry teachers' responses were significant because all values of Chi-square were greater than the critical value of 7.82.

From the findings, most of the teachers (above 60.00%) agreed that group work entails a small group, consisting of at most six students and serve as an incentive for students learning. They were also of the opinion that group work encompasses a broad array of practices and relates to a collaborative learning that enables students more likely to understand complex concepts. The participants were also of the view that the use of group work pedagogy stimulates and promotes learner's recollection of group discussions better; encourages questioning, discussion and debates; engage students as active participants; and safeguard against students being isolated. Finally, in the view of the research participants, group work pedagogy develops transferrable skills and stimulates creative ideas among students.

The findings confirm the works of Brame and Biel (2015), CAD (2013), and Davidson and Major (2014) that a group consist of a small group (Beebe & Masterson, 2003) of two to six students organized with a range of abilities to study a concept. Also, Hammer Chirac (2014) believes that group work serves as incentive for students to learn something, which motivates and arouses their interest in learning. In addition, group work engages learners as active participants in class as opined by Burk (2011), Metto and Ndiku Makewa (2014), and Sanjana (2018), which promotes peer cooperation and enables them to be socially aware and focused on succeeding as a group success instead of as individuals. Group work help students to remember discussions better (Barkley et al., 2005; Taqi & Al-Nouh, 2014) by encouraging questioning, discussion and debates as confirmed by Kasim (2015) and Laal and Laal (2012). Students learn better in an environment where they argue constructively and debate among themselves. This therefore helps group members to tap resources and ideas from group members as opined by Burke (2011). Because of the diversity of backgrounds and experiences, groups have a larger pool of resources to draw from and more information to share. Taqi and Al-Nouh (2014) argued that group work safeguard against students being isolated during classroom instructions. Burke (2011), Badache (2011), Metto and Ndiku Makewa (2014), and Sanjana (2018) confirmed in their studies that students develop transferable skills and creative ideas when they are engaged in group work as agreed by most of the teachers in the study.

Extent to Which Teachers Use Group Work Teaching Approach in Teaching Chemistry

To ascertain the extent to which chemistry teachers use group work as a pedagogical approach, analysis of the data collected through survey is presented in **Table 2**.

With respect to data analysis presented in **Table 2**, over 50.00% of teacher's responses indicated that they use group work teaching strategy due to: inadequate teaching and learning materials (TLMs) for chemistry, large number of students in class, diversity in level of understanding among students, impossibility for chemistry teacher to attend individually to students, and unavailability of time. The research participants also believed that when there are balanced numbers of good and weak students;

when they want students to collaborate, cooperate and do teamwork, and when task is too large and complex and required to think creatively and originally, they employ group work as an instructional approach. In addition, the analysis of responses of the respondents revealed that, all responses of chemistry teachers were significant because all values of Chi-square were greater than the critical value of 7.82.

Similarly, some selected respondents who were interviewed to ascertain their in-depth understanding on the use of group work as teaching strategy in chemistry lesson delivery and how often they used this pedagogical approach indicated that their use of the group work teaching strategy depended on the topic being taught. Majority of them indicated that they only organize their students in groups when the topic is practical and would engage the brainstorming of two or more students. The qualitative result gathered indicated that majority of the chemistry teachers engage in group work as a teaching strategy for practical chemistry lessons. This was done at least once in a school term, even though the maximum number of the use of group work as indicated by one of the research participants was supposed to be ten times in a term. Additionally, the study gathered qualitative information on what factors chemistry teachers considered before the use of group work as teaching strategy in lessons. Majority of the interviewees indicated that factors they usually considered were the availability of teaching learning materials, the nature of the teaching materials to be used and the interest of the students.

With respect to the stages in forming a group for students in chemistry lessons, the pattern of decision teachers took based on the responses of majority of teachers interviewed indicated that chemistry teachers first of all decide on the number of students to be placed in the group. Secondly the members of the group were also decided before task was given to them. It was also gathered that some teachers assigned groups to students based on their abilities. In terms of supervision of the groups' activities, majority of teachers indicated that their normal practice was to move from group to group during lessons to instruct and guide the activities of students. During this period, students were corrected on errors they might have commented in their steps. According to Teacher 'A':

> During group work instructional sessions, most students were able to express their views, and this would send a clear signal to the teacher on whether the concept was understood by all or not. The process helps me to identify the shortcomings and possible misapplications of concepts while appropriate measures are sanctioned for students understanding in concepts.

In congruence to the results of the study, Connery (1988) pointed out that the instructor can form the groups while taking to account performance levels, academic strengths and weaknesses, ethnicity, and gender. Wright and Lawson (2005) also found that group work helped students feel that the class was smaller and encouraged them to come to class more often. They felt more invested in the course and in the class material, which promoted active learning in a large class environment.

The result of the survey agrees with the findings of CAD (2013), which identified some appropriate conditions for which the use of group work is appropriate. As per their findings it was appropriate to use group work when goals of the course are best achieved through students working in groups, when the aim is targeted to teach students collaborative, cooperative and team-working skills, when task is too large or complex for one person and when resources are limited.

The discussions on class size and how it affects group work seems unending. However, to tune the discussion to the scope and context of the study result, Davis (1993) indicated that assigning members of the group is integral to the success of the group. Even though the group size maybe dependent on a lot of factors that may include the class size, research have revealed relatively small group size as the most effective. In terms of the choice of students to form part of the group, even though the study results indicated that teachers' selection in the setting were mostly based on the ability of the group, some faculty members prefer to randomly assign students to groups. According to Davis (1993), this form of selection has an advantage of maximizing heterogeneity of the group and is an effective way of assigning group members in large classrooms. The results of Davis (1993) however contradict the applicable strategy used for assigning groups for lessons due to the wide diversity of learners' academic achievements in most secondary schools in Ghana. As pointed out by Connery (1988), if the class size is small and the instructor is familiar with most of the students, the instructor can select the group members based on known attributes of the class. For example, the instructor can form the groups while taking to account performance levels, academic strengths and weaknesses, ethnicity, and gender. This observation may not be necessarily applicable in the Ghanaian context. The results of the observation indicated that most schools had large class size and therefore teachers were constrained with time and the size of the class, which mostly rendered the contribution of group works ineffective.

Factors That Inhibit Chemistry Teachers' Use of Group Work to Teach Chemistry in Senior High Schools

This was to examine teachers' knowledge on factors that inhabits practice of group work teaching approach in SHS (**Table 3**).

The results of the study revealed that pressure from majority of students in the group who may be wrong in their submission deter teachers from using the group work for lessons. This was represented by 74.14% of teachers' whose responses agreed with the statement while 3.45% of teachers disagreed and the remaining were uncertain of the assertion. The response of the majority of teachers was statistically significant since Chi-square calculated of 44.11 is greater than the Chi-square tabulated 7.82 with 3 df.

The results further indicated that majority of the teachers (68.96%) agreed that individuals who articulate well dominates group discussions in group work teaching approach. This statement was however disagreed by only 3.45% of teachers while the remaining teachers were uncertain of the response to the statement. The response of the majority of teachers was statistically significant since the Chi-square calculated of 38.21 is greater than the Chi-square tabulated 7.82 with 3 df. Similarly, the interview with teachers identified most prominent factors that hinder the use of group work activities for practical chemistry lessons as difficulty in preparation of TLMs, class size, availability of facilities, inadequate TLMs, time constraints and lack of students' participation in group activities.

Table 3. Teachers' knowledge on factors that inhibits chemistry teachers' use of group work to teach chemistry in SHS (Researcher's Data, 2019)

Contributing factors	A	%	NS	%	D	%	X^2
1. Pressure from majority of students in the group	43	74.14	10	17.24	5	8.62	44.11
2. Individual who articulates well may dominate	40	68.96	16	27.59	2	3.45	38.21
3. Overreliance of some members on other, members	36	62.06	17	29.31	5	8.62	25.28
4. It takes time to work in group	35	60.34	17	29.31	6	10.34	22.18
5. Lack of facilities	33	56.90	17	29.31	8	13.79	16.59
6. Lack of expertise of chem. Teacher	37	63.79	12	20.69	9	15.52	24.45
7. Tendency for friend to form the same group	38	65.52	15	25.86	5	8.62	29.63
8. Inability for chem. teachers to supervise	42	72.41	12	20.69	4	6.90	41.52
9. Prolonged argument and disagreement	44	75.86	11	18.97	3	5.17	48.87

Note. n=54 & χ^2 tabulated=7.815 at 5% level of significance

In support of the findings of the study, it was acknowledged that even though many researchers consent to the use of group work in chemistry lessons, the challenges facing teachers in the use of this approach is enormous. Katane and Selvi (2006) pointed out the skills and competence of the chemistry teacher as one of the major challenges for the use of group work in SHS for chemistry practical lessons. Research have also shown that well-constructed group work with a clear rationale and conviction of the value of the process leads to a greater retention and understanding of what is taught (Boud et al., 1999; Millis & Cottell, 1998). However, Boud et al. (1999) observed that group discussion takes a longer time since the opinions of each member is sought. This may result in prolonged argument and disagreements and the objectives for the discussions may not be achieved.

It has also been identified that during group work sessions, some students may be under pressure based on their level of preparedness. This confirms the results of Beebe and Masterson (2003) that identified four disadvantages of group work as pressure from the group to conform to the majority opinion, individual dominance, time consuming and overreliance on others to do the work. The result of the study confirms the findings of Beebe and Masterson (2003).

CONCLUSIONS

Even though the study revealed that more than 60.00% of the respondents (chemistry teachers in Ghanaian SHSs) have knowledge of group work as a pedagogical approach, and that more than 50.00% of them use group work pedagogical strategy in the delivery of chemistry lessons, there is the need for policy direction to address the lack of knowledge (on the part of those who have no knowledge and do not use group work pedagogy) and non-utilisation of group work pedagogy in chemistry lesson delivery in Ghana. Pressure from majority of students in the group, prolonged argument and Inability for chemistry teachers to supervise students were identified as the major hindrances to the use of group work pedagogy. Targeted professional development strategies is therefore recommended since it will equip teachers to adopt group work pedagogical approach, knowing the immense benefits it delivers to the 21st century learner.

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