



The effect of teachers' attitudes on using active learning methods in teaching chemistry for senior two students of Gatsibo district, Rwanda

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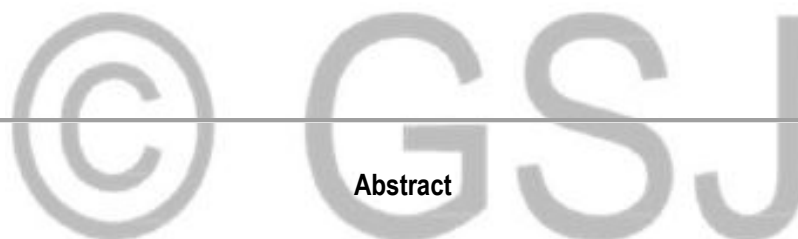
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Abstract

The use of active learning methods was found to improve the teaching and learning process. However, the use of these methods was found to be influenced by different factors including the attitudes of teachers. In this regards, this research is aimed to assess the effect of teachers' attitudes on using active learning methods in teaching chemistry at lower secondary schools in Gatsibo district. Both quantitative and qualitative data were collected by using questionnaire and interview protocol. 78 senior two students, 5 chemistry teachers and 3 Head Teachers were selected purposefully to participate in the study. Obtained data were analysed by using both descriptive statistics and Chi-square and the results showed the positive relationship between teachers' attitudes and frequency of using active learning methods. However, some active learning methods like inquiry-based and problem-based were found to be not effectively used. Therefore, adequate training on effective use of different active learning methods in their teaching is needed.

Key words: Senior two Students, Chemistry, Active learning, Students' performance, learning methods, teaching techniques.

Introduction

The effective methods of teaching science can lead to the achievement of scientific and technological greatness. Based on the studies conducted within the science education context, chemistry has been identified as a very important subject in schools and its importance in scientific and technological progress of any nation has been widely reported (Adesoju & Olantunbosun, 2008). In east African countries like Kenya, the government has put a lot of emphasis on learners' performance in science education within the curriculum as the way of preparing pupils for the world of science and technology (Ndemo., 2007). In the same context, the government of Rwanda has put great efforts in developing sciences and technology education where chemistry should also be emphasized. Chemistry enhances student's learning of Biology, Physics and Agriculture on which Rwanda industries and prosperity depend.

Regardless to the importance of chemistry in development, it has been reported that most students perform poorly in this subject due to inadequate teaching and learning techniques used (Jayawarda, 2001). Therefore, teachers have to adopt effective teaching and learning methods in education of science especially in chemistry in terms of enhancing students' performance. Different methods stimulating the active learning have to be identified and used on the basis of certain criteria like the students' knowledge, the environment and learning goals decided in the academic curriculum (Yachun., 2008). The active learning is essential because it involves students in doing things and thinking about what they are doing. The methods of teaching employing the students' activity are widely encouraged in terms of promoting effective learning than the traditional teacher-centred. This could be emphasized because teacher-centered methods inhibit the students' problem-solving capabilities (Silberman, 1996)

In terms of adopting the contemporary teaching methods used globally, the government of Rwanda through the Ministry of Education, was compelled to introduce new Competence based Curriculum (CBC) into the education system in 2015 where active learning methods are given priority. The study discovered that students in passive classes are likely to fail 1.5 times than students in active classes (Haslam, 1997). The lack of knowledge on learner-centered teaching methods and their impact on academic achievements persist to be a big problem in Rwanda not only for the teachers, but also for the students. Because of that reason, both teachers and students may delay to adopt the proposed changes about the active learning approaches because the teaching strategies of active learning were unfamiliar to them. In terms of responding to the above issue and facilitating the smooth learning of science including chemistry, much effort has been put into a variety of activities helping teachers shifting from teacher-centered pedagogy to learner-centered pedagogy. Among these activities different active learning methods have recommended to be used in teaching and learning process. The

Irrespective to the importance of active learning in improving teaching and learning process as well as students' performance, its application was found to be challenged by different factors in which attitude of teachers is included.

Within this context, this research is aimed to assess the impact of the teachers' attitudes on the frequency of using active learning in teaching chemistry at lower secondary school in Gatsibo district with reference to three selected secondary schools.

Purpose of the study

This study is aimed at investigating the effects of teachers' attitudes on the frequency of using active learning methods for teaching chemistry in selected schools of Gatsibo district.

Objectives of the study

The specific objectives of this study were:

1. To identify the degree at which senior two students in Gatsibo district use active learning methods in learning chemistry.
2. To determine the perceptions of chemistry teachers towards the importance of using different active learning methods on improving teaching and learning process and students' performance
3. To find out the relationship between teachers' perceptions and frequency of using active learning methods during teaching and learning process.

Literature review

Different active methods were found to be relevant for teaching and learning process. Here below some active learning methods used in educational settings are discussed.

The meaning of active learning

Agreeing with the study of Felder & Brent., (2009), active learning method is any teaching and learning that stimulate all learners in a class session to participate actively rather than simply watching, listening and taking notes". In the context of this research, active learning is the method of learning involving the learners in some activity requiring them to reflect upon their thoughts and how they are making use of those thoughts. These methods help learners to commonly examine their levels of understanding and capacities of management of different issues in specific subject areas. Brown (2001) stated that the active learning considers the learners' desires, styles and aims. In chemistry lesson, the use of active learning methods comprises the involvement of simulations, discussions among students, presentations of students, the use of games, flip-charts, role play, and handout (Silvan; Leung; Woon; Kemer, 2000). In addition, a number of active learning strategies are explained below. Among these include cooperative and collaborative learning; problem-based learning; discovery learning and inquiry-based learning.

Cooperative and collaborative learning

Cooperative and collaborative learning is an active method (Felder & Brent, 2007) having a foundation in the constructivist learning theory. Different researches proved that cooperative learning has more benefits over competitive and individualistic efforts. In referring to Vygotsky, Russ-Eft (2011) pointed out that effective learning occurs when persons interact among themselves and this is achieved through cooperative and collaborative learning method. Cooperative and collaborative learning method showed a positive influence on the effective learning of students and increased their satisfaction.

In relation to its name, cooperative and collaborative learning method enhances students to work in groups which should be carefully structured and contain well prepared activities and common learning goals. In this perspective, students have to be grouped according to a variety of learning capabilities so as they can benefit from each other. Sometimes, students are invited to present their work to the teacher based on responsibility they took in the group. During group interaction, interpersonal support and evaluation may be involved (Felder, 2000). In some models which are commonly used in education, five principles are encompassed in cooperative learning. These principles are individual accountability, shared support, direct encouragement of interaction, the appropriate sharing of particular capabilities and the continuous evaluation of the team members' engagement. Commonly, a sense of cooperativeness and sharing of mutual incentives in terms of promoting common learning goals is the expected learning environment instead of a competitive atmosphere (Hattie., 2009).

Problem-based learning

Problem-based learning (PBL) is an active learning method identified by presenting the problems having a relationship with the lesson topic during the first session of the instruction and students use them to find out the learning content that follows in an accurate situation. This active learning method is commonly used together with cooperative or collaborative learning methods (Hattie., 2009). According to Nilson (2010), case study and problem-based learning methods equip students with knowledge related to the problems that occur in actual life situations having a variety of proper answers then students are provided with the opportunity to struggle with doubt and uncertainty.

From their review of the literature, Yew (2012) identified PBL as constructivist method of instruction. It is classified as constructivist method since it provides students with a learning environment that enables significant learning through reliable problems. This kind of environment helped students in collective construction of knowledge, and helped them to direct their own learning. In PBL, the problems used have to be appropriate to the field of students and relevant learning topic. In this context, teachers can initiate discussions with students about the nature and structure of the problem, based on the previous experience of students. After discussion, students in their groups examine the problem, produce some expected clarifications, construct ideas based on collective contributions, and determine the basic points to consider in the future during dealing with the problem (Yew, 2012).

Discovery learning

Discovery learning is an active method where students are actively engaged and participated different activities and investigations to gain knowledge. Within classroom setting, discovery learning refers to a kind of instructional activity that stimulate students to actively search and analyse the ideas, answers, or plans presented during the instructional session (Chen, 2008). Based on the findings from the study of Alfieri (2011), discovery learning occurs when the students are not equipped with the needed information that could help them to get the basic ideas related to a certain phenomenon. In this line, students are simply presented with the learning material to be used for dealing with the phenomenon and sometimes some explicit instruction are given to the students. However, some students get little assistance while in other cases they are given too much directions during the learning process. The provision of these assistance could be performed in different ways such as providing the students with manuals, simulations, feedback and exemplary problems.

Inquiry-based learning

Inquiry-based learning in other term called inquiry-guided learning (Nilson, 2010), is a type of learning method where students are provided with challenging problems and are required to solve these problems by gathering information related to the problems and analysing the final outcomes (Woolfolk, 2009). Lee (2011) defined inquiry guided learning as one type of active learning where students gain new competencies through examination of questions and problems by various means and principles of inquiry in a given field of study.

Based on Haslam (1997), the strategies used by inquiry-based learning method comprise: appreciating and comprising the students' ideas and questions; frequent use of open-ended questions, and asking the explanation of students' ideas. In the same context, this active method involves the ways of motivating students to evaluate their own ideas, to suggest answers, to speculate about causes and to deduce the effects; and motivating self-analysis, gathering information to scaffold ideas, and adjusting ideas in line with new compassions and new indications.

Concept of performance in a school and factors influencing learners' performance

Performance in schools is something expected by everyone to be of higher quality for producing relevant personnel to provide service to the community. On the other hand, those who failed to perform better cannot contribute well to the human resources because they don't have skills needed. Babyegeya (2002) has revealed a number of factors that affect students' academic performance like teaching and learning materials, teachers' qualities, learners' motivation, environment factors and learners' background. On the other side, students' performance was found to be associated with the teaching and learning techniques used. Active learning techniques were found to influence the increase of students' performance. Regardless to the importance of active learning on improving the students' performance, its application was found to be influenced by many factors such as teachers' attitudes, teachers' knowledge, teaching materials and students' attitudes towards the importance of active learning for the improvement of their performance(Teshome, 2017). In this regards,

this research was planned to investigate the effect of teachers' attitudes on the frequency of using active learning methods for teaching chemistry in senior two students.

Research methodology

This section describes the research design adopted, the location of the study, targeted population, sample size and sampling methods, data collection tools, data collection techniques, and methods used for data analysis and interpretation.

Research design and sample size

This research used descriptive correlational research design with mixed approach. The study design was suitable because it helps the investigation of the real context of the problem and find out the relationship between teachers' attitudes and the frequency of using active learning in their teaching and learning process. The study was conducted in Gatsibo district which is a rural district of Eastern province in Rwanda. During data collection, a sample of 86 participants were randomly selected to participate in the study. These participants include 78 students from Senior two, 5 chemistry teachers and 3 Head Teachers.

Instrument and data collection techniques

During data collection, different tools and techniques have been used. These tools include Likert square questionnaire administered to both students and chemistry teachers, and interviews for chemistry teachers and head teachers. All questions contained in all questionnaires had the same purpose of assessing the effects of teachers' attitudes on the frequency of using active teaching and learning techniques for improving the students' performance in general and particularly in chemistry subject.

Data analysis techniques

After entering data in SPSS software, descriptive statistics was computed, then the tables of frequencies, percentages and mean were used to present the findings. For better understanding the relationship between teachers' attitude's and the frequency at which different active learning methods were used, a chi-square test was used. This statistical test was found to be appropriate because the distribution of items' responses was not normal. The output of SPSS was chi-square value (X^2), the degree of freedom (df), and asymptomatic significance (p-value). In this context, the p-value greater than 0.05 indicated non-influence while the p-value less than 0.05 identified the influence teachers' attitude on the frequency of using active teaching and learning for students' performance. In addition, the results from interview were thematically analyzed to complement the statistical findings.

Presentation of research findings

This research was aimed to investigate the effect of teachers' attitudes on the use of active learning strategies in teaching senior two students in Gatsibo District. The section below presented the findings related to the topic in different tables and figures.

Students' perceptions on the importance of different active learning in improving the performance in chemistry

Students' perception towards a certain educational concept may influence the way they can benefits from it. In this concept the table below summarized the perceptions of senior two students from selected schools of Gatsibo District to see if the understand the value of using active learning strategies. Their good perception on the value active leaning techniques may be a good indicator of the level at which they are being taught by using these techniques.

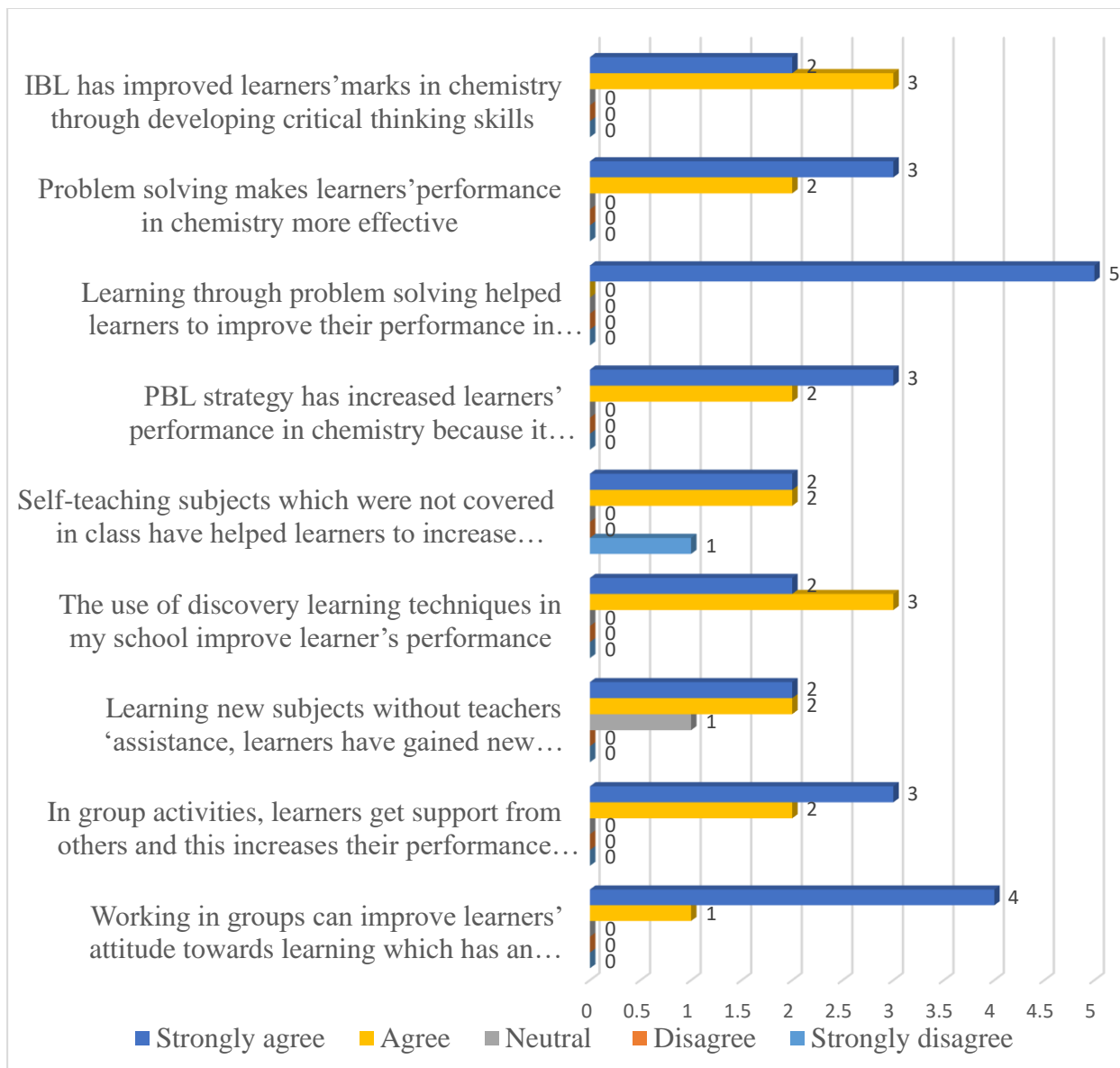
Table 1. Overall means and standard deviations (SD) from students' perceptions on using different active learning strategies.

Active learning method	N	Overall Mean	Overall SD
Cooperative and collaborative learning strategies	78	4.7	0.57
Problem-based learning	78	4.35	0.89
Discovery learning	78	4.16	1.05
Inquiry-based learning	78	4.00	0.66

Source: Primary data, 2021

Perception of chemistry teachers in selected schools towards the use of active learning strategies

Teachers' perceptions towards the usefulness and importance of a certain educational paradigm, influence the adoption and frequency at which they use different teaching and learning techniques. In this context, the figure below summarized the judgements of chemistry teachers involved in this research on the importance and value of using active learning on improving teaching and learning process as well as increasing students' performance.



*PBL: Problem-Based learning, IBL: Inquiry –Based learning

Figure 1: Perceptions' of teachers on effects of active learning strategies on learners' performance

Source: Primary data, 2021

Based on the findings in the figure 1 above, it has been shown that most of chemistry teachers involved in this research had a good perception towards the importance of different active learning strategies on the learners' performance. Among 5 chemistry teachers selected from three schools to participate in this study, between 4 to 5 teachers supported the statements describing how various active learning techniques improve teaching and learning process hence the increased learners' performance. These good perceptions may influence the frequency at which these chemistry teachers may use these techniques in their daily teaching and learning process. In this context, the frequency at which chemistry teachers from selected schools used active learning in their practices are presented in section below.

The frequency at which chemistry teachers used active learning strategies

The table below is presenting the findings on the mean frequency at which different active teaching and learning strategies were used by chemistry teachers involved in this research.

Table 2: Mean and SD Scores of how often teachers use different active teaching and learning strategies in their daily activities

Active learning strategies	N	Minimum	Maximum	Mean	Std. Deviation
Collaborative and cooperative	5	1.00	3.00	2.20	1.09
Discovery learning	5	1.00	3.00	2.00	.70
Problem based	5	1.00	2.00	1.20	.44
Inquiry-based learning	5	1.00	3.00	1.60	.89
Overall				1.75	3.12

Source: Primary data, 2021

Based on the findings in the table 2 presenting the average of how chemistry teachers used different active techniques in teaching and learning process, it has been found that the active teaching techniques are moderately used in teaching as the overall mean was found to be 1.75 greater than the mid-point that could be 1.5. This implies that chemistry teachers involved in this research aware the importance of active learning strategies on the improvement of teaching and learning process. However, a low frequency of use was found on the problem-based (1.2) and inquiry-based (1.6). The above results are in line with those from the interviews with Head Teachers who also confirmed that chemistry teachers in their schools had positive attitudes towards the use of active learning techniques and they have a good understanding on the importance of these techniques in improving the students' performance thus they frequently used some of these techniques in teaching and learning process. They added that continuous support is needed to increase the teachers' knowledge on the effective use of various active learning techniques.

Table 3: Relationship between teachers' attitudes and the frequency of using different learning methods in teaching chemistry

Problem based learning	Difference		
Items	X ²	p	Difference

Problem-based learning strategy has increased learners' performance in chemistry because it improves problem solving capabilities	5.00	0.02	<0.05	Significant
Learning through problem solving helped learners to improve their performance chemistry because this method of learning increased critical thinking among Learners	5.00	0.03	<0.05	Significant
Problem solving makes learners' performance in chemistry more effective	10.50	0.01	p<0.05	Significant
Discovery learning				
Learning new subjects without teachers 'assistance, learners have gained new knowledge which increased their performance especially in chemistry	10.00	0.04	p<0.05	Significant
The use of discovery learning techniques in my school improve learner's Performance	6.25	0.39	p>0.05	Non-significant
Self-teaching subjects which were not covered in class have helped learners increase their performance especially in chemistry	12.135	0.01	p<0.05	Significant
Inquiry-based learning				
Inquiry-based learning has improved learners' marks in chemistry through developing critical thinking skills	3.75	0.44	p>0.05	Non-significant
Learners' involvement in teaching and learning process has helped to increase learners' performance in chemistry	5.000	0.02	p<0.05	Significant
Collaborative and cooperative learning				
Working in groups can improve learners' attitude towards learning which has an impact on learners' performance in chemistry	9.42	0.02	p<0.05	Significant
In group activities, learners get support from others and this increases their performance in chemistry	5.00	0.17	p>0.05	Non-significant

Source: Primary data, 2021

From the table above, it has been observed that the p-value is less than 0.050 for seven questions and greater than 0.050 for only three questions. This showed a significant influence of teachers' attitude on the frequency of applying different active teaching strategies among chemistry teachers. The positive perceptions in most of chemistry teachers who were involved in this research influenced them to frequently use active techniques in teaching and learning process. However, some few findings showed non-significance of between teachers' attitudes and frequency of using active learning techniques.

Discussion of findings

Based on the findings from this study, it has been clearly shown that the perceptions of chemistry teachers towards the use of active learning had a great influence on the frequency of using these techniques in teaching and learning

process. The figure 1 showed that chemistry teachers involved in this study had a positive perception on the importance of using active learning in improving teaching and learning process as well as students' performance. It has been indicated by their high frequency of agreement on how inquiry based learning has improved learners' marks in chemistry through developing critical thinking (40% strongly agree and 60% agree), and how problem solving strategies increased the problem solving capacity of learners resulted into their high performance (60% strongly agree and 40% agree). On the other side, they have argued that the use of discovery learning as one of active learning techniques has resulted into the increase of learners' performance (40% strongly agree and 60 agree). This helped learners to work independently while dealing with new subjects. Similarly, chemistry teachers involved in this research understand how group works were found to play an important role in improving learners' attitudes towards learning and finally cause the increase of learners' performance (80% strongly agree and 20% agree). They agreed that when learners are working in groups, they get support from others which help them to perform better.

During interview with teachers and head teachers, they agreed that active learning techniques increased learners' performance by empowering them the skills of conducting their own research and increasing their critical thinking ability. This could be linked to the ideas of Nnaka & Anaekwe (2004) who asserted that active learning is associated with higher-order thinking tasks like analyzing, synthesizing and evaluating. In this context, most of chemistry teachers involved in this research have shown a moderate use of active learning methods during their teaching and learning process as shown in the table 2 indicating the frequency of using active learning. It concurs with the findings of Silberman (1996) stating that teaching methodology and the ability of teachers to use could be one among factors that could promote the learners' performance. Additionally, Kyriacou & Newson (1999) stated that active learning instructional approaches positively impact learning outcomes.

By analyzing the frequency at which active learning methods were used by selected chemistry teachers, it has been shown that most of active techniques were used at moderate rate with a high frequency of use for cooperative and collaborative learning as well as discovery learning used compared to the other active learning strategies. This has been shown by their respective overall mean of 2.2 and 2.0 which are compared to 1.2 for problem based learning and 1.6 of inquiry based learning (refer to the table 2). These findings were supported by result from the interview with both chemistry teachers and head teachers who confirmed that most of were trained on the effective use of group works the reason why the commonly use group works in their teaching and learning process. This concurs with the views of Russ-Eft (2011) who pointed out that, according to the constructivists, learning takes place when a person interacts with others. However, a knowledge gap was identified on the use of other active learning techniques like inquiry-based and problem-based learning. The use of cooperative and collaborative and discovery learning techniques in expense to the others active learning techniques was also identified from the findings collected from learners on their perceptions toward the importance of different active learning in improving their performance in chemistry as presented in table 1.

The level of using various active learning techniques may be associated with teachers' attitudes and perceptions towards the importance of these techniques. The table 3 highlighted the relationship between the perceptions of chemistry teachers and frequency of using active learning strategies in teaching and learning process. From the results presented in this table (table3), the positive relationships were recorded on chemistry teachers who have positive perceptions on the use active learning techniques like those who believed that problem-based learning methods has increased learners' performance in chemistry because it improves problem solving capabilities ($p=0.02$), those who knew that problem based learning increased critical thinking among learners thus their increased performance ($p=0.03$) and the one who declared that learners self-teaching helped them to perform in different subjects ($p=0.01$). On the other side, chemistry teachers who understood that learners' involvement in teaching and learning process has helped them to increase their performance in chemistry were found to frequently use active teaching and learning process ($p=0.04$). Finally, chemistry teachers who understood how working in groups improve learners' attitude towards learning and impact on their performance in chemistry also showed positive results on frequency of using active teaching and learning techniques ($p=0.02$). It is in line with the findings of Kyriacou & Newson (1999) stated that active learning instructional approaches positively impact learning outcomes.

Regardless to the importance of active learning to the improved students' performance, a weak relationship has been observed on how discovery learning techniques are used in their whole schools to improve learner's performance ($p=0.39$), how inquiry-based learning has improved learners' marks in chemistry through developing critical thinking skills ($p=0.44$) and how collaborative and cooperative learning through group activities helped learners to get support from others so as increasing their performance in chemistry ($p=0.17$). This may be linked with the lack of adequate laboratory facilities, lack of sufficient teaching and learning materials and lack of adequate trainings on the use and importance of active teaching strategies as outlined by chemistry teachers and head teachers during interviews.

Conclusion and recommendations

From the findings of this study, it has been found that active learning strategies played a great role on students' performance in Chemistry. This has been confirmed by students, teachers and head teachers who were involved in this research. Different active teaching strategies were found to be used during teaching and learning chemistry, but the most used active learning strategy were found to be cooperative and collaboration as well as discovery learning. However, the frequency of using these strategies were found to be associated with the attitudes of chemistry teachers towards their importance. In this context, more trainings related to the effective use of different active learning techniques and provision of teaching and learning materials are needed for effective use of active learning strategies. In this regards, all educational stakeholders should work in collaboration to equip teachers with relevant skills for improving the use of active learning techniques in their teaching practices and make all necessary materials available for this aspect.

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