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STUDENTS' PERCEPTIONS ABOUT MULTIMODAL INSTRUCTIONAL METHODS OF TEACHING CHEMISTRY CONCEPTS: A COLLEGE OF EDUCATION'S PERSPECTIVE

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ABSTRACT

Methods of teaching have effects on students' perceptions of learning concepts in class because different teaching methods create varied levels of motivation and learning environments. This study was designed to determine the perceptions of students about Multimodal Instructional Methods (MIM) for teaching chemical bonding concepts in chemistry. The study employed a mixed method research approach and a concurrent triangulation research design to engage 120 students from two Colleges of Education as participants for the study. Data were collected with questionnaire and interview guide to determine the students' perceptions towards the use of MIM. The findings from the data revealed that after being instructed with multimodal instructional approaches participants developed highly positive perceptions about MIM, and viewed it as a better approach for teaching chemical bonding than single-modal approaches. The study also revealed that there is no discriminating perception effect for gender-based and different academic achievers' groups of learners instructed with MIM. It was therefore concluded that all groups of students had positive perceptions about the use of MIM for

teaching bonding concepts in chemistry because it created a positive learning environment that caused no learning difficulties for students at the Colleges of Education in Ghana.

Keywords: Chemistry, Multimodal Instructional Methods, Perceptions, Student, Teaching.

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Introduction

Over the years, Science educators have constantly put up efforts to improve students' learning outcomes in Chemistry by implementing nontraditional instructional strategies such as MIM. The efforts are to provide students with rich cognitive activities for critical thinking and problem-solving skills for them to wholly construct scientific knowledge (Gunel, Hand, & Prain, 2007; Yeşildağ & Günel, 2013; Azure, 2018). The continuous research into getting the right instructional methods underpins the fact that one major problem facing science education is the identification of mostly suitable, effective, and efficient pedagogical strategies for improving learners' science literacy in any learning environment (Bennett, 2011). There is an endless call for an instructional method that motivates and promote better understanding of scientific concepts by learners than the current traditional lecture method. Primarily, teachers' instructional approach that caters learners' learning styles has direct effect on how they develop science literacy and achievement of learning outcomes in Chemistry (Tatto, 2001). It is therefore reasonable to relate learning experiences of a learner to that of a teacher's approach of teaching.

Development of instructional strategies to improve the teaching and learning of Chemistry concepts is a major concern for Colleges of Education. Researchers have focused their attention on new methodologies that integrate technology and multimodal methods in the learning process (Moharrer, 2012; Akotuko, Pappoe, Awuni & Ameyaw, 2021). This has been necessitated by the need to respond to current classroom learning situations as a result of new generation of learners with differential learning styles, and the need to foster lifelong learning and professionalism (Mayer, 2010; Naimie et al., 2010: Akotuko, Alexander, Awuni &

Ameyaw, 2021). Also, there is growing concern that some learners are being disadvantaged because of their lack of differentiated instructional methods, negative perceptions towards teaching methods and, more importantly, their lack of awareness of their personal learning style. This is on account that effective learning involves both the knowledge of students' learning styles together with adequate instruction that meets students' desires to learn (Moharrer, 2012; Girón-García, 2013). The learners in most classrooms are different in abilities, interests and styles to learn to their full potential (Ganapathy & Seetharam, 2016). Teachers are therefore to identify these learning styles and discover appropriate instructional strategies that cater for the interest of all learners to enhance effective learning outcomes (Olufunminiyi, 2015).

One of the current methods is the use of diversified concept representation-to-learn activities that include forms of modal representations (text, graph, table, formula, etc.) to explain ideas in Chemistry. The integration of modal representations into traditional teaching (lecture methods) has been suggested as one means of improving the learning outcome (Gunel, Atila, & Buyukkasap, 2009; Yeşildağ & Günel, 2013). Though students' competence in learning chemical bonding concepts is bedeviled with so much misconceptions, multimodal instructions approach has revealed positive relationship between the method and better understanding of the concept (Bawa, 2018; Akotuko, Pappoe, Awuni & Ameyaw, 2021).

Several studies have focused on the correlation between multimodal representational instructions and learners' achievement, but there are few studies on the learners' perception on the use of multimodal instructional approaches for teaching Chemistry concepts at the College of Education. There are indications that integration of multimodal representations can assist learners to develop modal competencies and critical thinking skills (Ainsworth, 2006; Hand, Gunel, & Ulu, 2009). According to Sankey, Birch, and Gardiner (2010), students perceived the use of learning resources with additional modal representations of content as a way to assist in comprehension, understanding and retention of content. Like the study of Sankey*et al*. (2010), most sdudies did not indicate learners' perception on the use of multimodal instructional approaches to interpret and comprehend diverse concept representations to avoid various misconceptions in learning science. Some studies also indicated that multimodal methods may be of greater benefit to lower-achieving students than higher achieving students, suggesting that one factor explaining it is the lack of impact and interest of multiple representations of content on learning performance (Zwyno, 2003). This confirmed the definition of Mangal (2017) that, Perception is an individual's awareness aspect of behaviour, for it is the way each person processes the raw data he or she receives from the environment into meaningful patterns. This

allows students to know the world or concepts in different perspectives which help their mind to make meaning by organizing it into meaningful experiences, considering that different students differ in their sensitivity and the way they perceive things.

Learners' perceptual learning modals make them feel more comfortable to learn even if a concept is perceived to be difficult (Gargallo-Camarillas & Girón-García, 2016, Girón-García & Gargallo-Camarillas, 2021). This reinforces the need to find out students' various modes of perception in a multimodal learning environment. Guided by this literature report and the difficulty learners at selected colleges face in learning chemical bonding, this study sought to find out about learners' perceptions on using multimodal instructional approach to teach bonding concepts at the College of Education.

Research Questions

To achieve the stated purpose, the study addressed the following research questions;

1. What is the perception of students instructed by Multimodal Instructional Method for effective learning of bonding concepts?

2. What are the most preferred modal instructions of Multimodal Instructional Method by students for effective learning of bonding concepts?

3. What perception exist between different groups of students about the use of Multimodal Instructional Method for effective learning of bonding?

Theories and philosophical underpinning of the study

The major theories that informed this study are Self-perception Theory (Bem, 1972 cited in Mohebi & Bailey, 2020) and Transmediation Theory (Suhor, 1984 cited in Bawa, 2018). Bem's self-perception theory is based on the assumptions that; (1) People understand their beliefs, attitudes and perceptions by considering their own behaviour and the environments behind it, and (2) an individual without full understanding of his /her behaviour, acts like an outsider who observes the actions and attempts to make a meaning out of it or deduce their own inner characteristics (Mohebi & Bailey, 2020). The theory proposed that individual's own behaviour is used as a source of indication for his beliefs and attitudes. The self-perception concept is built on the assumption that people remain what they do. The self-perception theory is one of the most influential theories that explain how self-knowledge is acquired. The extension of Bem's theory towards educational research suggest that pre-service teachers (students of college of education) hold certain beliefs and views about teaching because they perceive themselves as unique from other learners and teachers, as well as having distinct

attributes and different motivations (Woolhouse, 2012). For transmediation, a student transfers key concepts and ideas from one text and creates a new text incorporating those key themes and ideas. Charles Pierce first examined this idea of deeply examining how symbols are used to create meaning and he suggested that a symbol simply does not stand for something, rather its meaning is culturally mediated (Siegel, 1995).

Methodology

This study employed a mixed-method approach by collecting qualitative and quantitative data from students who had experienced the MIM instruction. The study also showed the characteristics of basic interpretive qualitative research and case studies to discover participants' perceptions of MIM. It also employed concurrent triangulation mixed research design for data analysis to determine learners' perception about the instructional modal of MIM for effective learning of bonding concepts at the two Colleges of Education. This brought together the different strengths and non-overlapping weaknesses of quantitative methods (large sample size, trends, generalization) with those of qualitative methods (Creswell & Plano Clark, 2007), reducing the problems that are related to the use of only a single method.

The Perspective that underpinned the decision of the choice of the research approach, design, and method is epistemological assumption. This was informed by the assumption that the perspective provided the bedrock based on a study's basic assumption, belief and the influence phenomena of the study, the approach, source of knowledge and interpretation used in the research outcomes (Khatri, 2020). The epistemological assumptions guided the understanding of the knowledge acquired and the methods used to determine its availability, adequacy, and reliability during the research (Al Ababneh, 2020). This study was grounded in the epistemological view that suggests phenomena can be studied through both objective and subjective approaches. According to Al Ababneh (2020), epistemological perspectives include: 1) Objectivism – social realities exist independently of social actors and are external to them; 2) Constructivism – meaning and knowledge are formed through social actors' interactions with their environment; and 3) Subjectivism – phenomena and knowledge are shaped by the perceptions and subsequent actions of the researcher (Saunders, Lewis & Thornhill, 2009). These perspectives enable a researcher to decide on issues on a learner's perception of the use of MIM and their performance with learning chemical bonding, employing information orally and visual data collected through questionnaire and interviews.

Research Sample and Sampling Procedure

According to Castillo (2009), there are two types of populations: the target population and the accessible population. The target population for this study was all first-year students of Dambai College of Education and Jasikan College of Education in Oti Region of Ghana offering Chemistry.

A total of 120 students from the Colleges of Education were randomly selected. Sixty (60) students representing 20 % of the first-year students' enrolment of 300 per a college were selected to constitute the sample for the study.

Research Instruments

The research instruments employed to collect data for the study were questionnaire and interview. A questionnaire was designed based on the purpose of the research questions to obtain learners' perceptions about the use of multimodal instructional approaches. It gathered information about the demography of students and their perceptions about the MIM. All the items on the questionnaire were 5-point Likert scale type. The scale also provided the opportunity to use frequency and percentage as well as mean scores to compute the data.

A structured interview schedule was employed to get insights into students' perceptions on the use of the MIM to teach. The interview was scheduled for a total of 10 students only (that is, 5 students from each College). The respondents' voices were recorded with a tape device.

The questionnaire and interview were vetted by experienced research fellows to ensure that they measured the domains and variables of the focus of the study or elicit appropriate information from the participants. Evidence of the reliability of the questionnaire instrument was determined through pilot test by computing the internal consistency (Cronbach's alpha coefficient) for the data for the whole sample and for the scales. Cronbach's alpha coefficient of 0.78 was realised for the instrument which is an indication of a higher overall reliability of the questionnaire items.

Data Collection and Analysis Procedures

Data for this study was collected from the two institutions with permission from their management. First, data on the entrance grade of the participating students in science were collected. Second, participating students' performance in science was assessed by examining scores in their exercises and assignments according to the West Africa Examination Council grading standard for Senior High Schools. The next stage was employing the multimodal

instructional method to teach the participating students chemical bonding concepts for four weeks. This was followed by using the questionnaire to collect data about learners' perception about the multimodal instructional method. The final stage was interviewing the participants to solicit their perceptions about the use of the multimodal instructional method for science lessons. The questionnaire and interview administration were conducted on the same day to allow students to respond according to their perceptions about the approaches. This was on the assumption that their perceptions about the approach was fresh in the students' minds.

Data from the questionnaire was analyzed using **S**tatistical Package for the Social Sciences (SPSS) version 20.0 programme. Descriptive statistics such as frequency, percentage and mean were employed to analyse the quantitative data obtained with the administration of the questionnaire. Interview data was analyzed with inferencing interpretation and thematic approach. Analysis of the participating students' interviews and questionnaire data were used to obtain an in-depth information to answer the research questions on the students' perception about multimodal instructional approaches.

Result and Discussion

Results

This section presents results obtained from the analysis of the quantitative and qualitative data. The quantitative results are presented with tables and diagrams, whereas excerpts of the interviews are presented for the qualitative results.

The background information on participating students' grade in science used to obtain admission into the colleges was determined to ascertain their academic achievement level in science for grouping. The result of this information is presented in Table 1. The result indicates that 9.2 % of the students had high grade which is an indication of high academic achievement in science. Out of this percentage of students, 8 were males and 3 were females. Table 1 also revealed that 30.8 % of the students used average grade in science (average academic achievement) to gain admission into the colleges, out of which 23 were males and 14 female students. Again, Table 1 revealed that 60 % of the participating students gained admission into the colleges with low grade in science (low achievement). Twenty (20) of these students were males while 52 were female students. From these results, it was concluded that most participating students gained admission into the two colleges with low grade in science, an indication of low academic achievement in science. The majority (60%) of these students were females. This result confirmed the reports that females often perform poorly in Science

(Anmuah-Mensah, Mereku & Appiah, 2009), especially in learning Chemistry concepts like chemical bonding (Bernett, 2010).

Table 1: Background information of students' performance in science before entering the college

Performance Indicators	Frequency	Percentage (%)	Male	Female
High Grade	11	9.2	8	3
Average Grade	37	30.8	23	14
Low Grade	72	60	20	52
Total	120	100	51	69

High grade = Grade A, Average grade = Grade B, Low grade = Grade C

The students' abilities in learning Chemistry concepts were determined through documentary analysis of their exercises and assignments to ascertain their academic achievement level for confirmation regarding the entering grades. The results as presented in Table 2, indicates that 9.2 % of the students had high scores, which is the same percentage of the entering grades for admission into the College. The result also reveals that 30.8 % of the students had average score grade, with majority been males enter gain admission into the colleges. Only 9.2 % of the student admitted into the colleges had high grade in science. Meanwhile, 60 of the students with majority being females used low grade to acquire admission into the college. The result indicates that few female students compared to their male counterparts used high grade in science to acquire admission into the college.

Table 2: Report of Student's abilities in learning Chemistry concepts

Achievement Group	Frequency	Percentage (%)	Male	Female
High Ability	10	8.3	8	2
Average Ability	36	30.0	22	14
Low Ability	74	61.7	19	55
Total	120	100	51	71

Again, Table 2 revealed that 61.7 % of the participating students had low scores as against 60 % students' grades used for admission into the colleges. From these results, it was resolved that most participating students were in the group of low, average, and high abilities for learning chemistry concepts, which was similar to the percentages of students with grouping grades used to enter the colleges. The majority of these students were females and scored marks within low ability group.

To evaluate the students' prior perceptions of learning chemistry concepts, their preferred instructional strategies, and their awareness of their learning styles, they were asked to complete a five-item questionnaire. The results of the outcome are presented in Table 3.

Table 3: Summary of students' perceptions before instructed by MIM

Thematic Indicators	Agreed		Not sure		Disagreed	
	Freq.	(%)	Freq.	(%)	Freq.	(%)
Learning Chemistry concepts is difficult	107	89.2	3	2.5	10	8.3
Instructional methods cause learning difficulty	82	68.0	25	21.0	13	11.0
Know my learning style	43	35.8	26	20.7	51	42.5
Have interest of learning Chemistry concepts	12	10.2	3	2.7	105	87.1

** Percentage= %, Freq. = Frequency*

The results in Table 3 reveal that 89.2 % of the students agreed, 2.5 % students were not sure, whiles 8.3 % of the students disagreed with the idea that chemistry concepts are difficulty to learn. This clearly indicates that most students' perception about the learning of chemistry concepts are that they are difficult. Also, 68.0 % of the students agreed, 21 % of the students were not sure, while 11.0 % of the students disagreed that instructional methods used to teach them were the cause of their learning difficulties of chemical bonding. This outcome suggests that many students believed that instructional methods are the cause of their learning difficulties with regards to chemistry concepts. The results on whether the students knew their learning styles that teacher needed to know and adopt appropriate teaching methods, 35.8 % of the students agreed that they knew their learning styles while 20.7 % students were not able to tell, and 42.5 % of the students disagreed that they did not know. With regards to their interest in learning of Chemistry concepts, only 10.2 % of the students agreed that they had interest while as many as 87.1% of the students disagreed by indicating that they did not have interest in learning chemistry concepts. It could be concluded from the above results that most students in the study area thought that Chemistry concepts are difficult to learn, and the instructional methods by teachers cause learning difficulty for them. A few numbers of the students (35.8 %) knew their favorite learning styles that they thought teachers should use while few students (10.2 %) had interest to study the chemistry concepts.

To determine the perceptions of the students on the use of Multimodal Instructional Methods on the understanding of chemical bonding, responses of the participants were analyzed using a descriptive statistic such as frequency, percentage and mean score. Table 4 presents the results of the participants' perceptions of multimodal instructional strategies.

Table 4: Perception of students about MIM

	Percentage (%) count			
	Agree	**Not sure**	**Disagree**	**Mean(M)**
MIM improves understanding of chemical bonding	91.6	8.3	-	1.5
MIM motivates learning of the concept	91.6	1.7	6.7	2.6
MIM makes me feel comfortable in class to the concept	95.0	5.0	0.0	1.4
Improves my ability to interpret and comprehend the concept	85.0	11.7	3.3	1.8
Learn better when taught only with verbal mode of instruction	1.7	16.7	81.6	4.1
The Five MIM improve understanding and interest in learning chemical bonding.	92.7	2.3	5.0	1.2
Average mean (M)				***2.2***

**Positive perception= Mean below 3 and Negative perception = Mean above 3*

From Table 4, 91.6 % of the students felt that MIM improved their understanding and motivated them learning chemical bonding concepts. The mean (M) value of 1.5 indicated that majority of the students had a strong perception that MIM improved their learning. Also, majority (M=2.6) of the students believed that the instructional approach motivated them to learn. According to the students' respond, 95.0 % of the students strongly agreed that the MIM approaches made them feel comfortable learning the concepts. Again, 85 % of the students felt they could interpret and comprehend the bonding concepts without difficulties with the new method. Another 11.7 % of them responded that they were not sure, with only 3.3 % of the respondents disagreeing. However, with regards to the use of verbal modal instruction the only 1.7 % of the students who were students with high grade as indicated in Table 1, agreed that the use of only verbal mode of instruction helped them to learn whiles as many as 81.6 % disagreed, with 16.7 % of them indicating they were not sure. This result suggests that using verbal mode for instruction in teaching concepts in chemistry has negative effect on the students learning of chemical bonding.

A significant majority (92.7 %) of the students strongly agreed that the five multimodal instructional approaches used in teaching improved their understanding and interest in learning chemical bonding, with only 8.3 % were not sure and 5.0 % of the them disagreed. The responses of the students on the use of MIM which comprises of five multimodal instructional approaches revealed that the type of instructional approach was very important to students in

learning chemical bonding concepts. Generally, students felt that they should be instructed by MIM instead of the commonly used traditional methods of teaching of chemistry concepts in the college of education. From the students' perceptions about the methods on their understanding of the concept, it is clear that the use of one modal instruction (verbal interaction) does not help them learn. This might have been the cause of the difficulties in the learning of chemistry concepts resulting in several misconceptions in the learning of chemical bonding as identified by some studies (Bennett, 2010: Levy, Manlok-Naamon & Hofstein, 2010). The finding also supports earlier study reports that using multimodal method for teaching creates positive learning environment and meet preferred learning styles of students (Omrod, 2008).

Further survey also revealed that the students had preferences in for the different types of modal representations employed in teaching. This included use of word (lecture), analogy to explain concepts, doing experiments, use of vidoes and animations, use of symbols and MIM The result of students' preferences is shown in Figure 1.

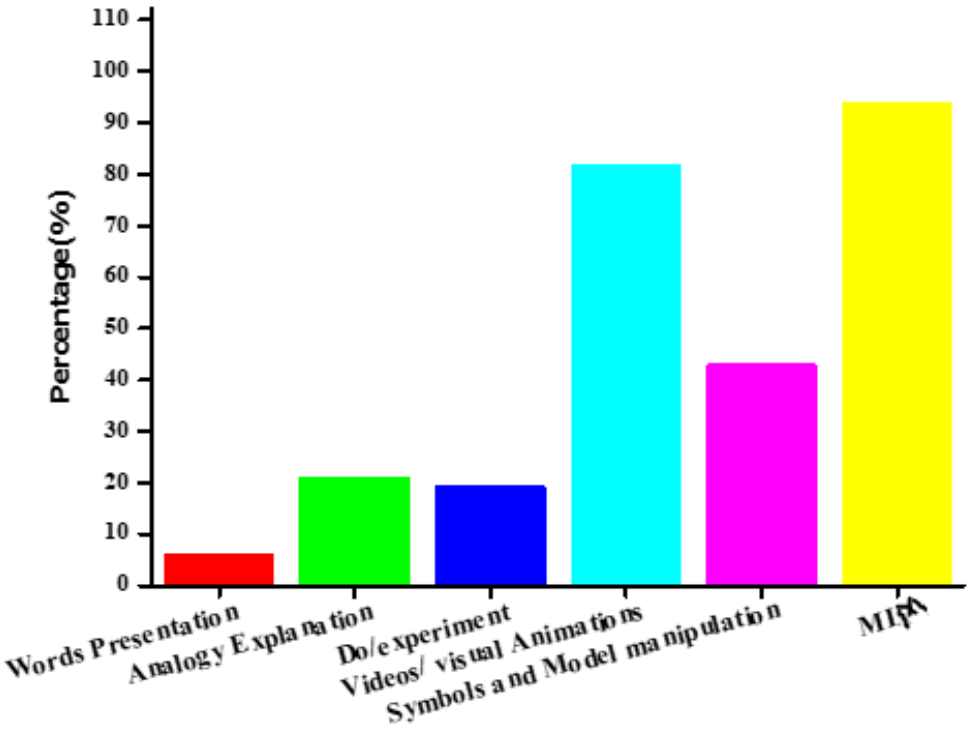

Figure1: Perception of students on different modal instructions

Introduce and show Figure 1, and then present the narration as discussed in earlier comments. Thanks. From Figure 1, majority of the students 91.5 % and 81.7 % preferred the use of Videos/visual animation methods to teach them because that mode of instruction in class cater for their learning styles. However, only few students 6.3 % preferred using words or

lecture method, 21 % of the participating students preferred analogies and 19.3% of the students preferred do/experimental method to teach chemical bonding concepts. From this result, it was concluded that teachers considering learners' perception and preference of instructional method for teaching bonding concepts, must consider the MIM and video /visual animations for the teaching chemical bonding concepts and for the teaching of chemistry in general. This is because most students indicated that instructed words presentation, analogies and experimental as well as symbols manipulation do not help them understand chemical bonding of compounds.

Introduce the figure below before you give a narration after its presentation.

Presentation of Qualitative Data Results

After the students were exposed to MIM teaching 10 students were interviewed. Findings from the interview results provided an in-depth understanding of the students' perceptions about the use of multimodal methods to teach concepts in chemistry. From the interview results, it was confirmed that students had positive perception about MIM by indicating that it improved their learning and understanding of bonding concepts. They believed that using a combination of different modes that involve students' manipulation of symbols, video and verbal interactions to teach is the key to effective understanding or learning. All the students interviewed felt that using MIM enhanced their learning of chemical bonding concept as well as other chemistry concepts. An interviewee who is in low achieving group of students stated that:

> "I want the use of words, the use of drawings, the use of videos and computer animations, relating things learn to life situation, the use of experiment and drawings to teach a bonding. Sometimes one area is not clear to me but the other will be" *(Male and Low achiever student)*

Another interviewee who is a male and an average achiever in science, after being instructed with MIM, had this to say about the approach:

> "I think of different modes to teach science gives me a physical representation and understanding of what it is. The concepts teacher wants to teach; I can physically see it, see how it works, or feel it. Drawing and illustrations, symbols illustration, computer videos are pictures way of looking at a number of concepts. Words should be used to explain the concept seen videos" *(Male and average achiever student)*

The importance of teachers using multimodal instructions in learning process was emphasised that each mode of instruction provides a necessary contribution to the teaching and learning process with each mode strengthening students' understanding of the underlying concept. They seemed to value MIM with the reason that it made them to engage in an active translation across modes and to address learners' differences and feel like learning:

> It gave me opportunity to interact with the concept in various ways, and I would now be able to construct my own understanding. If am taught just one way, am not able to explain or interpret the concept well, or when asked to say it in different way cannot do it. So, taught in multimodal ways, it provided bases for teacher to meet more students learning styles for each us to learn well or motivated to learn. *(female and high achiever student)*
>
> "For example, if a concept is how electrons are transferred then I would expect different modes of instruction such as videos or computer animations, diagram illustrations, verbal explanation etc. but not only lecturing. Its' not about doing the same activity time and time again, but making you learn" *(female and average achiever student)*
>
> I think that majority of us students differ in the way we learn things; some learn by visual/videos than others; some by listening than others; some by performing experiment or manipulation of symbols only than others. But majority of us I think learn when those situations are combined and used together, I like it. Very few of us learn one particular way only. *(Male and average achiever student)*
>
> I think multimodal ways will give me a variety of ways to understand topics and answer questions with confidence. It serves as a reminder in my mind; I see the concept clear in mind and how it works in my daily life. *(Male and low achiever student)*.

From this interview extract, students confirmed the importance of MIM to them for learning the chemistry concept. This supports the earlier finding that the students had positive perception towards MIM teaching.

Perception by Gender

The perception of the male and female students who were exposed to the MIM teaching and learning was analysed using descriptive statistics. Table 5 presents the gender-based

perception of the participants instructed by MIM. Data was collected to find out whether the two groups of students (Male= 60 and Female = 60) had the same perceptions about MIM.

Table 5: Perception of Male and Female Students about MIM

	Percentage (%) count				
	Gender	**Agree**	**Not sure**	**Disagree**	**Mean**
MIM improve understanding of chemical bonding	Male	96.6	3.4	-	1.5
	Female	87.2	12.8	-	1.5
MIM motivates learning of the concept	Male	96.6	0.0	3.4	1.7
	Female	86.6	3.4	10.0	2.0
MIM makes me feel comfortable in class to the concept	Male	90	10.0	-	1.5
	Female	100	-	-	1.2
Improves my ability to interpret and comprehend the concept	Male	86.6	13.4	-	1.9
	Female	83.4	10.0	6.6	1.7
Learn better when taught only with verbal modal instruction	Male	3.4	10.0	86.6	4.2
	Female	0.0	23.2	76.8	4.4
Five multimodal instructional approaches improve understanding and interest in learning chemical bonding.	Male	93.0	7.0	-	1.9
	Female	97.2	2.8	-	2.0
Average Mean Score	Male				***2.12***
	Female				***2.13***

**Positive perception= mean below 3 and Negative perception =Mean above 3*

From Table 5, male and female students' views on their preference for MIM for teaching chemical bonding, are presented using descriptive analysis. Out of a total number of 120 participants, 96.6 % male and 87.2 % female participants with same Mean (*M*=1.5) reported that the MIM strategy improved their understanding of chemical bonding. Whiles 96.6 % males against 86.6 % females reported that MIM motivated them to learn, 3.4 % and 10.0 % of the male and female respondents respectively were of the view that they were not motivated by the multimodal instructional method to learn the concepts. As to whether multimodal instructional methods make students learn with comfort, 90 % male and 100 % female with the respective means of 1.5 and 1.2 strongly agreed that the method gives them comfort to learn. Also, 86.6 % male and 83.4 % females indicated that the method improved their ability to interpret and comprehend concepts and enhanced their ability to communicate well science concepts. The result also shows that only 1.7 % of the male students and 0.0 % females reported that instruction based on Verbal Modal Instruction (VMI) only help them learn the concept better, whiles the majority of the students (86.6 % male and 76.6 % female, means of 4.2 and 4.4 respectively) disagreed and stated that using only VMI to teach the concept of chemical bonding was inadequate to explain the concepts for them to understand. Finally, 93.0 % male and 97.2

% female of the respondents stated they would prefer that the five multimodal instructional approaches are employed to teach them the concepts. There was no male or female student who disagreed, suggesting that the two groups of students had positive perception toward the use of MIM.

An absolute majority (93.%) of both male and female students preferring the use of MIM to teach them affirms the position that learning outcomes would improve by employing multimodal teaching approaches because it caters for the different learning styles of learners (Sankey, Birch, & Gardiner, 2010), and also makes them feel comfortable (Omrod, 2008). This is also confirmed by excerpts of interview of the respondents. The results indicating that no female student preferred the use of a single mode of instruction such as verbal mode is confirms the findings of Wehrwein, Lujan, and Di Carlo (2007) that, among others, female students learn better from teaching and learning instructions that involve touch, hearing, smell, taste, and sight. They argued that concepts should be taught with integrated modes of different instructional approaches to enable them do away with their misconceptions which are not scientific.

Analysis of the data was also conducted based on students' achievement levels as described in Table 1. This was to determine groups perceptions toward the use of MIM to know whether the method had discrimination effect on feelings according to their academic achievement's abilities.

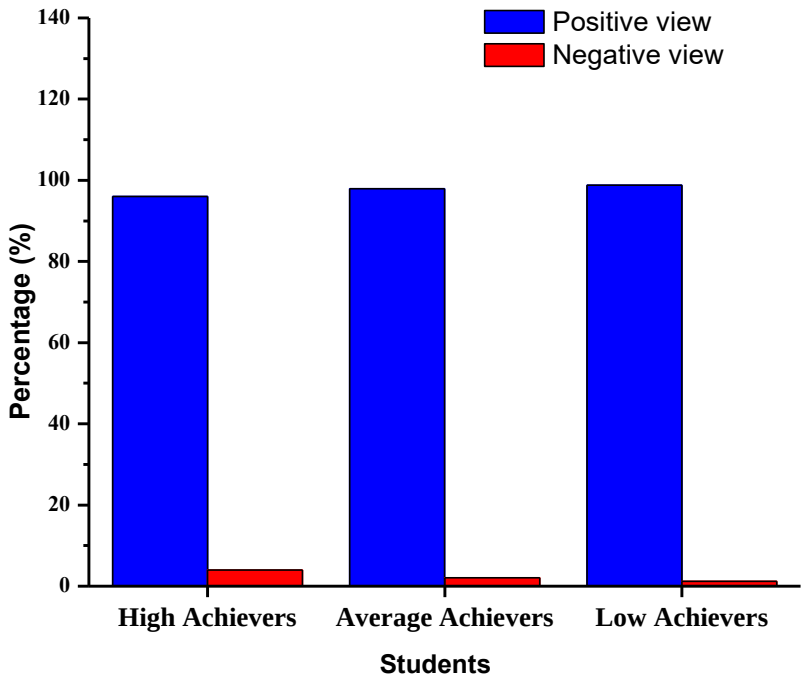

Figure 2. Comparison of different group of students and their degree of perception on MIM.

According to the results obtained as indicated in Figure 2, it could be affirmed that there was a high degree (over 97 %) of positive perception of the students towards MIM. It was also clear that the positive perception impact was on more of the low achievers, followed by average achievers and then high achievers. This result suggests that the three groups of students (high, average and low achievement groups) as described in Table 1 have all showed a positive degree of perception towards multimodal instructional methods as against only a few, who reported negative views regarding the use of MIM for teaching. Thus, MIM appears to stimulate students' sensory preferences, which result to positive perception for effective learning of chemistry concepts.

Conclusion

The study investigated the perceptions of students about the MIM method, and their preference for each of the instructional modals in the MIM and whether their preferences are based on their gender and different academic achievement levels.

The findings from data gathered indicate that majority of the students who participated in the study felt MIM improved their understanding of the concept, motivated and made them feel comfortable in class to learn. They also indicated that the method improved their ability to properly interpret and comprehend the concepts. The students revealed that using only verbal instructional modal does not encourage and motivate them to learn like a combination of different instructional modals. Also, the findings revealed that majority of the students had positive perceptions towards the videos/visual animation and five-multimodal instructional approaches (MIM) in teaching than the use of only verbal, analogues and the experimental methods of teaching, indicating that the latter makes learning the concepts abstract.

Further, the findings indicated that both male and female students had positive perception that MIM is a good method of teaching that helps them to learn the chemistry concepts without difficulties. Almost all the students of different academic achievement groupings, especially the low achievers, also showed high perception towards MIM. Considering these outcomes, it was concluded that MIM commands a high level of positive perception among students and should be employed by teachers for the teaching of chemical bonding concepts and other concepts in the subject because it has been confirmed as creating comfortable learning environment for students.

IMPLICATIONS AND RECOMMENDATIONS FOR CHEMISTRY EDUCATION

These findings obtained from students' perceptions on the use of Multimodal Instructional Method to teach bonding concepts in chemistry imply that Colleges of Education teachers' knowledge about students preference of teaching methods have signification effects interest of learning chemistry concepts. Hence, it is imperative that teachers become aware of students' perception on the instructional methods they use to teach a difficult topic like bonding concepts in chemistry. This will also make teachers to be informed about students' preferred teaching method that caters for their potential way of learning.

Although some studies have suggested that teachers' perceptions of concepts difficulty inform their choice of effective teaching and learning strategy and influence the students' experiences for learning (O'Dwyer and Childs, 2017, Nartey and Hanson, 2021). However, when a teacher's method does not meet the learning needs of students in modern class it creates negative perceptions that affect learning (Olufunminiyi, 2015). The insights gained from the study suggest that Multimodal Instructional Method is positively perceived by the participating students in the study because it caters for their differentiated learning styles for learning concepts in chemistry. The author believes that the awareness of the perception on this approach of teaching could benefit both teachers and students by making them achieve the teaching objectives and individual learning to their full potential, respectively.

It is therefore recommended that further studies are conducted on the use of Multimodal Instructional Method to teach chemistry concepts without creating misconceptions and students' perceptions on the method at all level of education. Also, further study could be carried out on how students' perceptions about the method influence teacher's assessment practice, beliefs, and students' reflective practice for achieving the national goal chemistry education.

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