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Use of songs in teaching and learning ionic bonds: a case of a secondary school in Vihiga County, Kenya

Daniel Omollo Odhiambo

THE AGA KHAN UNIVERSITY

Institute for Educational Development, East Africa

USE OF SONGS IN TEACHING AND LEARNING IONIC BONDS: A CASE OF A SECONDARY SCHOOL IN VIHIGA COUNTY, KENYA

BY

OMOLLO DANIEL ODHIAMBO

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APPROVAL

THE AGA KHAN UNIVERSITY

Institute for Educational Development East Africa

Omollo Daniel Odhiambo

I hereby give my permission for the research project of the above-named student, for whom I have been acting as supervisor, to proceed to examination.

Dr. Winston Edward Massam

(Research Project Supervisor)

Date: 29th November 2021

The members of the Research Project Evaluation Committee appointed to examine the research project of the above-named student find it satisfactory and recommended that it be accepted.

(Internal Examiner)

Date: **20th May, 2022**

DEDICATION

I dedicate this piece of work to the following people;

First, I dedicate it to My Loving wife Valentine, to whom I owe so much for her selfless efforts in taking care of the family during my long absence from home. Secondly, I dedicate this work to my son, Samson Omollo, who despite our strong bond, persevered the pain and challenges of growing up away from the dad.
I also dedicate the work to my mum Joan, who always encouraged and prayed for me, even when I was almost giving up at the earlier stages of the master's program. Special dedication goes to all my friends and relatives, whose prayers and well wishes pushed me this far. May God bless all of you.

ABSTRACT

Factoring learner engagement during chemistry lessons is key if conceptual understanding is an objective. In Kenya however, the gradual decline in chemistry mean scores, coupled with evidence from studies, reveal disengagement in chemistry among learners. One of the most cited causes of this disengagement is the domineering teacher-centred teaching pedagogy. This action research studied how science content songs can be used to enhance engagement and interest in ionic bonding among high school learners in Kenya. The study, which was conducted in a mixed double-streamed secondary school, involved two collaborating teachers and 65 students, out whom, 8 participated in a focus group discussion. Data collection was conducted via multiple tools like document analysis protocol, lesson observation protocol, interview protocols, and focus group discussion protocols to enhance corroboration of findings. The findings revealed that the current teaching methods and resources in chemistry and particularly in ionic bonding, like lecture method, charts, and models are less engaging, thus leaving learners as passive consumers during lessons. At the intervention stage where songs were used, it was found that songs engage the learners throughout the lesson, capture their attention, enhance their recalling abilities, and have the potential to restore their positive attitudes towards chemistry. Additionally, findings revealed that songs enhance diverse learner preferences and extend learning outside the classroom. Despite the remarkable classroom benefits of songs, data revealed that the use of songs is associated with challenges like inappropriate vocabulary, diverse learner preferences for songs, and reduced classroom control. The findings recommend that secondary school teachers embrace engaging pedagogies like teaching through songs to engage their learners in the classrooms and to transform their attitudes. The findings are also projected to inform the ministry of education and other stakeholders on the formulation of a policy guiding use of songs as a pedagogy in high schools. Finally, it was recommended that future studies consider pure boarding schools or mixed days schools, and concepts involving experiments.

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DECLARATION OF ORIGINALITY

I, **Omollo Daniel Odhiambo**, hereby declare that this research project is my own work. It represents my own effort and has not been taken in whole or in part, without reference to whom or from where the information was attained.

Signature:  Date: 29th November 2021

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LIST OF ACRONYMS AND ABBREVIATIONS

AKU: Aga Khan University

AKU-ERC: Aga Khan University- Ethical Review Committee

AKU-IED, EA: Aga Khan university institute of educational development

CPs: Course Participants

ERC: Ethical Review Committee

FGD: Focus Group Discussion

H.O.S: Head of Subject

HOD: Head of Department

ICT: Information Communication Technology

IED: Institute for Educational development

KCSE: Kenya Certificate of Secondary Education

KICD: Kenya Institute of Curriculum Development

KNEC: Kenya National Examination Council

MASSIVE: Math and Science Song Information Viewable Everywhere

NACOSTI: National Council for Science, technology, and Innovations

PDT: As a Professional Development Tutor

SMASSE: Strengthening of Mathematics and Sciences in Education

STEM: Sciences, Technology, Engineering, And Mathematics

TSC: Teacher Service Commission

CHAPTER ONE

1.1 Introduction

This study aimed to explore how the use of songs could lead to improved teaching and learning of chemistry in a selected secondary school in Vihiga County, Kenya. The research focused on one selected topic in form two syllabus, the ionic bonding, and explored how songs can be used to increase learner attitude and engagement in chemistry. Discussed in this chapter are; the study background, problem statement, rationale, purpose, and significance of the study, research questions that guided the study, limitations, and significance of the study.

1.2 Background and context of the study

The past decade has been characterized by declining mean scores of sciences, technology, engineering, and mathematics (STEM) subjects, resulting in decreased popularity of STEM courses. KNEC report 2019, as summarised by Too (2019), shows that chemistry has recorded very low percentage mean scores. Further, students transiting from high schools to colleges no longer fancy STEM courses. A study by Tai et al. (2006), as cited by Sithole et al., (2017) reveals that STEM programs have experienced considerable declines in the number of graduates. At the heart of STEM subjects is chemistry, which has been perceived by a majority of learners in Kenya as a very hard subject.

Table 1.1 showing 2015-2019 KNEC chemistry results

Year	chemistry
2015	34.36
2016	23.71
2017	24.05
2018	26.88
2019	26.09

Source: KNEC report 2019 summarised by Too (2019)

It is worthy to observe that the declining numbers of stem graduates in Kenya draw its manifestations from high school and primary schools. Students begin losing interest and engagement in science subjects like chemistry while still in high school. By the time they are completing high school, a majority have opted for non-science courses. Could the problem of learner disinterest in chemistry and other sciences be attributed to less engaging traditional teaching pedagogies? In response to this

question, Prensky (2012) asserts that 21st century learners are easily bored when lecture method is applied to teach them. To restore the popularity of chemistry in high schools, teaching strategies that enhance learner motivation, interest, and engagement should be adopted.

Currently, among the teaching strategies that increase learner engagement during chemistry lessons include information communication technology (ICT) integration and experiments. A study by Ullah and Anwar (2020) found that the use of computer technology positively influences learner engagement. A similar study by Zulirfan et al., (2018) showed that attitudes of secondary school students can be enhanced through laboratory experiments. However, from the experiences of other science teachers, and my experience as a chemistry teacher, the laboratory may not be applied to teach theoretical concepts like ionic bonding, thus, may not engage learners in such concepts.

Studies conducted by (Ludke, 2009; Nurvia, 2016) show that songs have been successfully used to teach foreign languages and the results were impressive. Crowther, (2006a), through his advocacy on the use of songs in teaching and learning, has inspired teachers globally to consider using songs.

In the global context, the contents of various national anthems are organized into songs, which have stuck in the minds of citizens since their early childhood days. Stephens (2013) argues that music like national anthems has symbolic meanings and when sang, they help fix phrases. In another study by Floridou et al., (2012) to test retention of the finish national anthem, 91.2% of the participants demonstrated familiarity with the national anthem, implying that it had been retained in their minds.

In Africa, very few studies have been conducted concerning use of songs in the classroom. A study by Ogidi and Ojukwu (2020) found that songs have the potential to improve learning since, through songs, learners internalize concepts, and develop an interest in learning. In another study conducted by Njoroge and Gathigia (2018), results indicated that songs not only reinforce Swahili teaching but also increase interest, memory, and joy during lessons. Just like in global contexts, songs are used to teach in lower primary classes and early education years in African schools, Kenya included. The songs learned several years back have remained in our memories despite the time-lapse.

Though studies on the relationship between songs and learning among teenagers have not been exploited in both Kenyan and global contexts, the impact of

early childhood songs in learning could also apply to teenagehood, especially with areas like ionic bonding, which learners perceive as difficult. This study is therefore founded on the understanding that poor attitudes and low engagement developed by learners in chemistry could be transformed through the use of science content songs.

1.3 Problem statement

Current learners require teaching strategies that elicit their interest and increase their motivation to be active participants in the learning process. Hornstra et al., (2015) propose that teachers today should create a learning environment that promotes and triggers students' motivation and engages them in learning, to make them active participants during the lesson. If teachers use instructional strategies that correlate with preferred styles of learning among the learners, the latter develop a lot of interest in the pedagogical strategies of the teacher and the entire learning process. Somji (2018) suggests the need for teachers to tailor their teaching strategies to suit students' learning styles to make learning interesting.

In most Kenyan schools, however, teachers are stuck on the traditional teaching strategies, like lecture methods during their lesson deliveries. A study by Nyagah and Irungu (2013) revealed that the lecture method is the most widely used teaching method in Kenyan schools, leading to poor performance in science subjects in Kenya Certificate of Secondary Education, KCSE. Lecture method, though practiced by a majority of classroom teachers, is teacher-centred, thus it makes learners passive and withdraws their interest from learning (Izuagba, 2015).

The rigidity of teachers to change their pedagogical strategies to suit the interest of learners could be one of the reasons why Kenyan students' performance in chemistry, physics, and biology is always poor. Students record poor performance in sciences despite Communities and the Kenyan government investing heavily in science subjects (Wangari, 2011).

Due to the poor performance in chemistry, it was of concern to examine if the use of songs in teaching and learning chemistry could trigger learners' interest and attitudes towards the subject, and consequently reverse the declining performance. This study, therefore, sought to explore how the use of songs could lead to improved learning and increased engagement and attitudes of learners towards chemistry. However, ionic bonding under the topic structure and bonding was chosen for this study since it is among the topics that learners globally face difficulties and disinterest

in. A study conducted by Cooper et al.,(2015) revealed that most students fail to understand the connection between structures and properties. Through this study, the structures and properties were incorporated into songs to enhance interest and understanding. As found by Ogidi and Ojukwu (2020), songs by enhancing interest and internalization of concepts among learners.

1.4 Rationale of the study

Having been a practicing chemistry teacher for quite some time, I have frequently been exposed to the challenges of teaching absent-minded, gloomy, and passive learners. Occasionally, I ask questions during the lesson to enhance participation, but end up answering my questions. This passivity, as illustrated by Alam and Shakir (2019), could have been contributed by my non-interactive and less engaging teaching methods.

Learner attitudes and engagement in chemistry can be enhanced in a variety of ways, including chemistry experiments in the laboratory. However, not all chemistry content areas involve experiments, thus teachers find it so hard to engage learners and trigger their interest when teaching content areas that lack experiments.

As a scholar at the Aga Khan university institute of educational development (AKU-IED, EA), I was exposed to various open educational resources and pedagogies like; teaching for conceptual change, integrating the nature of science in the classroom, using you tube content, which if properly exploited, can solve the issues of learner disinterest in chemistry and engage them during chemistry lessons. This revelation is what intrinsically pushed me to delve into this research topic. With the discovery of the YouTube app and website, it is possible to acquire free instructional materials like content songs, which can engage the learner in multiple ways during the lesson, and even motivate them to compose their content songs for use and for sharing in such platforms. In my country Kenya however, there is a dearth of research on the use of songs in teaching and learning.

1.5 Purpose of the study

The purpose of this study was to add interest to teaching and learning of non-practical chemistry contents like ionic bonding through the use of content songs as a pedagogical strategy. The study sought to shift teaching and learning from the boring traditional strategies to more learner engaging and interactive strategies to improve learners' attitudes in chemistry and to make them part of the teaching and learning process.

1.6 Significance of the study

The findings of this study have demonstrated how the use of songs could result in improved learner engagement and interest in the challenging chemistry subject, subsequently leading to conceptual understanding. Though other instructional methods that elicit learner interest exist, most of them do not enhance learner engagement outside the lesson, unlike songs. The study is of great significance to all teachers, who are determined to engage most of their learners fully during and outside the lessons. However, it focused on chemistry since the attitudes of learners in chemistry have significantly dropped. Adesokan (2002), as cited by Ogembo et al., (2015), asserts that students have a negative attitude towards chemistry, leading to lower enrolment and poor performance in chemistry.

The findings of this study may also inform the ministry of education on the formation of a policy guiding use of songs as high school classroom teaching strategies.

1.7 Research questions

1.7.1 Main question

The main question for this research study was:

How can I work with collaborating teachers to enhance learner interest and understanding of ionic bonding through songs?

1.7.2 Subsidiary questions

Reconnaissance questions

1. What are the current pedagogies used by teachers to engage learners in chemistry concepts like ionic bonding?
2. What are the pre-intervention teachers' perceptions of the use of songs in the teaching and learning of Ionic bonding?

Post-intervention question

3. What are the learners' and teachers' perceptions of the use of songs in the teaching and learning of Ionic bonding, having gone through the intervention?
4. What are the teachers' and learners' perceptions of the role of songs in promoting learner engagement with chemistry lessons like ionic bonding having gone through the intervention?
5. What are the challenges of using songs to teach chemistry topics such as Ionic bonding?

1.8 Scope of the study

The study was carried out in a mixed day and boarding public secondary school in Vihiga County, Kenya, using one form two-stream with 65 students and two chemistry teachers. The focus of the study was to use science content songs as an intervention to learner disengagement during chemistry lessons.

1.9 Limitations of the study

The study was conducted in a narrower context since it was limited to a very small sample size, which represented the broader context.

Due to a shorter time limit on the side of the researcher and rush to compensate for the year that was lost to Covid-19 on the side of the research participants, only two action research cycles were conducted. The study however required more cycles for a proper intervention of the identified problem.

1.10 Assumptions of the study

This study assumed that all the learners in the participating class liked singing and would certainly enjoy and benefit from the instruction of ionic bonding using songs. Further, the study assumed that all the learners would automatically embrace the songs chosen for the intervention.

Another assumption in the study was that the learner behaviour would remain constant, despite the coming in of a new teacher, who doubled up as a researcher.

1.11 Definition of key terms

Several definitions of science content songs exist. Adopting the definition by Governor et al., (2012), science content music is a genre of songs, designed to instruct science-related concepts. Such songs have the science content and concepts to be instructed in their lyrics.

According to Vladusic et al., (2016), ionic bonding is an entire set of electrostatic forces between positively charged ions and negatively charged ions, distributed in an ionic substance that holds its crystal in place.

Perceptions, as defined by Merriam-Webster dictionary, are peoples' regard to or understanding of something.

1.12 Chapter summary

This chapter has discussed; the study background, problem statement, rationale, purpose and significance of the study, research questions that guide the study, limitations, significance of the study, and definition of key terms. This was the

first chapter of five chapters. Subsequent chapters; include literature review, methodology, findings, analysis and discussions, and finally recommendations and conclusions, organised in the order described.

CHAPTER TWO

Literature Review

2.1 Introduction

Presented in this chapter, is a review of literature that guided and informed the study on teaching and learning ionic bonding through songs. The literature emphasizes the relationship between science content songs and science teaching.

2.2 Teaching practices in Kenya and their challenges

In a century that has become highly globalized like the 21st, a teaching strategy that puts focus on the learner and learner activity in the classroom rather than the teacher, is invaluable due to its continuous support for competencies including collaboration, communication, and creativity. To fulfil collaboration needs and shift emphasis from the learner to the teacher, such a teaching strategy should be exceedingly engaging and extremely interactive. However, studies have found that such engaging teaching strategies are rarely practiced in Kenya, especially among the science subjects, where they are ultimately required. Conducting a study to examine the teaching practices in Kenya, Nganga and Kambutu (2017) found that the teacher-centered pedagogical practices have dominated the Kenyan classrooms. However, Kerkhoff and Makubuya (2021) argue that Kenyan teachers are in a position to embrace learner-centered pedagogies since the government has initiatives for learner-centered pedagogies and has supported teachers through provision of resources. The question however remains. Nevertheless, the latter have not confirmed if the learner-centered initiatives have been implemented already, and the extent to which schools are supported towards learner-centered strategies. Despite the important roles played by teacher-centered instructional strategies in teaching and learning processes, Arends, (2012) found that they are not perfect in delivering skills and enhancing interactions.

Among the teacher-centered pedagogies being practiced in Kenya is the lecture method. Unfortunately, lecture method reduces learner activity and forces the learners to be passive listeners during teaching and learning (Chege, 2013). As passive listeners, learners get no opportunity to interactively negotiate with the teacher and construct meaning out of the learned concepts. Chege further asserts that lecture method reduces the self-esteem levels of learners since over time, they get

affected by teachers' and parents' negative reinforcements. According to Govender (2019), lecture method makes learners passive and less engaged. In contrast, Jones (2007), as cited by Cavanagh (2011), asserts that active engagement occurs in lectures. Since the latter has not given the nature and extent of active engagement in lectures, his assertion may not be considered. Without esteem, engagement, and activity, learners may neither respond to questions asked in class nor ask questions in class.

Satisfactory Performance in any subject depends on the Learner's attitudes towards the subject, which lies purely on the ability of the teaching pedagogies used to spark them. The persistent poor results in chemistry borrow its roots from factors related to learner attitudes, influenced by poor teaching pedagogies (Ogembo et al., 2015b). Although lecture method, discussion, and use of models and charts are some of the methods recommended for handling chemistry by the Kenya institute of curriculum development, lecture method has failed in developing the attitudes of learners towards chemistry. The findings by Chepkorir et al., (2014) that negative attitudes of learners towards chemistry result from inadequate teaching experience just inform of how Kenyan teachers' teaching pedagogies have led to poor learner attitudes towards chemistry. As found by Taat et al., (2020), lecture method still remains very non-interactive despite it being the most preferred method of teaching by most teachers. Could be, these are the reasons why chemistry results in KCSE have remained poor (table 1.1).

Globally, studies have shown that teachers still embrace the use of teaching and learning resources that are less interactive like charts and models. Findings from a study by Graulich, (2015) revealed that charts and models lack the potential to engage all learners during the lesson. In addition, use of models is among the scientific practices which have a relationship with neither scientific tasks nor ideas (Windschitl et al., 2012). The findings by Dewan (2015) that charts and concept maps can promote learner engagement and increased interactions are however contrary to those of Graulich and Windstchitl. It would be quite impractical to accept Dewan's findings without questioning how a teacher pointing at a chart or a model would promote learner interaction with it, if not just for mere observation. This thus implies that use of charts and models, having no relationship with scientific tasks, may not engage the learners much.

Given the demerits of teacher-centred methods of teaching, there is a need to switch to more engaging and learner-centered pedagogies like teaching through songs.

2.3 Science content music and sources

The lyrics of science content music are constructed through science content, which can be used in teaching and learning. However, very little research has been conducted on the sources of science content music. Crowther (2006) analyzed various sources of content songs. Among the sources, science content songs can be obtained from; science songwriters association, singing science records, and math and science song information Viewable Everywhere (MASSIVE).

A good number of pre-composed science content songs can also be downloaded from YouTube. Even though readily composed songs are available, they may not have the desired beats, flow, and content, and sometimes may be contextual. Therefore, teachers and learners can compose their science content songs for use if not impressed by readily composed ones. For instance, in a study by Toppel (2015), one of the respondents composed songs for teaching, an act that motivated her students. Yee Pinn Tsin (2015) proposes composition of songs for use in teaching. Currently, however, no science content songs have been composed for chemistry teaching in Kenya since little research has been conducted on the use of songs in teaching chemistry. Besides, teachers perceive songs as time-consuming and immorality boosters. According to Almutairi et al., (2017), teachers believe that songs need a lot of time and are culturally inappropriate. Citing Bell hooks (1994), Wandera (2013) urges teachers to engage with learners through songs despite knowing that songs are time-consuming.

2.4 Singing and the brain

The cerebrum, the part of the brain that controls emotions and learning, is divided into the right hemisphere and left hemisphere. The right hemisphere deals majorly with speech processing while the left hemisphere deals with music, emotions, and pattern processing. Even though both hemispheres have distinct roles, Grover (2015) suggests that teachers should involve more than one area of the brain during the learning process, thus both speech and emotional parts of the brain should be engaged in a single learning task for an effective learning process. Arguably, teaching activities that rely only on one side of the cerebrum are not

only biased to the learners but also out fashioned. The lecture method currently used involves the speech but ignores the emotions of the learners, thus likely to hinder their interest in the subject. Being that current learners love music, then songs could be used to touch them emotionally during lessons.

There exists a very close relationship between emotions, thinking, and learning. Since emotions, thinking and learning are linked, emotions are a core and very invaluable section of every child's learning, and therefore teachers need to consider emotions before going to class (Jazeel, 2016). Governor et al., (2012) define emotions as biological responses which when activated, make learners more attentive and able to recall learned content.

Music triggers Emotions, which affect interest in the content being learned, consequently impacting learner engagement. Music, based on the findings of Moeller (2021), initiates emotions in the classroom and instantly creates some cognitive engagement with the content among the learners. Similarly, Koelsch (2014) perceives music as a universal character of various societies probably because it has the power to elicit strong emotions among people and influence their moods. Further, Koelsch (2014) argues that music can enhance transitions in the activities within the core structures of emotions. Similarly, songs, as found in a study by Coyle and Gómez (2014), arouse strong emotions among learners, which keep them motivated and engaged. However, Baills et al., (2021) question the potential of songs to engage mature learners. From experience though, music is about emotions, and emotions are not preserved to children only, with total exclusion of mature persons. Deductively, if included as part of any learner's experience, therefore, music could impact strong emotions which could consequently change their moods in the classroom.

2.5 Songs and mnemonics

Since time immemorial, mnemonic devices have been applied as means of recalling learned information. An empirical study by Jurowski et al.,(2015) on a comprehensive review of mnemonic devices and their applications in teaching and learning science found that mnemonic devices have a huge impact on teaching since they improve recalling of learned information. Through the composition of content songs and identification of content songs that learners find interesting, learners may initiate their own mnemonics as Jurowski ignored the idea of self-initiated mnemonics in his study.

In a similar study, Bellezza and Reddy (2013), through a quantitative study on mnemonic devices and natural memory using 72 psychology students, showed that the familiar cues group recalled relatively more information than the unfamiliar group and the no cues group. These results informed the conclusion that the operational ways of mnemonic devices and natural memory are similar, and that through mnemonic devices, people can effectively recall events involving verbal resources through visual imagery. Arguing from this conclusion, mnemonics, if applied in teaching and learning, could create memory among learners, which is akin to their natural memories. Belleza and Reddy however limited their focus on visual imagery as mnemonic devices, ignoring the possibility of songs in serving as mnemonic devices.

A study conducted by Eaton (2020) exploring the impact of musical mnemonic strategies on student achievement and engagement in inclusive science classes recognized songs as mnemonic devices that aid in the retention of taught information. Unlike the previous studies on the same, the study by Eaton (2020) was inclusive and catered for learners with disabilities.

In disagreement with the literature cited on mnemonics, Krzeczkowska et al., (2014) argue that mnemonics are not teaching and learning methods. To counter this assertion, the teaching strategy here is the song, which relies on mnemonics just for recalling. Songs serve as mnemonic devices through rhymes and the connection of words. This review helps to place songs as mnemonic devices and gives an idea about the impact of mnemonic devices like songs in a chemistry classroom.

2.6 Impact of songs on interactions

Songs have for a very long time enhanced social interactions and bonding within communities. During events such as initiation rites and weddings, celebrants sing together, and the nature of songs used is usually predetermined by the occasion. Through a study conducted on persons with Autism, Geretsegger et al., (2014) found that music appeals inherently since the singing action, together with the musical instruments, create some sense of social interactions. When people and societies get exposed to songs therefore, they get subjected to some levels of social interaction, especially if the songs are common amongst them. Even though Geretesegger and colleagues conducted the study on music and social interactions, their study was only

limited to people with Autism. It is unfulfilling that the findings were non-inclusive of neurotypical persons yet they too listen to and have tastes for music.

Earlier studies by Maschi et al., (2013) on the relationship between recreational music and stress levels among social workers using social workers, a social work teacher, and a musician revealed that group music can grant individuals a collaborative experience and enhance their interpersonal beings through stress and burnout reduction. Actually, a collaborative experience can only be achieved in an interactive setting, which as per the study by Maschi et al., could have been facilitated through group music. If only the study participants in the study by Maschi et al., (2013) would have been students, and the study site a school, perhaps the cases of burnout and stress among chemistry students would have been solved.

Studies by Rabinowitch and Meltzoff (2017) on the impacts of joint musical movements on four-year-old participants further showed how engagements with music influenced interactions in rhythmical patterns and coordinated activities, which consequently resulted in increased pro-social behavior among the pre-schoolers. Citing Kirschner and Tomasello (2010), the duo asserts that it is likely that nursery school children will co-operate more with one another after sharing a similar musical experience. The former confirmed this through a study on joint music-making among four-year-old participants, whose findings influenced the proposal that composition of music, including singing and dancing, enable participants to collaboratively vocalize, making them have common experiences and activities. Though the studies by Rabinowitch and Meltzoff (2017) focused on Kindergartens, it would not be a limitation to investigate if music could have a similar interactive effect among high schoolers.

The review of these studies aids in this study by categorizing songs as interactive teaching resources, which if brought to a chemistry classroom setting could enhance social interaction among learners and in the process relieve them from burn out that could otherwise stop them from associating with chemistry.

2.7 Songs and science teaching

As teaching strategies, songs have unimaginable benefits in a science classroom. Crowther (2012), in his paper on using science songs to enhance learning, asserts that enjoyable music could be applied to help learners who feel out of place during science lessons feel some sense of belonging in a science classroom and

perceive it as friendly. Additionally, teaching science through music, especially if accompanied by videos and dance, have the potential of reaching diverse participants through several modalities. Projected Songs, coupled with body movements therefore might have the potential to serve as multimodal teaching resources in a chemistry classroom.

Governor et al., (2012), in an empirical study to explore the experience of students and teachers in teaching and learning science through song, found that educators applied songs rich in content to enhance learners' conceptual understanding and to give learners additional examples. In the same study, it was found that content songs engaged learners through fulfilling their situational and individual interests. Similarly, Songs can engage learners and make learning enjoyable (Bokiev et al., 2018). Krzeczkowska et al., (2014) however disagree with the finding that songs enhance conceptual understanding by citing a lack of or very little relationship between conceptual understanding and the concepts being learned. However, a quick reflection on the current learners globally, place music at the heart of their interests, implying that content-rich songs could not only engage them but also equip them with additional examples and concepts in a given learned area.

The empirical results of the science song project study by Yoon (2017) using education science finalists as participants show that the study helped the participants to develop positive attitudes towards science and to understand science better. The key requirement towards conceptual understanding is simply a positive attitude, which as found by Yoon, could be enhanced through singing. However, Yoon's focus was on potential teachers, whose disinterest in science is usually somehow challenging to determine. Additionally, being that the participants were science educators, the findings were general for all science subjects rather than being specific on a single science subject like chemistry. Could similar results be obtained if a related study was conducted on teenage chemistry students?

Investigating the impact of musical mnemonics on vocabulary recalling of Iranian young learners, Nikkhah et al., (2019) found that the musical group could recall more words than the non-musical group. Further, songs helped the musical group understand words in new contexts. The findings by Nikkhah imply that through songs, learners can develop high recalling capabilities and learn more concepts, enabling them to respond to questions during lessons. Though the study was dealing

with English vocabulary, this study will focus on concepts in ionic bonding, which are more scientific.

Songs not only spark interest among the learners but also engage them during the lesson. Current learners, being digital natives, interact with social media, from where they download and listen to a variety of music. Moll and Nielsen (2017) went ahead and researched the impact of social media on science learning. From the focus group discussions conducted by the duo, it was revealed that both secondary school and non-secondary school students use social media platforms like Facebook, Twitter, and YouTube to chat and google answers to science assignments. The fact that students use social media for learning implies that they can easily access science songs for learning since social media is the major source of science content songs.

In another study on the use of songs to enhance learning, Diakou (2013) realized the ability of songs to arouse positive emotions among students, which in turn increase their motivation and attention retention. Similarly, music sets the classroom mood and creates a positive learning atmosphere among the learners (Hershner, 2018). Conducting a similar study, (Ly and Quynh, 2020; Rambli et al., 2013) found that songs can claim learners' attention and create a deeper learning experience among them. Once attentive, learners can grasp some lesson concepts that can help them participate in group discussions and answer questions asked in class (Kotob & Bazzoun, 2019).

While the studies have shown the benefits of songs in teaching and learning, the strategy may be associated with certain challenges and controversies, among them, being the loss of class control. Noise from the player may make learners start making noise instead of listening. Additionally, the noise may extend to adjacent classes. Nurvia (2016)**,** citing Murphey (1992), found loss of class control, disturbance to adjacent lessons, and poor vocabulary as some of the challenges associated with using songs in teaching. Concerning poor vocabulary however, (Fonseca-Mora et al., 2011; Millington, 2011) urges teachers to choose songs appropriately for the comfort and benefit all the learners.

A similar study by Chung (1997) as cited by Nugroho (2014) singled out Differences in students' tastes in music and poor sound equipment in some schools among the challenges associated with songs as instructional strategies. He found that Differences in music preferences might result in partial engagement in the classroom.

Consequently, learners who are not interested in the song being used may not get engaged during the lesson.

Murphey and Maley (1992), as cited by Nurvia (2016) disagree with the use of songs in teaching and learning, arguing that teachers might lose control of the class and that some songs have a poor vocabulary. Additionally, the duo maintains that the use of songs in a lesson might interfere with the adjacent lessons. The use of songs, just like any other teaching strategy, demands a teachers' control of the classroom. Chemistry teachers do control learners during laboratory experiments, hence controlling them while using songs will require the same skills. In addition, concerns on poor vocabulary demand less concentration since science content songs have only science vocabulary. With proper lesson planning, the use of songs in a lesson cannot interfere with the adjacent lessons.

Dokulil (2018) questions the use of songs in teaching among the elderly teachers, noting that they are so conservative with matters technology and that their view on songs is quite different from the youth's view. Most schools have recently employed teachers, who reason at the level of the learner, and therefore what might be interesting to the learner might be interesting to them too. As for elderly teachers, the use of songs requires very little ICT, and therefore they can implement it.

2.8 Conceptual framework

Impact of songs on social interaction, as found by (Geretsegger et al., 2014; Kirschner and Tomasello, 2010; Maschi et al., 2013; Rabinowitch & Meltzoff, 2017) are underpinned by social constuctivism theory. Songs enhance social interaction among learners, which in turn results in learner engagement, leading to learning. According to Vygotsky (1978), learning is social and originates from human intelligence. Tracing the origin of personal development, Wertsch (1992) found that personal development results from social interaction, which according to Vygotsky (1978), can be attained through songs. In support of this assertion, Rogoff & Chavajay, (1995) posit that individual cognitive development and learning originate from social activities. Songs in a lesson, therefore, create an avenue for social interaction, which subsequently enhances personal cognitive development within each learner.

Vygotsky (1981) lists mnemonic techniques, art, and writing among the tools that enhance social development and later, individual development. Science content

songs, being mnemonic devices therefore can promote individual development if used as classroom instructional strategies.

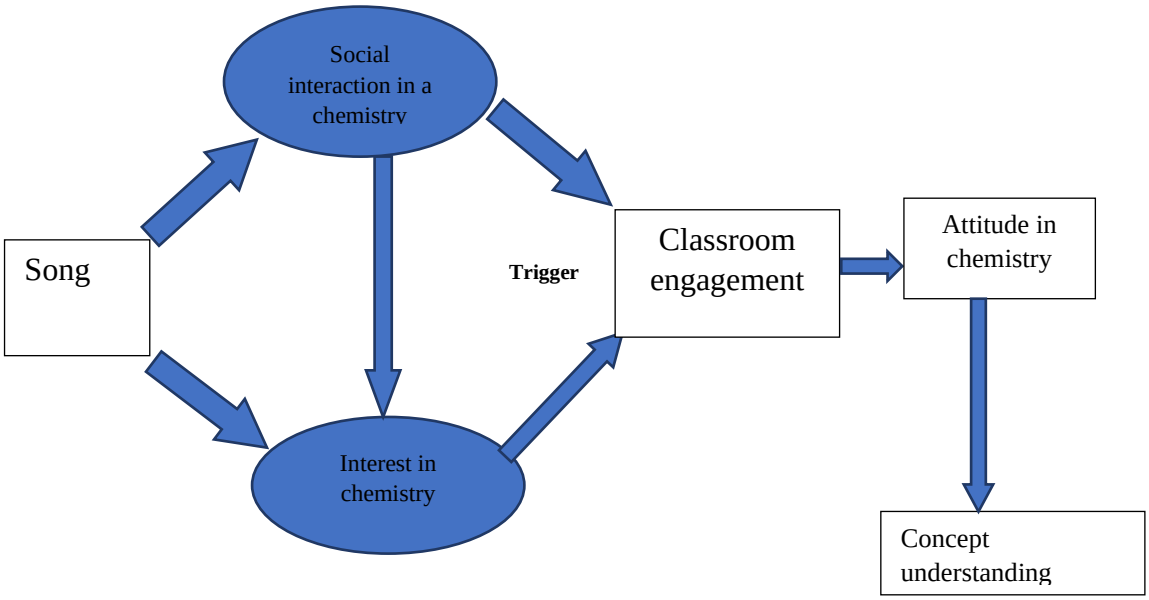
For teachers to engage learners in a chemistry lesson, they could embark on interactive strategies of teaching and learning like songs. Songs may enhance the construction of concepts and transformation of learners into active participants in a chemistry classroom. By listening to songs together and learners composing songs and sharing among each other and with teachers, an interaction occurs (Kisanga, 2015). In a collaborative learning atmosphere, songs may be reliable learning resources.

The composition of songs, which is suggested by (Toppel, 2015; Yee Pinn Tsin, 2015) is supported by gestalt theory. Content parts of the song, if connected, can form a whole concept. By engaging with the song, learners can connect parts of the song to form a whole, leading to knowledge acquisition. Koffka (1935) maintains that the whole is better than its parts. Kohler (1929, 1969), and Wertheimer (1959), as cited by Taetle and Cutietta (2002), maintain that an individual can complete wholes that are not perfect through matching with parts that are closely related. If the learner has prior knowledge concerning a concept, joining the related parts of the song would make the learner understand the concept in deeper details.

Operant conditional theory underpins the studies by (Governor et al., 2012b; Hershner, 2018; Moeller, 2021) in which music, acting as reinforcements, triggered emotions like attitudes. Learners will always respond to the reinforcements brought by the teacher to the classroom. According to Skinner (2014, 2016), the response can be strengthened or weakened through the introduction or removal of reinforcements respectively. Skinner further argues that mental change, which he calls learning, is dictated by the environment. Upon acting on the environment, organisms (learners) change their minds, leading to learning. Citing Skinner (1953), Schunk (2014) expresses the need for learners to enjoy and long for learning. When science content songs are used for teaching, the songs act as a reinforcement, which makes the learners enjoy the lesson and get engaged in the entire lesson by joining in singing and reporting the words in the songs, which are actually the lesson content. Being able to get the concepts might change the attitude of the learner towards the lesson, leading to learning.

Reinforcements in this study were the songs. Singing and composing songs together increase social interaction among the learners, leading to learner engagement

in a chemistry lesson (Bokiev et al., 2018). Together or independently, social interaction and learner engagement influence the attitude of the learner towards the chemistry concept, resulting in cognitive development which in turn impact conceptual understanding. Additionally, linking various parts of a song could form a whole concept. These relationships, as drawn from the studies discussed above, form the conceptual framework below.



Source: author.

Figure 2.1 showing the conceptual framework

2.9 Implications of the literature

This study is driven towards a transition from the ancient pedagogical strategies that do not engage learners to strategies that engage the learners in multiple ways, spark their interest in chemistry and restore their attitudes through the use of songs. From the literature reviewed, the potential of songs to enhance engagement and interaction in a typical lesson has been evident.

The literature has also informed that the use of songs has been effective in various contexts in improving the attitudes of learners. Judging from the benefits discussed and the fact that teaching through songs has worked in other contexts, songs were applied in the researcher's context to make pedagogical practices more engaging.

Lastly, the literature on the pedagogical practices currently in use in Kenya is very significant since they have exposed the limiting lecture method, which has consistently compromised learners' attitudes towards chemistry.

The Previous studies have however not reviewed the impact of science content songs in engaging teenage chemistry students in a chemistry lesson. This is despite the teenagers loving singing and listening to songs compared to any other stage. This study sought to add songs as alternative teaching resources that target learner interest and learner engagement during chemistry lessons.

CHAPTER THREE

Research Methodology

3.1 Introduction

This chapter gives a detailed description of the methods and procedures that were applied in the data collection and analysis process. The rationale and justification for the approach, design, data collection instruments, and data analysis methods have been discussed.

Also discussed in this chapter are the study site, sample and sampling procedures, data trustworthiness, assumptions and limitations of the study, and ethical considerations applied during the study.

3.2 Research approach and design

3.2.1 Research approach

The study was conducted through a qualitative research approach since the approach gave the participants a chance to tell their experiences with the use of songs as a teaching and learning strategy. In this case, the participants described their experiences in the use of songs in teaching and learning properties and uses of ionic bonds, and the challenges they faced with regards to the teaching strategy. According to Creswell (2014), the concern of qualitative research is the comprehension of a social phenomenon, based on the perceptions of the participants.

Being that the study was interested in the views of the participants concerning the use of songs as a teaching strategy, it agreed with Creswell and Guetterman (2018) that qualitative research is more reliant on the participants' views and less reliant on the researcher's direction.

3.2.2 Research design

In this study, an action research design was adopted. This is because the issue that the study sought to address was specific and its intervention was based on a systematic procedure (J. Creswell & Guetterman, 2018b). Additionally, action research deepened the participants' understanding of teaching and learning in a classroom setup. Through action research, as explained by Mertler (2017), the researcher was guided by the perceptions of learners and collaborating teachers to transform their pedagogical practices in ionic bonding. This was possible because through partnerships aimed at improving the pedagogical practices, the researcher and

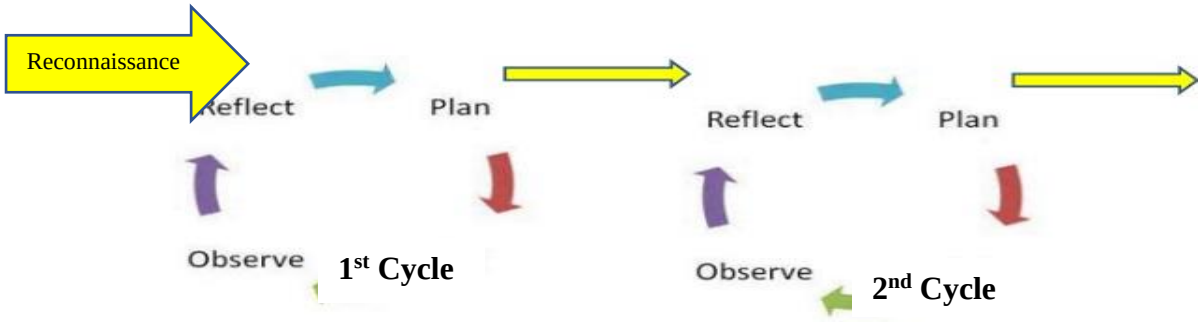
the collaborating teachers focused on a common goal (McNiff & Whitehead, 2006). Action research subjected the participants to a socio-collaborative process that aimed at investigating poor pedagogical practices and devising interventions for them (Hendricks, 2017).

3.2.3 Action research

Action research is a systematic study conducted by teachers, administrators, counselors, or persons interested in the teaching and learning process, to gather information about how their particular schools operate, how they teach, and how their students learn (Mills, 2011).The definition by Lewin (1946) as comparative research based on conditions and effects of different forms of social action and research leading to the social action best justified this quest. In this study, the participants became partners and shared the challenges they faced in teaching or learning chemistry, with a focus on ionic bonding, and the application of action-oriented steps to solve the challenges. Through participation, coupled with the experience of the participants, there was the ability to identify pedagogical gaps in chemistry and seek solutions for the learner's disinterest problems in chemistry.

Action research was chosen to generate a strategy that could be applied in the researcher’s context to improve pedagogical skills. Through action research, a rare opportunity to work with fellow teachers and students in improving teaching and learning pedagogies was acquired. Through self-reflection, it was realized that the educational values of teaching for conceptual change and consistently developing pedagogical content knowledge had been ignored. Adopting the action research model by Lewin (1946) not only equipped the researcher with better teaching practices but also helped contribute to a new chemistry teaching strategy geared towards learner engagement.

Two action research cycles were conducted in this study due to limited time. Each cycle lasted five days, with four days in between the cycles.



Action research model adopted from (Lewin, 1946)

Figure 3.1 showing the action research cycle process

3.2.4 The Process of action research

The spiral nature of action research involves four stages in each complete cycle as shown in the model above; planning, action, observation, and reflection stages. At the reflection stage, the commencement of a new cycle, which is aimed at improving and influencing learning, is marked. Having identified ionic bonding as a target area of study, a reconnaissance was conducted, which opened avenues for the intervention and post-intervention stages.

3.2.4.1 The Reconnaissance stage

At this stage, data was collected concerning the ability of the current pedagogical practices used by teachers to engage learners. Using the reconnaissance findings, I navigated to the planning stage. At the planning stage, three critical reflection techniques were embraced; reflective critique was applied first, followed by dialectical critique and collaborative resource principle (McAteer, 2013).

Through the reflective critique, the researcher was able to understand how the pedagogical practices of the teachers have over time been influenced by the learning environment and generation of learners. The dialectical critique assisted the researcher and the collaborating teachers to evaluate the findings and assess the effectiveness of the current pedagogies in chemistry in engaging learners. Through this, the possibility of an additional pedagogy as an intervention was explored. The collaborative resource principle identified the collaborative teachers' roles as co-researchers.

3.2.4.2 The intervention stage

This stage was full of activities geared towards a transition from traditional pedagogical practices, which are less engaging, to highly interactive pedagogical practices. All these activities were aimed at improving the pedagogy in teaching

chemistry concepts through songs. Together with the collaborating teachers, a lesson summarised using a song was planned, where the researcher was the instructor. The collaborative teachers noted and recorded the strengths and weaknesses observed during the lesson. Songs on ionic bonding were used, which are open educational materials obtained from:

https://www.youtube.com/watch?v=M0qOI_2WnGE_(*Structure and Bonding Song - YouTube*, n.d.)

https://www.youtube.com/watch?v=kscpRNX4AIQ (Dsewojh, n.d.)

After playing the two songs, learners were given time to compose songs on the concept and subsequent concepts, which would be used in the lessons that would follow.

3.2.4.3 The Post-intervention stage

At this stage, the participants were engaged through an extensive reflection exercise. The collaborating teachers and the learners were asked about their experience in teaching and learning using songs. Before the reflection exercise, a reflective session with the collaborating teachers was held. After the reflection, the collaborating teachers were interviewed and a Focus group discussion was held with eight students on their perceptions concerning teaching or learning through songs and the associated challenges.

3.3 Sample and sampling procedure

3.3.1 Research site

The study was carried out in a mixed-day and boarding public secondary school in Vihiga County, Kenya. Akili mingi[1] High School is a county secondary school having a student population of 621 students and 32 teachers, four of whom teach chemistry. Because of the boarding facility, the school attracts students from all parts of the country. The school also has good infrastructure and a projector, which supported the projection of prerecorded songs during the intervention.

This study would inform the use of songs to teach chemistry in similar public institutions, thus benefiting many learners since most learners attend public schools.

Additionally, the school's ease of accessibility made it convenient to collect data within a short period of time at a considerably lower cost.

3.3.2 Research participants

This research study involved two form two chemistry teachers, who were purposively chosen as collaborative teachers, and one form two stream, which was taught by one of the collaborating teachers. Form two class was chosen because they were well conversant with the topic of structure and bonding, which is taught in the form two syllabus. Action research participants are purposively selected to enhance focus on the practice to be improved (McNiff & Whitehead, 2006). The site and class chosen posed the characteristics that the study focused on (Cohen et al., 2011).

From the participating class, 8 learners were chosen through a stratified sampling technique to participate in the focus group discussion (FGD).

3.3.2.1 Collaborating teachers

After an agreement with the Head of science department, Mr. Tembo[2] and Miss Zuhura[3] were purposively settled on as best suited to be collaborating teachers.

Mr. Tembo was a teacher of chemistry with a teaching experience of seven years and had taught chemistry in all the classes consistently. He was a holder of a bachelor's degree in education and had attended the strengthening of mathematics and sciences in secondary education (SMASSE) workshops and other chemistry workshops organized by the ministry of education and the teachers' service commission, equipping him with the relevant experience.

Miss Zuhura had a teaching experience of two years under the teachers' service commission and had taught for three years under the board of management. She was also a holder of a bachelor's degree in education and had attended school-based chemistry workshops.

At the time of the study, both teachers were teaching chemistry in form two, and therefore were best fit for the study, which involved a form two topic.

The experience that the two collaborating teachers had was very useful for this study since they had an idea about the challenges of teaching chemistry at the secondary school level and had tried several interventions to curb these challenges.

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[1] Pseudonym for the research site

[2] Pseudonym for a collaborating teacher

[3] Pseudonym for a collaborating teacher

With their experience in teaching, they had tried most of the traditional teaching strategies and were not hesitant to try yet another method, teaching through a song. Finally, the teachers had a lot of interest in participating in the study.

Table 3.1 showing Profiles of the collaborating teachers

Teacher	**Teaching experience**	**Academic Qualification**	**Professional training**	**Responsibility**
Mr. Tembo	7 years	Bachelor's degree in education	-SMASSE -Chemistry workshops	-Chemistry teacher -H.O. S Chemistry
Miss Zuhura	2 years	Bachelor's degree in education	Chemistry workshops	-Chemistry teacher -chemistry patron

3.3.2.2 Form two stream

Form two stream was purposively chosen for the study since ionic bonds are taught in form two, implying that the study could not be relevant to another class. Additionally, it was easier to transform learner attitudes in lower secondary classes like form two, compared to upper classes. The stream had 65 students.

The participating stream was taught by Miss Zuhura, one of the collaborating teachers. From the participating class, 8 learners were chosen through a combination of simple and stratified random sampling methods to participate in focus group discussion.

The stratified sampling method was chosen since it reduced bias by ensuring that all the categories of learners, concerning performance in chemistry, were represented in the study. According to Sharma (2017), stratified random sampling reduces the chances of bias during selection.

3.4 Data collection methods and instruments

The instruments for data collection used in this study included lesson observation guides, interview guides, Focus group discussion protocols, and Document analysis protocols. Multiple data collection methods helped in strengthening the evidence from the findings since comparing the results from each data instrument used gives more evidence for a particular case. According to Denzin and Lincoln (2018), triangulation increases rigor. Further, the evidence examined from various sources was used to build a coherent justification.

3.4.1 Lesson observation

Following the designed lesson observation protocol (Appendix A), Lesson observations were conducted during reconnaissance to have evidence of use of the current practices in pedagogy and during the intervention to assist the collaborating teacher in learning the integration of songs in a chemistry classroom. Direct observation was used since it reduces bias. Through observation, first-hand interactions with the participants are obtained (McAteer, 2013).

The data obtained answered the question on challenges experienced with the use of content songs and perception of teachers on the use of songs

Data from lesson observation at intervention informed on whether or not the intervention was successful and the impact of the research setting on the study.

3.4.2 Document analysis

Document analysis is a type of qualitative research that involves the interpretation of documents by the researcher to bring meaning around the topic being assessed (Ary et al., 2014; Bowen, 2009).

For this research, document analysis helped generate data concerning what the teachers have been doing and instructional strategies that the teachers have been using.

A document analysis guide (Appendix B) was designed to assist in carefully analysing documents like schemes of work, reference books used, chemistry syllabus, lesson plans, and the collaborating teacher's lesson notes.

3.4.3 Interviews

Through interviews, the collaborating teachers shared their perceptions verbally concerning songs in teaching chemistry. Interviews enabled the research participants to describe their views using their own words, leading to new insights (Gallagher, n.d.).

Two Interview schedules with the collaborating teachers were planned. The first interview was conducted at reconnaissance to gather data about how songs can be used in teaching and learning and pre-intervention perceptions on the use of songs. The second interview was done at the end of the second cycle of the action research to collect data concerning the perception of the teachers in teaching through songs, learner engagement during teaching through songs, and the challenges experienced.

The interview questions were semi-structured to ensure that detailed data was obtained and that only questions relevant to the research were dealt with, increasing the accuracy of the data collected ((Hendricks, 2009). According to Ary et al., (2014), semi-structured interview questions prompt the respondent to speak, but with a focus on the area of interest. Hendricks (2009) also recommends semi-structured interviews for action research since they give the respondents a chance to give additional necessary information. Entrance (Appendix C) and exit interview (Appendix D) guides were designed to guide the interview process.

3.4.4 Focus group discussion

From the class of participants, eight were selected through a combination of simple and stratified random sampling methods. As stated under the sampling procedure, a stratified random sampling method helped reduce bias. The participating class was subdivided into five categories, A-E based on the grades they scored in the previous chemistry exam. Thereafter, all the learners in each category were subjected to picking folded papers with a yes or no writing on the folded part. With each of the learners given equal chances of picking yes or no, we ended up with two students in each category, giving a total of eight students.

Table 3.2 showing how sampling for FGD was conducted

Grade	**Number of students**	**% Representation**	**Sampled number**
A	0	0	0
B	12	18.46	2
C	22	33.85	2
D	26	40	2
E	5	7.69	2
Total	65	100	8

Citing Bloor et al. (2001), George (2013) gives the benefit of focus group interviews as allowing participants to engage in collective discussions of typically unarticulated information. Further, focus group interviews enhance synergism, which cannot be experienced in individual interviews. The writings by Mertler (2017) that focus group discussions are more informative and are used under limited time conditions made FGD to be considered in this study since there was very little time yet a lot of information was required.

Through Focus discussion, learners with low confidence levels were able to express their perceptions and experiences concerning learning through songs. For a successful FGD, an FGD protocol was designed (Appendix E).

3.5 Data analysis procedure

Data sorting and analysis were conducted as per the procedures of Whitehead and McNiff (2006), where only information relevant to the research questions were sorted from the various data collection and recording tools.

Audio recorded data from interviews with the collaborating teachers and FGD were transcribed to verbatims for storage in the researcher's google drive, alongside the other collected data to avoid data loss.

Through reflection on findings, Data analysis was done concurrently with the collection of data to assess the emergent themes and to confirm if the data obtained answered the research questions. Data from various data collection instruments were compared to get a glimpse of research questions that had insufficient data and therefore required the collection of additional data. A matrix was designed for triangulation, to enhance the identification of repeated themes and to enhance credibility. As suggested by Hendricks (2017), to ensure credibility in a study, one should collect multiple forms of data for the research questions.

3.6 Data trustworthiness

Data from several sources were analyzed to ensure credibility and to build a stronger justification. Hendricks (2017) suggests the collection of multiple forms of data to ensure credibility. According to Flick (2020), triangulation promotes the quality of data since it gives information that is beyond that which could be produced by only one method. Mills (2011) further considers triangulation in the sense that the weakness of one method can be compensated by another method, enhancing dependability.

For trustworthiness, all research activities' records were maintained in the researcher's journal. An audit trail describing each process and data collected from each tool was established.

To ensure transferability, detailed descriptive data of the research site was collected to guide on judging the possibility of the results of the study in applying in other contexts (Mills, 2011).

Lastly, the collaborating teachers and the interested members of the science department were engaged in reflective discussions, to reduce bias. Mills, (2011) recommends persistent observation, engaging colleagues, peer debriefing, and corroboration as some of the strategies of enhancing credibility.

3.7 Ethical considerations

In research, ethics are societal expectations on the researcher concerning certain standards that the researcher must abide by (Denscombe, 2017). Stutchbury and Fox (2009) assert that Knowledge of ethical considerations makes a researcher aware of the ethical issues likely to arise from a study and how the study might affect the participants, ensuring integrity. The study stuck to all the principles of ethical considerations as prescribed by Aga Khan University- Ethical Review Committee (AKU-ERC). Informed consent, confidentiality, anonymity, and prevention from harm or risk were all adhered to.

Being action research, a considerable number of ethical issues were taken into consideration. The ethical issues arose from; recorded interviews with collaborating teachers and students, observing the collaborating teachers teach, conversations, among others.

With guidance from the ethical considerations of AKU and the standard research regulations stipulated by the national council for science, technology, and innovations (NACOSTI), ethical values were maintained throughout the research study process.

After obtaining a research clearance certificate (Appendix K) from AKU-ERC, permission was sought from NACOSTI to conduct a research study in Kenya (Appendix L). Authority to research in Vihiga county (Appendices M and N) was then sought from Vihiga county director of education and county commissioner respectively.

Consent from the principal of the research site was then sought. She was given the information sheet (Appendix F) and two consent forms to sign; her consent form (Appendix H), and the student's assent form to be signed on behalf of their parents (Appendix G). Upon request, two collaborating teachers were availed, who accepted to sign the collaborating teachers' consent forms (Appendix J).

Following insights from Marczyk et al., (2005), the participants voluntarily participated in the study, without any coercion. Throughout the study, their autonomy and dignity were respected.

There was a likelihood of participants being at risk of psychological harm, especially while responding to questions during lessons. However, the participants were not forced to answer any question during the intervention stage or any lesson.

The participants' and the research site's identities were concealed through pseudonyms to protect them. For confidentiality, all the copies of the data collected were locked in a metallic cabinet. The password-protected softcopies were stored in the researcher's google drive. As for the song, a standard volume that could interfere with participants' ears was used. The researcher took some classes and engaged in other profession-related duties for reciprocity. After the study, a summary of the findings was presented to the participants.

3.8 Chapter summary

Presented in this chapter is the research design and approach that guided the study. The sample and sampling procedure, data collection tools, data analysis procedure, and data trustworthiness have all been discussed. Also discussed are the ethical considerations that guided the study. The next chapter gives the findings, analysis, and discussions.

CHAPTER FOUR

Findings, analysis, and discussions

4.1 Introduction

In this chapter, the findings gathered from the study are presented. It gives detailed findings of the study at each of the three phases of data collection: The reconnaissance phase, the intervention phase, and the post-intervention phase.

The reconnaissance stage of this study sought to obtain data on the pedagogical practices that the chemistry teachers at Akili Mingi high school are currently using to teach the topic of structure and bonding, with a focus on ionic bonding. The shocking finding was that despite the observable generational transitions among the learners, chemistry teachers are yet to switch from the traditional non-interactive pedagogies to more interactive ones. This finding informed the agreement to use songs in teaching and learning ionic bonding at the intervention.

The post-intervention stage was a reflection stage targeted at improving the gaps noticed at the intervention stage in the second cycle of the study. Additionally, the stage enhanced the collection of data concerning the perception of teachers and learners concerning the use of songs in teaching and learning ionic bonding respectively, and the challenges associated with the use of songs. Discussed below are the findings at each of the three stages.

4.2 Reconnaissance stage findings: Pre-intervention pedagogical practices

Acting as a baseline for the study, the findings from this stage aimed at answering three subsidiary questions; ***(a)*** *What are the current pedagogies used by teachers to engage learners in chemistry concepts like ionic bonding?* ***(b)****What are the pre-intervention teachers' perceptions of the use of songs in the teaching and learning of Ionic bonding? and* ***(c)*** *How do songs promote learner engagement in a chemistry classroom/lesson such as ionic bonds?*

This stage was introduced by a brief with Zuhura and Tembo on the nature of the action research and how it was intended to be conducted. This was followed by a detailed analysis of their schemes of work, lesson plans, lesson notes, and chemistry syllabus. The Findings at this stage would play a key role in informing the best way to implement the intervention that the study was up to during the first cycle of this study.

At the reconnaissance stage, the findings are presented beginning with the traditional pedagogies, reflection, and finally a stage summary.

4.2.1 Current teaching pedagogies and resources

Data collected at the reconnaissance stage exposed the ancient strategies currently used by the teachers in handling structure and bonding. Globally, the ancient pedagogies like the lecture method are past time since they rely more on teacher-influenced instruction where the teacher dictates what to be learned and how to learn it (Kaddoura, 2011). The only roles the learners play in such pedagogies are content consumption and note-taking. Consequently, there results in poor conceptual understanding among the learners.

Results from the study revealed the commonly used strategies and resources by teachers in ionic bonding are: lecture method, models, charts, and ICT. Upon reflection on the strategies, the teachers' lack of learner-engaging pedagogies and interactive resources was evident. The two findings are as discussed below.

4.2.1.1 Lack of learner engaging pedagogies

From the data obtained, Zuhura predominantly relied on the lecture method to deliver ionic bonding. Zuhura preferred the lecture method since it is an easy and less involving method of teaching and she said:

> If you use something like demonstrations, discussions, the only challenge that's there is time because you find that it takes a lot of time to deliver a content when you use these, so we don't teach that much, but when you use lecture method, it's much easier and quicker.

Contrary to Zuhura's approach, Tembo used the lecture method just to add on missing concepts from his video lessons. He said, "I use the lecture method to impart more skills on the areas that I feel that the videos never touched on."

Even though the lecture method has its benefits to the teacher, its impacts on the learners are unfriendly. Being teacher-centred, this pedagogy reduces learners to passive observers, consumers of lesson concepts, and note-takers. Learner participation should not be limited exclusively to classes involving experiments but should also be observed in theoretical lessons. Tembo confessed that although he applies the lecture method, he is aware of its limitations. This is what he had to say concerning the potential of the lecture method to engage his learners:

> The lecture method does not engage my learners fully. The lecture method most of the times become very boring to my students. Most of the students get

little but when you go to now demonstration that is where at least they become …very active.

In any lesson, desirable outputs from the students can only be attained if learners concentrate. The choice of a teaching method therefore should be that which enhances concentration among the learners. Results from this study however revealed that the lecture method is not child-friendly since learners have a very low concentration span, which cannot be maintained by the teacher-dominant lecture style. When asked whether her learners concentrate when she uses lecture method, Zuhura said, "For the learner participation, I think there is a problem with lecture method because most of them if you use continuous lecture method, they lose concentration." Similar findings were obtained from the lesson plan analysis and pre-intervention lesson observation. From the lesson plan remarks, learners were not able to recall the concepts taught. This inability to recall could be attributed to the non-interactive lecture methods used by the chemistry teachers. Similarly, during the lesson observations, it was clear that the learners' interest was very low when Zuhura was teaching them through the lecture method. They were less engaged, less active, interacted less, concentrated less, and most shockingly, seemed not to be part of the lesson.

Concerning its ability to enhance retention of learned content, results from this study revealed a very low retention ability on the lecture method, agreeing with Seymour and Hewitt (1997) as cited by Yadav et al., (2013) that continued use of the lecture method has resulted to low retention levels. The inability of learners to retain concepts learned could imply poor delivery methods and a lack of interest in the lesson. In addition, the findings revealed the lecture method does not spark learners' attitudes in chemistry. On attitude, retention, and lecture method, Tembo revealed that;

The lecture method has a very very big challenge because one the retention is very very low; the retention is very very low. It does not help to change the attitude; it has the opposite effect. In fact, they can hate the subject…

During the lecture method, chemistry teachers ask questions, as an engaging strategy. This engagement technique ensures that only a section of the students participates during the lesson upon responding to the questions asked, excluding those who are shy. When asked how she engages her learners, Zuhura confessed;

> Lecture method, as usual, very low in engaging learners. I make them participate just by asking them questions and giving them, some work to do while I check…. They don't concentrate so maybe you can ask questions. In most cases am the one talking.

From the confession, it is without a doubt that the chemistry teachers are helpless with regards to learner engagement in ionic bonding lessons. The helpless state has pushed teachers to shift focus on their teaching at the expense of the students' learning. The extract above has no intervention on the section of learners that do not answer questions in class and what the teacher does to avoid talking alone during chemistry lessons.

The lesson observation further revealed that the teacher was not tolerant of slow learners and was not giving the learners time to interpret the questions asked. She would reveal the answers to the learners even before the learners gave their attempts. This demonstrated a high teacher dominance level and exclusion of the learners' input in the lesson. Further, the teacher never gave the learners a chance to ask questions and this made them less attentive.

The only option the chemistry teachers have is the use of ICT. However, ICT, as reported by Zuhura, consumes so much time and cannot be used most of the time. The teacher must download the ICT resource to be used in teaching. Additionally, the school must be equipped with projectors and laptops, which most schools do not have. Zuhura said, "Actually, all the students like ICT, even if you tell them they are going to the computer lab, they are very happy compared to when you are in class. Though you can't go there every time."

These findings show that by using the lecture method, little is done concerning learner engagement and attitudes, which are ingredients of concept understanding. These results corroborate the findings of Nganga and Kambutu (2017) that teacher-centred pedagogical practices have colonized other teaching methods in Kenyan classrooms. The results are also consistent with the findings that despite being popular, the lecture method is teacher-centred, leading to increased passivity and withdrawal of interest from learning among learners (Izuagba, 2015). Chege (2013) further found that the lecture method reduces learner activity and forces the learners to be passive listeners during teaching and learning.

Also consistent with the findings of Chege (2013), this study found that the lecture method reduces the confidence levels of learners, impairing their ability to answer questions in class.

The data presented so far reveal that the teaching methodologies used ignore the learner and fail to engage the learner in the teaching and learning process. Through reflection, it was felt that the engagement gap can be filled by teaching using songs. As written by one of the students when the learners had an opportunity to give their feedback about the lesson, learners are in serious need of a more engaging strategy of teaching.

4.2.1.2 Non-Interactive teaching and learning resources

From the analysis of various documents like approved chemistry syllabus, teachers' schemes of work, chemistry textbooks, lesson plans, and lesson notes, the data collected revealed charts and models as teaching resources for ionic bonding. This was confirmed by Zuhura and Tembo during the entrance interviews. On his teaching resources on ionic bonding, Tembo's response was, "I use some models; we have some models in the lab and also ICT. I use models with demonstration."
Miss Zuhura on the other hand, uses both models and charts. Concerning her teaching resources, she said, "Like in ionic bonds, when you are looking at the structure, you normally have a model of sodium chloride. They don't prepare on their own, I just use the already made model…I also use charts."

Though it is understood that the Kenya institute of curriculum development, as evidenced in the course books and the approved syllabus, recommends the use of charts and models in teaching ionic bonding, their interactive potential, and ability to engage the learner, especially those with diverse learning preferences are questionable.

How for instance would the model and chart in figures 4.1 and 4.2 respectively below promote learner engagement when the teacher exhibits them to the learners? What the teachers may have failed to factor in is that a section of the learners is auditory and would not learn by visualizing the charts or models while others, being kinaesthetic, prefer to be practical.

Figure 4.1 showing a model of Sodium chloride

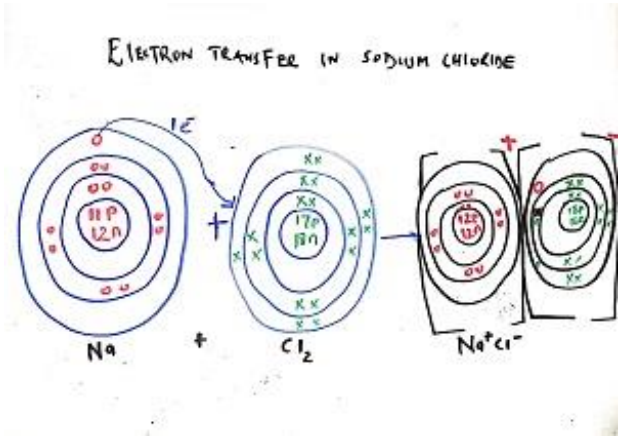

Figure 4.2: Showing a Chart demonstrating electron transfer in sodium chloride

Responding to the question on the potential of charts and models to engage her learners, Zuhura had to say;

> For the chart, I don't think it engages them much because first of all you draw it on the board, they will concentrate there. The chart must remain in class so that they look at it every time…Not all my learners are usually engaged with my charts or models.

Given the current advancements in teaching and learning, charts and models are too ancient to offer a learner interactive and engaging environment to the current generation of learners and ultimately boost their attitudes towards a science subject like chemistry. Additionally, drawing from the data findings of this study and the findings of Graulich (2015), models do not engage the learners, portraying them as passive recipients of information. For a long time, over-reliance on charts and models has ignored the interests, learning preferences, and learning paces. Funnily, they have

reduced learning to a classroom phenomenon that cannot be extended outside the classroom. From the lesson observation, displaying the charts and models and pointing at them was basically the teacher activity, with learners' role being to watch.

With songs, however, most learners can be engaged in singing the lesson concepts and the songs can be extended outside the classroom, enhancing interaction with learned content outside the classroom (Governor et al., 2012a).

4.2.2 Pre-intervention views of teachers on science content songs

Before the intervention, it was important to examine the views of teachers concerning the use of songs in teaching and learning chemistry concepts like ionic bonding. Findings showed that science content songs can be obtained from the internet or composed before the lesson. Findings also revealed that the learners are familiar with the songs, hence can easily get engaged when taught through songs. Though the teachers perceived songs as beneficial in the classroom, they also viewed them as associated with certain challenges.

4.2.2.1 Sources of songs

Data collected from the interviews revealed that science content songs can be obtained from the internet or the learners through their compositions. According to the teachers, Internet databases like you-tube have songs to aid in the delivery of selected chemistry content. On potential sources of songs, Zuhura said, "You can get songs from the internet, or you can compose one on your own. learners can also compose their own songs…. Some of them are capable of composing their own songs, the ones they understand better."

Information obtained from Mr. Tembo showed concurrence with Zuhura. He further pointed out that consultation with colleagues can also be a source of songs since some colleagues are composers. Collaboration in composing, according to Tembo, would be a very reliable source, and he said, "There are ways maybe you can one use the net to figure out the songs, maybe you can ask your colleagues how to go about it. Even from the students themselves, the students can also compose their own songs."

Though there are diverse sources of songs as obtained from the findings, composition of songs would be an option if the context is to be considered. Composing songs might also result in increased interactions with the content and among learners. However, just as revealed in the challenges, composing songs is time-consuming, unlike downloading songs which might save time.

The findings on sources of songs concur with the findings by Crowther (2006a) that science content songs are available on various internet databases like MASSIVE and YouTube. On composition of songs, the findings are in line with those of (Yee Pinn Tsin, 2015) that teachers can subject learners to compose songs, which can help learners with diverse academic abilities to grasp science concepts and Toppel (2015) that teachers and learners can compose songs relevant to their context.

4.2.2.2 Familiarity with songs

Information obtained on familiarity with songs revealed that students like songs and know most of the artists by names. The teachers, therefore, felt that if science content is put in desirable lyrics, then the learners will certainly like them. This would translate into positive attitudes and better results. Tembo confessed that although he had never used songs in teaching any of the chemistry concepts before, songs are good since they can create a positive impact on learning. He said:

> Use of songs is a very new area to me but I really love to engage it because these students love songs…if you tell them the artists around, they will always tell the artists…I believe it will impact so much because these are students who love songs, they love songs, they love to dance so that will now bring a positive impact in teaching.

Having used songs to teach the topic *'Atomic structure and the periodic table'*, Zuhura viewed the potential of songs to enhance attitude change, increase learner activity, and increase response to classroom questions as great. She said:

> For students they will like, most of my students they will like songs. I am very sure that it can change their attitudes……If they can find a song to master ionic bonds, they can be able to answer such questions and performance obviously will have improved.

Asked to gauge the learners' participation during her lesson on the periodic table using songs, she said, "Their participation was very good with songs on the first 20 elements. That's why am saying if you can find a song in this topic, it can be good."

From the data obtained, it seems easier to make learners participate in class through songs since songs are not unique to them. Since most learners will like songs as said by the teachers, then it would be easier to engage most of them as the pedagogy would factor in their interests. These findings agree with the ideas of Crowther (2012), that enjoyable music could be applied to help learners who feel out of place during science lessons feel some sense of belonging in a science classroom

and perceive it as friendly, hence participating in the classroom activities. They also seem to be consistent with Governor's study which found that songs can engage learners in various ways (Governor et al., 2012). The moment learners who feel out of place develop a sense of belonging; they will certainly participate in the lesson. Additionally, an engaged learner finds various reasons to participate in the learning process.

4.2.2.3 Projected benefits of songs in teaching and learning ionic bonds

The teachers perceived songs to have numerous benefits in teaching and learning chemistry. According to them, using songs would help end the dominant lecture method, which has made learners reliant on teacher activity. In Tembo's perspective, songs would bring a very positive impact on teaching and learning as he said, "And it will help them now to change their attitudes in chemistry because through learning via songs, they will be able to grasp a lot of stuff…So, it will have a very very positive impact on teaching."

According to Zuhura, Songs will enhance understanding of the taught concepts. Since they are lyrical and have a repeating nature, learners will be in a position to grasp key concepts of the lesson for easier application. Concerning songs and concept understanding, she said:

> Songs make learners to understand better…for the one who was taught using a song, he or she can sing the song as he masters the elements. So, I think if we can find a song for bonding, it can be better.

Songs, according to Tembo, will not only enhance retention of lesson concepts but will also help learners change their negative attitudes in chemistry, which resulted from consistent poor understanding during teaching, as evidenced in their results. On the effect of songs on attitude and retention, Tembo said:

> …it makes the learner to have that positive approach, positive attitude, and also it changes the attitude…that they can compose on their own and this is something that can stick and it will highly help in retention of the topic.

For the duration that Tembo and Zuhura had taught, they had experienced the inability of learners to recall concepts after learning. In their opinions, songs will enable learners to recall the concepts. Tembo added "It helps in retention because if you are very very keen, most of these students are able to sing songs of various artists…if that one happens in this field, maybe they can recall all that they have learned."

The respondents' preconceptions on songs show that songs will not only bring an end to the lecture method but will also bring some positive impacts in a chemistry classroom, some of which include; attitude change, conceptual understanding, concept recall, and retention.

These findings show concurrence with the findings of Yoon (2017) that songs helped the participants to develop positive attitudes towards science and to understand science better. The findings also support previous research by Governor et al., (2012) which found that teachers applied songs rich in content to enhance learners' conceptual understanding and to give learners additional examples.

The data collected from the teachers also agree with the findings of Diakou (2013) that singing results in positive energy among students, which subsequently motivates and helps them retain concepts. Similarly, studies by Hershner (2018) revealed the potential of songs to create a positive learning atmosphere.

4.2.2.4 Challenges of using songs

Even though the chemistry teachers viewed science content songs as reliable teaching resources for ionic bonding, they associated songs with certain challenges. Among the views on challenges of using songs to teach was the lack of proper science vocabulary in some songs. Tembo said, "the challenge is finding a good song which rotates around the topic, using the correct words because this is chemistry and chemistry is a science."

Zuhura had a view that the use of songs would consume so much time. Unlike the lecture method which demands a shorter time, songs would demand more time for composition, searching for the song, playing it in class among other activities. Zuhura was worried about syllabus coverage at the expense of learning and viewed songs as time-consumers.

From the respondents' views, undesirable vocabulary and time consumption were the major challenges of using songs as pedagogies. The findings match those observed in a study by Nurvia (2016), which found that some songs have a poor vocabulary, which may not deliver the intended content. Additionally, the findings confirm the findings by Toppel, (2015) that teachers spend more time composing songs. Since some songs are associated with inappropriate vocabulary and time consumption, Fonseca-Mora et al., (2011) suggest the selection of appropriate music rather than just any song.

4.2.2.5 Songs and learner engagement in a chemistry lesson

It emerged from the findings that science content songs can promote learner engagement in several ways. Being that the lecture method could not engage learners as per expectations, the ability of songs to engage the learners during chemistry lessons had to be assessed.

One way of engaging learners is to focus on learner participation, which the lecture method has over time failed to address. Data collected from the respondents showed that songs can make learners more participative during the lesson. Its ability to increase learner participation indicates a potential to engage the learners. Through singing alone, all learners will be part of the lesson, based on Zuhura's confession that:

> For the case of songs, we all want a participating class, they will be participative in class, therefore I think it's better if we use songs…… It is very easy to get 100% participation. I am very sure most of them will be interested.

It was also perceived that because of their interactive nature, learners get engaged upon interacting with the song. As learners strive to master the lyrics of the song during the chemistry lesson, they get a rare chance to interact with the content being taught and the teacher. Further interactions occur in case the learners are organized to compose songs in groups. On interaction, these were the views of Zuhura:

> Songs are interactive and enhance interaction with the learners. In lecture method, you can only interact with learners through asking questions. If you don't ask questions, you will not interact with them because they expect you to be delivering to them.

The chemistry teachers also viewed songs as attention enhancers. Increasing the learners' attention during chemistry lessons engages them, nourishing them with chemistry concepts. According to Zuhura, students never read their books to remind themselves about past concepts. Concerning the perceptions of songs on engagement, Zuhura said, "Most of our students don't read so much. After teaching, if you don't engage them, they forget. Songs will make them engaged through participation, interest, being attentive. They will love the songs."

The findings revealed clearly that songs might enhance learner engagement through increased participation, increased attention, and increased interest. They are in accordance with the findings of Rabinowitch and Meltzoff (2017) that music

enhanced engagements which further influenced interactions, resulting in increased pro-social behavior among the pre-schoolers. The findings further support the study by Bokiev et al., (2018) which found songs to be important educational tools that teachers can apply to engage learners and to make learning enjoyable. Likewise, when learners are exposed to and engaged using songs, their attention is grabbed by the songs, deepening their learning experience (Rambli et al., 2013). Though Ly and Quynh (2020) find the use of songs to be a new method, the views of Zuhura that songs will make learners attentive are in agreement with their findings that songs attract learners' attention.

4.2.3 Reconnaissance stage reflection

For a successful transition from the current teaching strategies (reconnaissance) to the desired change (intervention), a collaborative reflective process was embraced with Tembo and Zuhura. This reflective process focused on two reconnaissance gaps; non-engaging teaching pedagogy and passive learning among the learners.

4.2.3.1 Passive learning among the students

The findings clearly showed that the teaching resources used increased learner inactivity, which in turn hindered their understanding of chemistry concepts like ionic bonding. It was therefore needful to seek a more engaging and interactive strategy. The intervention would enable learners to embrace a learning strategy of their interest and extend their interaction with chemistry content outside the classroom. It would enhance their creativity by making them composers of the content to be learned. From the findings, it can be drawn that through singing science content songs, composing songs, or seeking desirable songs, the learners would be more interested in chemistry lessons and their attitudes towards chemistry would change.

4.2.3.2 Non-engaging teaching pedagogy

Though confirmed that the teachers were implementing traditional teaching pedagogies, they had certainly learned about modern teaching pedagogies from chemistry workshops. However, they might have been limited from implementing the modern pedagogies by inadequate resources and the rush to complete the syllabus within the timelines of the ministry of education and KICD. Besides, the syllabus itself recommended charts and models as aids for teaching structure and bonding.

The experiences of Tembo and Zuhura also could have convinced them that once they attain their teaching objectives, then their students would gain meaningful knowledge. From their reflections and feedback from students, the duo saw the line that separates teaching from learning and learned that learning can only be achieved through a pedagogy that embraces learner activities rather than teacher activities.

Upon further reflection on the potential of charts and models to engage the students emotionally, it was realized that they fade over time and become less attractive to the learners.

To shift attention from non-interactive to more interactive and engaging teaching strategies, it was agreed that science content songs would engage learners both physically and emotionally during the lesson. Additionally, as found by Diakou (2013), the method would enhance retention of learned content and the ability of the learners to recall chemistry concepts. Songs would further restore learner attitudes towards chemistry (Koelsch,2014).

4.2.4 Summary

Though commonly embraced in most schools, ancient teaching and learning pedagogies mandate the teacher to decide what is to be learned and how it should be learned since they are teacher-centred. Consequently, this leaves numerous gaps in teaching and learning, which include; low learner engagement, low classroom interaction, lack of focus on the learner activities, poor attitudes, and low content retention rates. The next section gives the results obtained at the intervention stage.

4.3 Intervention stage: The transition

This stage was full of activities geared towards a transition from the less engaging to more engaging pedagogies. It aimed at implementing teaching and learning theoretical chemistry concepts like ionic bonding through science content songs to fill the reconnaissance stage gaps (4.2.4 above). As captured in the reconnaissance stage reflection, songs were settled on as the most reliable intervention since they would engage the learners both during and after the lesson. Though songs from the internet were used, the learners were tasked to compose their songs, which would be used in the subsequent lessons.

During the intervention stage, a lesson was planned with songs as the teaching resources. The lesson was taught by the researcher as Tembo and Zuhura observed. Through observation of the lesson, they were expected to learn how to engage the

learners through songs, as opposed to the less engaging charts used during the reconnaissance lesson. The observations, coupled with the feedback from the duo and personal reflections, would be very important in improving the lesson during the second cycle's intervention stage.

Data obtained during the intervention answered the subsidiary question, *what are the challenges of using songs to teach chemistry topics such as Ionic bonds?* Being present in the lesson, the challenges could be observed easily. Presented and discussed below are the findings at this stage.

4.3.1 Challenges of using songs in teaching

During the intervention lesson, the lesson observation data revealed that though some songs are enjoyable, they have a foreign accent, which hinders learners from grasping all the words. One of the songs downloaded from YouTube had a western accent, making it too challenging for the learners to master the science content songs faster based on the study context.

Apart from the data obtained from lesson observation, some data on the foreign accent was obtained from the FGD. During the FGD, the issue of western accent was very clear. When asked to share their challenges of using songs, student 3 said, "The song was so nice that I can't forgot the song but the thing that make me dislike the song is the way that the songs were sung and the way the English was spoken."

Zuhura also confirmed during the exit interviews that songs with a foreign accent are hard to follow, making the learners miss some words. She said, "They are not at par with each other when they are singing, some are ahead some are left behind. And another thing following the lyrics…the accent also, then also time."

Each person is usually subscribed to a particular genre of songs, students included. For a better learning experience with songs, the song chosen should poses the tune of the learners' preferred music genre (Millington, 2011). Data obtained from the focus group discussions revealed that learners have different preferences for songs. This is what student 1 had to say.

> what I disliked is that for example you have chosen a song and the students say that your song is not interesting to them, maybe you are just singing on your own, some of the students will not be able to catch what you are singing

During the second FGD, student 2 confirmed that he disliked one of the songs due to the bad tune.

It emerged during the intervention stage that the use of songs during lessons reduce the teacher's ability to control the class. This could be due to increased noise that arises when everyone begins to sing. From the FGDs, it became clear that even controlling what the learners learn during the lesson with songs may be a problem since a section of learners would only concentrate on the songs yet ignore the lesson. Concerning content control, Student 4 said, "I disliked songs because the song may be enjoyable and students will continue singing and they might forget other things in learning." Similarly, during the first FGD, student 5 felt that the song may be interesting but the student may focus on the song but not on learning because the time given for the lesson is short**.**

Foreign accent, diverse learner preferences for songs, and reduced classroom control were among the challenges observed during the lesson. These findings accord with earlier studies by Nurvia (2016) which found loss of class control and inappropriate vocabulary as some of the challenges associated with using songs in teaching. The findings also support evidence from a study by Nugroho (2014) that singled out differences in students' tastes in music as a hindrance to the use of songs in teaching and learning. However, it is worth noting that class control should not be blamed on the weakness of a teaching resource but rather on the inability of the teacher since experience shows that teachers who encourage chorus answers for instance become victims of poor classroom control.

4.3.2 Summary of the findings

Concisely, the intervention stage aimed to improve the chemistry pedagogical practices through the use of songs. The findings gathered at this stage revealed that though the use of songs is good in learner engagement, it has its challenges, just like the other methods. Among the challenges include; difficulty in engaging with a foreign accent, diverse learner preferences for various songs, and reduced classroom control. When learners were asked to compose songs as a way of curbing the challenges, social interaction was observed through groupwork though most of the learners required a tune to compose a song.

4.4 Post Intervention stage findings

The objective of the post-intervention phase was to reflect on the intervention and get the post-intervention views of the teachers and learners concerning the use of songs in teaching and learning chemistry. The data collected answered the subsidiary questions; *a) What are the post-intervention learners' and teachers' perceptions of the use of songs in the teaching and learning of Ionic bonding? b) What are the post-intervention teachers' and learners' perceptions of the role of songs in promoting learner engagement with chemistry lessons like ionic bonding?*

To get responses, a collaborative reflective session was held with Tembo and Zuhura at the end of cycle two. Concurrently, a personal reflection on the intervention lessons was conducted. After the reflections, exit interviews were conducted with the collaborating teachers and FGD with eight students. Discussed in the sub-sections below are the findings.

4.4.1 Post-intervention reflection

Upon reflection on the strengths and weaknesses of the intervention lesson, it was realized that for successful use of songs in teaching, time and the origin of the song used are key factors. As observed during the collaborative reflection, the intervention lesson of the first cycle never ended within the specified time frame since a lot of time was spent connecting the audio gadgets and composing additional songs. Additionally, time was spent repeating the pre-recorded songs. The observation concurred with Tembo's observation as reported during the interview that:

> Actually, I never saw any major disadvantage, the only thing that I saw that was disadvantageous kwamba [is that] these songs I think it takes time for them to learn but once they learn them …they will know exactly what they are singing.

Apart from time lost in connecting the devices, it was realized that more time was lost when the learners were striving to master the lyrical lines or to follow the foreign accent in some songs. Additionally, it would take time to control the class.

Next, a mechanism that would ensure time wastage is minimized, and interaction with the songs is maximized in the subsequent cycle of the action research had to be thought of. It was unfortunate that the study would not move to another cycle due to limited time, but there was a need to get a mechanism of improving the

intervention since the collaborating teachers had an interest in implementing the study in their school.

Together, a course of action before the implementation of the use of songs in teaching and learning chemistry at Akili Mingi high school was agreed on: First, time would be organized outside the normal lessons to guide learners on composition and mastery of their science content songs in groups so that they don't spend so much time struggling with the western accent. For pre-recorded songs, it was agreed that learners would be given written lyrics of the songs before the lesson so that time is not lost in the struggle to master the lines.

For the foreign accent, it was agreed that it would be better if a particular song is listened to and it is confirmed that the learners can get the accent before use. Additionally, the composition of own songs from the science concepts or using songs within the Kenyan context, though very few exist, would be a good insight for the second cycle. All the suggestions pointed to the need to plan lessons with songs well in advance.

4.4.2 Post-intervention learners and teacher's perceptions on use of songs to teach chemistry concepts

4.4.2.1 Learners' perceptions on use of songs to teach chemistry concepts

There was a common feeling that songs enhanced understanding of chemistry concepts like ionic bonding in ways beyond mere teacher's explanations. The learners appreciated the use of songs and felt that it is what their teachers should apply to enhance their understanding of chemistry, not only in ionic bonding but also in other chemistry areas. When asked about what they liked about the lesson during the FGD, student 2 said, "For me, it was very entertaining. This is because it let me to understand better than the teacher explaining. With songs, I understand better." Student 5 on the other said, "For me, I enjoyed the song in teaching ionic bonds because I understood more about ionic bonds…that method may lead to more and well understanding of chemistry to the slow learners as well as others."

Upon a quick review of the lesson observations conducted by Zuhura and Tembo, it was realized that the students' responses perfectly explained why most of the learners were able to answer correctly, the summative questions asked during the lesson. The ability to answer questions correctly in class is a manifestation of conceptual understanding. When asked to explain the formation of ionic bonding at the end of the lesson, most learners were willing to explain and the few who had the chance

explained it perfectly. As reported by student 4, some learners had never answered any question in class before, but during the intervention lesson, they managed to answer since they understood the concepts. He said, “For me, I have never heard some students answering questions in class especially in chemistry but using the songs, I have at least heard their voices.”

It was also the view of the learners that songs have the potential to summarise their notes and taught concepts, making revision easier. They felt that chemistry books and notes are voluminous, a state that makes chemistry revision difficult. One of the students confided that if only the concepts in all the books could be composed into songs, she would have all the concepts. On the potential of songs to summarise chemistry notes, student 3 said, “I personally enjoyed how the songs summarised the topic ionic bonds and it made me understand them better.” In agreement, student 4 said that:

> It helps a lot because it summarises all the topics and when it comes to revision, even short notes can be hard to read sometimes but when you sing the songs, it can be very easy for you to remember**.**

The findings also revealed that students like songs and can adapt very fast should the use of songs be implemented in teaching them chemistry. They revealed that they spend most of their time singing and following musicians and that some of them are aspiring to be musicians. Out of passion for music, some of them expressed their lack of hesitance in making science content compositions. On students' love for songs, student 3 confirmed that, “I think that learning chemistry through songs can help students a lot because students like songs and they sing more frequently …so, when you teach chemistry through songs, it’s very hard for them to forget.” In agreement, student 8 said that:

> When people like those people who have sung their songs, musicians, when the student hears their songs, they will continue singing until they catch up with the song…they will continuously sing the song until they catch up with the song.

On liking songs and not easily forgetting chemistry concepts learned through songs, learners had a view that this would in turn boost their performance in chemistry since they will use the songs to remember learned concepts in an exam room. Comparing the ability of songs to enhance recall and that of the lecture method, the learners ranked the songs higher. Responding to the question on views of songs on

recall of ideas, student 4 said, “I may feel good using the songs frequently because when it comes in examination, you might remember the song and get answers freely without struggling.” The views of student 4 were supported by student 6 that:

> Learning chemistry through songs frequently helps students to remember each and every song which may help them during examination without straining to go to the teacher and ask questions if they have not understood.

A considerable number of the learners felt that songs appreciate diverse learning styles among the learners. Being that each learner has a preferred learning style it would be biased to subject all learners to a single learning pedagogy. This would mean that only a section would enjoy the classes, leaving a majority of the learners struggling to grasp the concepts. With songs, however, as reported during the FGD, majority of the learners found themselves enjoying the lesson. On songs and diversity, student 6 had a view that:

> …learning chemistry through songs is a very interesting process because some students may...some students are not better on reading their notes on their books but when they sing, they are better in singing, they can sing the song better than reading.

Student 8 added that, “some of the students can prefer songs because songs help them to understand and they can end up singing the songs and understanding it.”

The potential of science content songs to increase learners’ attitudes towards chemistry became a very clear perception among the students during the FGD. Learners felt that with learning through songs, their already negated attitudes towards chemistry could be enhanced since they could not enjoy the songs and fail to enjoy their science content. It emerged that teachers think learners are lazy yet they don’t just find reasons to engage with what they do not enjoy, but just changing to teaching through songs might restore their attitudes. On science content songs and attitude change, student 1 said:

> Songs can change the attitude towards chemistry because some students understand songs and like songs more …they are just lazy to learn but when you teach chemistry through songs, they might like songs and sometimes given the summarised notes they can also read them and sing the song which helps them to understand.

4.4.2.2 Post-intervention teachers' perceptions on use of songs to teach chemistry concepts

Just like the learners, teachers also had their views regarding the use of songs in teaching chemistry concepts, some of which resembled those of the learners. According to the findings collected from the exit interviews with the collaborating teachers, songs have the potential of making learners recall the concepts learned during the lesson. Reflecting on the comparative abilities of songs and lecture methods to enhance recalling of chemistry concepts, Tembo said:

> Using songs, I think the learners can remember a lot because if they can grasp the song and the song sticks… unlike the lecture method whereby you only talk talk talk talk, then at the end of the day there is nothing tangible that the students get.

On further reflection, Tembo revealed that although he had been using the lecture method for a very long time, the time was nigh for him to consider the use of songs as a teaching pedagogy. He really wanted a method that would enable his learners to grasp chemistry concepts, unlike the lecture method. Confirming his transition, Tembo said, "I think the songs can now take over the lecture method because I know they can grasp the fundamentals of chemistry using the songs."

Like Tembo, Zuhura felt that the lecture method that she had been using has not been good. However, unlike Tembo whose interest was on the ability to grasp chemistry concepts, Zuhura blamed the lecture method for its inability to make learners develop reactions towards chemistry. Zuhura too felt that it was time to try the use of songs. She said:

> After you've gone, I'll have to introduce the use of songs coz they will have to, they will want much of the songs. Just from the lesson, I think they liked and their reactions will be good compared to other teaching methods like the lecture method that I use.

Tembo too noted that songs enhanced positive learners' reactions towards chemistry. He observed that that was one of the few times he ever saw learners smiling during a chemistry lesson and really enjoying and actively participating in the lesson till the end. He said that:

> The entire class was participating, you could see the smiles in their faces, and they wanted to learn more and more and more…for the first time the whole class was positive... it rose the attention, it rose the curiosity, and definitely it

was something good…The impact was positive because when they were insisting on please replay.

Although her learners had over time developed negative attitudes towards chemistry, Zuhura had a view that science content songs have the potential of restoring her learners' attitudes towards chemistry, if adopted as a teaching and learning pedagogy. She compared the intervention lesson we held with her previous lessons and revealed that learners always want lessons to end but during the intervention, they wanted the lesson to continue despite it being time for lunch. On science content songs and learner attitudes, Zuhura said that:

> …It can bring the attitude of learners in chemistry back. So, when you use songs, their participation obviously will improve and with that their attitude will also improve…most of them were engaged, they were singing and they even liked the lesson, they didn't want it to end, so I think that shows a good attitude…I think if the practice continues, maybe the attitude will lead to a good performance.

Similarly, Tembo had a view that songs can transform learners' poor attitudes in chemistry. He noted that the learners insisting that the songs be replayed yet it was lunchtime was the climax of their attitude transition. He said:

> Now the change of attitude will be there because from the look of things when they were insisting, please replay…it was lunchtime and they never even cared about going for lunch, they only wanted to hear the songs, one more, one more, once more, once more.

From their views, the duo maintained that once learners change their attitudes, then certainly, their performance in chemistry will improve. Tembo said:

> The attitude was quite good, I think the songs can change the attitude because they really really loved it and through that one, I tend to believe upon that now that they can now love chemistry…if you love that subject, you will perform, so definitely they will perform.

Being that the songs, whether composed or downloaded have science content, the content might be part of additional examples left during teaching or missing in textbooks. By singing therefore, the learners might not only get more examples but also a better understanding of the chemistry concepts. From the joy of singing, learners are likely to develop positive attitudes towards chemistry.

The ability of learners to answer questions in class could have been attributed to concept understanding and diverse learning styles enhanced by the songs.

Findings of this study on perceptions of teachers and students on the use of songs in teaching and learning chemistry corroborate with the findings of Governor et al., (2012) that science content songs were used by tutors to give more examples to their learners and to facilitate conceptual understanding among them. The findings also agree with a study by Yoon (2017) which revealed the potential of songs to enhance better understanding of science concepts among the participants and to make them develop positive attitudes.

While it is the dream of teachers to see their learners perform better, very few of them target the emotions of their learners through their teaching pedagogies. On the relationship between songs and emotions, this study supports the assertions of Koelsch (2014) that music can elicit strong emotions among people and influence their moods. Being that attitudes are manifestations of emotions; songs are capable of making learners develop positive attitudes.

Comparison of these findings with an empirical study by Jurowski et al.,(2015) confirms that mnemonic devices like songs have a huge impact on teaching since they improve recalling of learned information. Similarly, the results support the findings of Nikkhah et al. (2019) that music enhanced recalling of more words among the learners who were taught through music. An identical study conducted by Eaton (2020) on exploring the impact of musical mnemonic strategies on student achievement and engagement in inclusive science classes, recognized songs as mnemonic devices that aid in the retention of taught information.

On diverse learning styles, this study agrees that teaching science through music, especially if accompanied by videos and dance, has the potential of reaching diverse participants through several modalities, as found by (Crowther, 2012).

4.4.2.3 Post-intervention learners' perceptions on the role of songs in promoting learner engagement with chemistry lessons

During the focus group discussion, it emerged from the learners that songs have the potential to enhance learner participation in diverse ways like singing, answering questions in class, composing songs among other ways. It also emerged that songs took care of the interests of those learners who usually, out of low self-esteem, fear any form of classroom participation. Classroom participation is attributed to some sense of engagement, implying that by enhancing learner participation, the

songs engaged the learners. With songs, all learners participated as evidenced by the views of students 5 that:

> Some students are very afraid they cannot participate or they cannot have people hear their opinion…when you give a wrong answer, some people may laugh at you but during songs when you teach through songs, you see everybody is singing and you have that desire to join them in singing, so it increases your participation in class.

In support, student 7 said, "Learning through songs may increase the participation of students in class because when you came here, we were just quiet but when you told us to join in the singing, all of us started singing."

Concerning engagement through summative questions, findings revealed that the learners were able to relate the science content from the songs to the summative questions asked in class and give the right responses. During the intervention, the learners were engaged by asking them questions at the end of every song. In observation, they would sing or hum some lines containing the science concepts asked, before raising their hands to signal knowledge of the content area. The FGD later revealed that some students had never answered any question in class before the intervention, but during the intervention lesson through songs, their voices were heard. On songs and response to questions, student 1 said, "some of the students who don't talk in class they can end up talking because they have heard a new song and that song can have to teach them how chemistry is done in ionic bonds."

In support, student 3 said that:

> The songs may increase the students' participation whereby some students who may not like talking in class they may interested on knowing the song and they may use the ability of the song to answer a lot of questions in class**.**

Upon further probing, it was realized that in the learners' opinions, what made the learners respond to questions and participate more than they usually do was because the songs sparked their interest and attention towards chemistry, which in turn enhanced their concentration during the chemistry lesson. By giving all their attention and concentration to the songs, the learners ended up engaged in the entire lesson. When learners were asked their views concerning the potential of science content song to engage learners in a chemistry lesson, students 2 and 3 responded that:

> Student 2: Song is the source of entertainment. In class when teacher is teaching through songs, you must concentrate because when teacher is teaching in class, some students they are feeling like they want to sleep but through songs, in class when teacher is teaching through those songs, they are able to concentrate.
>
> Student 3**:** Sometimes they lose their concentration by looking outside the window, some sleep but when the teacher wants to teach a song, they will have that desire to know that song, maybe the beats are too interesting you can't look out, you can't sleep. You just stay concentrated.

Apart from engaging learners within the classroom, findings revealed that science content songs have the potential to engage learners with chemistry concepts outside the classroom; in their daily routines like farming, walking, or washing. Additionally, they enhance engagement with content in the absence of the teacher and might help reduce noise making in such conditions. In his view of songs enhancing extension of the learning process outside the classroom and in the absence of the teacher, student 1 said:

> The songs will bring you in class because you will have that attitude, you want to be at the song, you want to know the song and can sing the song anywhere…In the classroom, some students like making the noise when the teacher is in class but when there is singing, there is a song being sung, they'll want to hear the song and know the song.

Student 3 also confirmed that songs reduce the ease of forgetting by saying that, "Learning chemistry through songs is not easy to be forgotten because even when you want to sleep you can sing that song, morning when you wake up, you sing that song."

The findings obtained from the students have given a clear insight into the potential of songs to enhance classroom participation, learners' ability to answer questions in class, interest in chemistry, increased attention in class, and engagement even outside the classroom. These findings are in agreement with those of Kotob and Bazzoun (2019) that science content songs enable learners to grasp scientific content which helps them to engage with classmates in discussion and the teacher in answering questions. Data obtained from the learners also indicate similarity with the findings of Gardner (1983), as cited by Coyle and Gómez, (2014) that songs create

very strong emotional impacts on the learners, making them motivated and engaging their attention.

4.4.2.4 Post-intervention teachers' perceptions on the role of songs in promoting learner engagement with chemistry lessons

The data obtained from the exit interviews also revealed that teachers had their perceptions regarding the potential of songs to enhance learner engagement in the classroom during chemistry lessons. Zuhura had a view that songs arouse learners' interests, making them participate and become attentive during chemistry lessons. With increased attention, participation, and interest in chemistry, there will be increased learner engagement and increased scores in chemistry. She said:

> Obviously using songs arouse the interest and all of them were happy, then another thing they were engaged, then that is remarkable compared to other teaching methods where they just look at you…The role of songs in teaching I think is just for engagement, attention, participation of students in class and they are also very important in the bloom's taxonomy, they help in recalling. They help in that recalling aspect…. High performance, attention, attitude, participation, and interest.

The high learner participation was also reported by Tembo. He noted that for the first time since he became a teacher, he witnessed over 90% learner participation in a chemistry lesson. Further, he attributed this high participation to high learner attentiveness, which resulted from higher engagement. In his response on the role of songs in enhancing learner engagement, he said:

> The participation was quite high, the students were enthusiastic…The learners were engaged for the first time like the whole class was engaged, like the entire class wanted to sing the song. It was something new to them and something very very entertaining… it was something that captured their attention… over 90% of the students participated… they were very enthusiastic…they wanted you to replay the song more.

The teachers also had a view that the learners' ability to respond to the summative questions asked during the lesson was influenced by their increased engagement with the lesson as triggered by their attention and participation. According to Zuhura, the learners would simply follow the lyrics before responding to the questions that I asked. She said, "I think the song helped in, just the way you were

asking questions, they were able to follow up the lyrics and use the lyrics to answer questions."

Just like the students, Tembo had a view that songs can enhance the extension of the lesson engagement outside the classroom since once the learners master the song, they will always sing it wherever they go and during whichever activities they will perform. He said:

> The moment you engage in songs, you write your own songs, you sing it, it stick in the brain and it will be something like a song. Anywhere they walk, they will be singing it, and in that process, it will help now to grasp the basics of chemistry and the areas that you wanted them to learn.

These findings expose the ability of songs to make learners engaged during the lesson and to increase their attention, participation, and interest in the classroom activities. They can participate by singing, composing songs, answering summative questions asked in class, and asking questions.

The findings from the post-intervention reflections are in agreement with the findings by Crowther (2012) that enjoyable music could be applied to help learners who feel out of place during science lessons to feel some sense of belonging in a science classroom and perceive it as friendly. Once learners develop a sense of being part of a classroom, they will participate in that classroom. The findings of this study further concur with the findings of Governor et al., (2012) that science content songs engaged learners by satisfying their situational and individual interests. From the findings, it seems that songs acted as reinforcements that motivated the learner, concurring with operant conditional theory by (Skinner, 2014).

By answering questions in class, learners were interacting with each other and with the teacher. This is in accordance with Geretsegger et al., (2014) finding that music appeals inherently since the singing and talking action, together with the musical instruments, create some sense of social interactions. These findings also confirm findings of earlier studies by Maschi et al., (2013) that group music can grant individuals a collaborative experience and enhance their interpersonal beings through stress and burnout reduction. They also agree with social constructivism theory and (Kisanga, 2015) that by listening to songs together and learners composing songs and sharing among each other and with teachers, an interaction occurs.

Based on the post-intervention findings, it was realized the songs can be used to enhance learner interest in chemistry concepts by composing the concepts into

interesting lyrical lines or seeking interesting lyrical lines with chemistry concepts. By making learners compose chemistry content songs or join in singing chemistry content songs, their conceptual understanding is enhanced.

4.5 Conclusion

This chapter dealt with the presentation, analysis, and discussion of the findings of this action research study. Among the discussed findings concerned; pre-intervention perceptions of teachers on the use of songs in teaching, challenges of using songs in teaching and learning, post-intervention perception of teachers and students on using songs in teaching and learning, and post-intervention perception of students on the role of songs in engagement during chemistry lessons. The next chapter presents a summary of the findings, recommendations, and conclusions of this study.

CHAPTER FIVE

Summary of findings, recommendations, and conclusions

5.1 Introduction

This chapter presents a summary of the study findings, implications of the findings to various secondary schools, and recommendations for future research. Additionally, the chapter gives the lessons learned as a chemistry teacher and as a researcher during the study period and the conclusions of the study.

5.2 Summary of the findings

From the research study, five major findings emerged. To begin with the reconnaissance stage, it was found that the teacher-centred ancient pedagogies like the lecture method and non-engaging teaching resources like charts are still being used to teach chemistry concepts like ionic bonding. In the teacher-centered strategies, the powers to decide what to be learned, how to learn it, how to present it, and how to assess it lie with the teacher. This leads to learner passivity and disengagement, resulting in poor attitudes and conceptual understanding, which ultimately ends in a consistently poor performance in chemistry.

Secondly, it was found during the intervention that science content songs are very effective in enhancing learner engagement and interactions among learners during the chemistry lesson. Through social interaction with each other, emotional engagement with the songs, and physical engagement during the lesson, learners get to find the lesson enjoyable, interesting and motivating, making them long for more learning hours. Apart from engagement with chemistry concepts during the lesson, songs also enhanced interactions with science concepts outside the lesson.

It was also found that through singing, learner participation was greatly enhanced during the lesson. Songs lead to increased learner participation, leading to the transition of learners' roles from passively listening to actively participating. Additionally, the songs increased the concept recall and concept retention abilities of the learners. The increased participation, coupled with increased recall abilities, consequently resulted in increased conceptual understanding and ability to respond to summative questions asked in class.

Fourth, the study revealed that the use of songs can be challenging, especially when the learners have different tastes for various songs. Learners with different

preferences for the songs suggested for use by the teacher might find the lesson too boring to participate in. Further, it would be hard to maintain proper classroom control while teaching through songs.

Lastly, the findings exposed how this study positively influenced the learning of the students generally, and the pedagogical strategies of the teachers, prompting the whole department to consider using songs in teaching. The teachers and learners developed desirable positive attitudes towards teaching and learning through songs for purposes of engagement, and were committed to switching to the latter from their traditional, non-engaging methods.

5.3 Implications of the study

As a practicing chemistry teacher, a potential professional development tutor, and a researcher, the whole action research process was a memorable learning experience.

5.3.1 As a teacher of chemistry

I learned that science content songs, if used properly, support various learning preferences, not only in global contexts but also in the study context, Kenya. By enhancing emotional engagement during lessons and engagement with content outside the classroom, science content songs improve learning outcomes and learner attitudes towards chemistry. In addition, singing together and composing songs together promotes 21st-century competencies like collaboration and creativity. As a chemistry teacher who is interested in the learners' holistic development, these benefits were so significant. By working with the collaborating teachers in their teaching station, I developed a sense of collaboration and collegial practice towards improving teaching practices through devising learner-centered strategies aimed at handling challenging chemistry areas.

5.3.2 As a professional development tutor (PDT)

Having successfully conducted this study, the need to offer professional development to teachers, to improve the teacher pedagogical skills they obtained from their various institutions of teacher education was seen. Through reflection, I saw several teachers becoming irrelevant in the future, should they insist on using the traditional teaching methods to handle 21st century learners. As a potential PDT therefore, it is my sincere desire to improve the pedagogical practices of teachers from

teacher-centred pedagogies to learner-centered pedagogies like the use of songs, through the provision of teacher professional development.

5.3.3 As a researcher

This action research study gave me a rare opportunity to experience and seek urgent solutions to some of the difficulties teachers and learners face in teaching and learning particular areas in chemistry. Through this, I managed to learn ways of improving how I deliver my chemistry lessons, with the interest of the learner in mind. As a researcher, I also learned that how to tackle various challenges that researchers face in the field like conducting data collection within a short period and working within strict timelines.

5.4 Recommendations

Following the findings from the study, schools, through their principals and heads of the science department are urged to use science content songs as a method of engaging their science students during science lessons and transforming their attitudes towards science subjects like chemistry. With such policies, the study believes that the performance in science subjects nationally can change.

Though the study was conducted in a double-streamed mixed public school, the findings can inform similar studies in similar contexts or other contexts. Therefore, it is recommended that future studies be conducted in single-gender boarding schools or mixed day schools to asses if similar findings can be obtained in such contexts. Future studies should focus on the impact of songs on chemistry areas involving experiments since mnemonics can enhance mastery of concepts like solubility of salts and qualitative analysis.

5.5 Conclusion

The study purposely aimed at improving teaching and learning theoretical chemistry concepts like ionic bonding through the use of songs. The finding of the study showed that even though learners have experienced significant generational changes, chemistry teachers still rely on ancient teaching methods to engage their learners and to spark their interest in chemistry, a practice that has overseen poor results in chemistry consistently.

The intervention stage, which was conducted through the use of songs, revealed that songs can actually engage learners in a chemistry lesson, spark their interest in chemistry, restore their attitudes towards chemistry, and eventually

improve their performance due to high content recall and retention abilities of songs. As per the findings, songs can restore learners' interest by making learners compose chemistry content songs with interesting lyrical lines. Even though the use of songs had benefits, results showed that some challenges including reduced classroom control, undesirable vocabulary, and diverse learner preferences for songs are associated with the practice.

The study recommended that schools should devise mechanisms driven towards changing chemistry teaching pedagogies through the use of songs. Additionally, the government, through KICD, should develop a database of science content songs, from where science teachers can obtain songs for teaching various science areas.

If all science teachers embrace the use of science content songs in their classrooms, then there will be an end to increased negative attitudes towards sciences among learners and the consistently poor results in science-related subjects.

References

Alam, R., & Shakir, M. (2019). Causes of the Passive Attitude in Children at Early Grade Level. *International Journal of Social Sciences and Economic Review*, *1*(1), 16–21. https://doi.org/10.36923/ijsser.v1i1.24

Almutairi, M., School, Jeddah, S., Arabia, & Shukri, N. (2017). Using Songs in Teaching Oral Skills to Young Learners: Teachers' Views and Attitudes. *International Journal of Linguistics*, *8*. https://doi.org/10.5296/ijl.v8i6.10464

Arends, R. (2012). *Learning to teach* (9th ed). McGraw-Hill.

Ary, D., Cheser, L., Sorensen, C., & Walker, D. (2014). *Introduction to research in education* (9th ed). Wadsworth Cengage Learning.

Baills, F., Zhang, Y., Cheng, Y., Bu, Y., & Prieto, P. (2021). Listening to Songs and Singing Benefitted Initial Stages of Second Language Pronunciation but Not Recall of Word Meaning. *Language Learning Research Club, University of Michigan*. https://doi.org/DOI: 10.1111/lang.12442

Bellezza, F., & Reddy, B. (2013). Mnemonic devices and natural memory. *Bulletin of the Psychonomic Society*, *11*, 277–280. https://doi.org/10.3758/BF03336829

Bokiev, D., Bokiev, D., Aralas, D., Ismail, L., & Othman, M. (2018). Utilizing Music and Songs to Promote Student Engagement in ESL Classrooms. *International Journal of Academic Research in Business and Social Sciences*, *8*(12), Pages 314-332. https://doi.org/10.6007/IJARBSS/v8-i12/5015

Bowen, G. A. (2009). Document Analysis as a Qualitative Research Method. *Qualitative Research Journal*, *9*(2), 27–40. https://doi.org/10.3316/QRJ0902027

Cavanagh, M. (2011). Students' experiences of active engagement through cooperative learning activities in lectures: *Active Learning in Higher Education*. https://doi.org/10.1177/1469787410387724

Chege, N. W. (2013). *Innovative Learning Environment and Teaching Methods in TVET Institutions*. http://oasis.col.org/bitstream/handle/11599/1904/2013_Chege_InnovativeMethods.pdf?sequence=1&isAllowed=y

Chepkorir, S., Cheptonui, E. M., & Chemutai, A. (2014). The Relationship between Teacher-Related Factors and Students' Attitudes towards Secondary School Chemistry Subject in Bureti District, Kenya. *Journal of Technology and Science Education*, *4*(4), 228–236.

Cohen, L., Manion, L., & Morrison, K. (2011). *Research methods in education* (7th ed). Routledge.

Cooper, M. M., Williams, L. C., & Underwood, S. M. (2015). Student Understanding of Intermolecular Forces: A Multimodal Study. *Journal of Chemical Education*, *92*(8), 1288–1298. https://doi.org/10.1021/acs.jchemed.5b00169

Coyle, Y., & Gómez, R. (2014). *Using songs to enhance L2 vocabulary acquisition in preschool children—PDF Free Download*. *68*(3). https://doi.org/10.1093/elt/ccu015

Creswell, J., & Guetterman, T. (2018a). *Educational Research: Planning, Conducting, and Evaluating Quantitative and Qualitative Research, 6th Edition*.

Creswell, J., & Guetterman, T. (2018b). *Educational Research: Planning, Conducting, and Evaluating Quantitative and Qualitative Research, 6th Edition*. Pearson.

Creswell, J. W. (2014). *Educational research: Planning, conducting and evaluating quantitative and qualitative research* (9th ed.). Pearson Education, Inc.

Crowther, G. (2006a). Learning to the beat of a different drum: Music as a component of classroom diversity. *Connect, 19*, 11–13.

Crowther, G. (2006b). Learning to the beat of a different drum: Music as a component of classroom diversity. *CONNECT, 19*, 11–13.

Crowther, G. (2012). Using Science Songs to Enhance Learning: An Interdisciplinary Approach. *CBE—Life Sciences Education*, *11*(1), 26–30. https://doi.org/10.1187/cbe.11-08-0068

Denscombe, M. (2017). *The Good Research Guide: For small-scale social research projects* (Sixth edition). Open University Press.

Denzin, N. K., & Lincoln, Y. S. (Eds.). (2018). *The SAGE handbook of qualitative research* (Fifth edition). SAGE.

Dewan, P. (2015). Words Versus Pictures: Leveraging the Research on Visual Communication. *Partnership: The Canadian Journal of Library and Information Practice and Research*, *10*(1), Article 1. https://doi.org/10.21083/partnership.v10i1.3137

Diakou, M. (2013). *Using Songs to Enhance Language Learning and Skills in the Cypriot Primary EFL Classroom*. https://doi.org/10.21954/OU.RO.0000A6E6

Dokulil, A. (2018). *The Pros and Cons of Using Pop Music in English Primary-Level Lessons*. Èeské Budìjovice: University of South Bohemia.(Online),(https://theses. cz ….

Dsewojh. (n.d.). *The Chemical Bonds Song—With closed captions!* Retrieved July 28, 2021, from https://www.youtube.com/watch?v=kscpRNX4AIQ

Eaton, Z. (2020). *Exploring the Impact of Musical Mnemonic Strategies on Student Achievement and Engagement in Inclusive Science Classes*. 64.

Flick, U. (2020). *Introducing research methodology: Thinking your way through your research project* (3rd ed). SAGE Publishing.

Floridou, G. A., Williamson, V. J., & Müllensiefen, D. (2012). Contracting earworms: The roles of personality and musicality. *Proceedings of ICMPC-ESCOM, 12*, 302–310.

Fonseca-Mora, C., Toscano-Fuentes, C., & Wermke, K. (2011). *Melodies that Help: The Relation between Language Aptitude and Musical Intelligence* (SSRN Scholarly Paper ID 1815339). Social Science Research Network. https://papers.ssrn.com/abstract=1815339

Gallagher---Brett, A. (n.d.). *Conducting interviews in action research*. Retrieved June 27, 2021, from https://www.google.com/search?client=ms-google&q=benefits+of+stratified+sampling+method%2Bpdf#gsc.tab=0&gsc.q=https%3A%2F%2Fwww.allresearchjournal.com%2Farchives%2F2017%2Fvol3issue7%2FPartK%2F3-7-69-542.pdf

George, M. (2013). Teaching Focus Group Interviewing: Benefits and Challenges. *Teaching Sociology, 41*(3), 257–270. JSTOR.

Geretsegger, M., Elefant, C., Mössler, K. A., & Gold, C. (2014). Music therapy for people with autism spectrum disorder. *Cochrane Database of Systematic Reviews*. https://doi.org/10.1002/14651858.CD004381.pub3

Govender, S. (2019). Students' Perceptions of Teaching Methods Used at South African Higher Education Institutions. *South African Journal of Higher Education*, *29*(3), 23–41.

Governor, D., Hall, J., & Jackson, D. (2012a). Teaching and Learning Science Through Song: Exploring the experiences of students and teachers. *International Journal of Science Education - INT J SCI EDUC*, *35*, 1–24. https://doi.org/10.1080/09500693.2012.690542

Governor, D., Hall, J., & Jackson, D. (2012b). Teaching and Learning Science Through Song: Exploring the experiences of students and teachers. *International Journal of Science Education - INT J SCI EDUC*, *35*, 1–24. https://doi.org/10.1080/09500693.2012.690542

Graulich, N. (2015). The tip of the iceberg in organic chemistry classes: How do students deal with the invisible? *Chemistry Education Research and Practice*, *16*(1), 9–21. https://doi.org/10.1039/C4RP00165F

Grover, V. (2015). Brain Based Teaching: Rethinking on Teaching Strategies. *Indian Streams Research Journal*, *5*, 1–6.

Hendricks, C. (2009). *Improving schools through action research: A comprehensive guide for educators* (2nd ed.). Pearson.

Hendricks, C. (2017). *Improving schools through action research: A reflective practice approach* (4th ed.). Pearson.

Hershner, J. R. (2018). *Exploring Nontraditional Learner Engagement and Motivation through Music Integration* [Walden University]. https://scholarworks.waldenu.edu/cgi/viewcontent.cgi?article=7156&context=dissertations

Hornstra, L., Mansfield, C., van der Veen, I., Peetsma, T., & Volman, M. (2015). Motivational teacher strategies: The role of beliefs and contextual factors. *Learning Environments Research*, *18*(3), 363–392. https://doi.org/10.1007/s10984-015-9189-y

Izuagba, A. (2015). Effects of the use of lecture method and wordle on the performance of students taught curriculum studies 1:EDU222. Journal of Education and Practice. .6, (18), 142-149. Www.iiste.org. *Journal of Education and Practice.*, *6*, 142–149.

Jazeel, A. M. (2016). *Brain based learning strategy: A new paradigm in learning teaching process*. National Conference on Dissemination of Research Findings.

Jurowski, K., Jurowska, A., & Krzeczkowska, M. (2015). *Comprehensive review of mnemonic devices and their applications: State of the art*. 6.

Kaddoura, M. A. (2011). Critical Thinking Skills of Nursing Students in Lecture-Based Teaching and Case-Based Learning. *International Journal for the Scholarship of Teaching and Learning*, *5*(2). https://doi.org/10.20429/ijsotl.2011.050220

Kerkhoff, S., & Makubuya, T. (2021). *Professional Development on Digital Literacy and Transformative Teaching in a Low-Income Country: A Case Study of Rural Kenya*. https://doi.org/DOI: 10.1002/rrq.392

Kirschner, S., & Tomasello, M. (2010). Joint music making promotes prosocial behavior in 4-year-old children. *Evolution and Human Behavior*, *31*(5), 354–364. https://doi.org/10.1016/j.evolhumbehav.2010.04.004

Kisanga, J. (2015). *Teachers' Use of Songs for Enhancement of Literacy Among Lower Primary School Pupils in Tanzania*.

Koelsch, S. (2014). Brain correlates of music-evoked emotions. *Nature Reviews Neuroscience*, *15*(3), 170–180.

Koffka, K. (1935). *Principles of Gestalt psychology*. lund Humphries. http://gestalttheory.net/cms/uploads/pdf/archive/1934_1960/Principles_Gestalt_Psychology_koffka.pdf

Kotob, M., & Bazzoun, A. (2019). The effect of using science songs on students' achievement. *International Journal of Multidisciplinary Educational Research*, *4*(2), 1–21.

Krzeczkowska, M., Jurowska, A., Jurowski, K., & Własiuk, P. (2014). *Preliminary studies about knowledge and applications of mnemonic methods by polish pupils, students and teachers* (pp. 28–36). https://uatacz.up.krakow.pl/~wwwchemia/pliki/ISBN%20978-83-7271-880-8%20Teaching%20and%20Learning%20Science%20at%20all%20levels%20of%20education.pdf#page=29

Lewin, K. (1946). Action Research and Minority Problems. *Journal of Social Issues*, *2*(4), 34–46. https://doi.org/10.1111/j.1540-4560.1946.tb02295.x

Ludke, K. (2009). *Teaching foreign languages through songs*.

Ly, L. N., & Quynh, N. T. T. (2020). Using English Songs in Teaching Biology 10 to Develop Student´s Foreign Language Competence. *VNU Journal of Science: Education Research*, *36*(4), Article 4. https://doi.org/10.25073/2588-1159/vnuer.4472

Lydiah Nganga, & Kambutu, J. (2017). Preparing Teachers for a Globalized Era: An Examination of Teaching Practices in Kenya. *Journal of Education and Practice*, *8*(6). https://files.eric.ed.gov/fulltext/EJ1133010.pdf

Marczyk, G. R., DeMatteo, D., & Festinger, D. (2005). *Essentials of research design and methodology*. John Wiley & Sons.

Maschi, T., MacMillan, T., & Viola, D. (2013). Group drumming and well-being: A promising self-care strategy for social workers. *Arts & Health*, *5*(2), 142–151. https://doi.org/10.1080/17533015.2012.748081

McAteer, M. (2013). *Action Research in Education* (1st ed.). SAGE Publications. https://doi.org/10.4135/9781473913967

McNiff, J., & Whitehead, J. (2006). *All you need to know about action research*. Sage Publications.

Mertler, C. A. (2017). *Action Research: Improving Schools and Empowering Educators* (5th ed.). SAGE Publications.

Millington, N. T. (2011). Using songs effectively to teach English to young learners. *Language Education in Asia*, *2*(1), 134–141.

Mills, G. E. (2011). *Action research: A guide for the teacher researcher* (4th ed). Pearson.

Moeller, A. J. (2021). *The Interplay of Emotion, Cognition, and Learning in the Language Classroom Classroom*. University of Nebraska - Lincoln.

Moll, R., & Nielsen, W. (2017). Development and validation of a social media and science learning survey. *International Journal of Science Education, Part B*, *7*(1), 14–30. https://doi.org/10.1080/21548455.2016.1161255

Murphey, T., & Maley, A. (1992). *Music and Song*. Oxford University Press.

Nikkhah, Z., Izadpanah, S., & Bijani, H. (2019). The Impact of Musical Mnemonic on Vocabulary Recalling of Iranian Young Learners. *International Journal of Instruction*, *12*, 977–994. https://doi.org/10.29333/iji.2019.12163a

Njoroge, M. C., & Gathigia, M. G. (2018). *Application of Songs in the Teaching of Swahili Grammar*. 1.

Nugroho, A. (2014). *Improving the Listening Skills of the Eighth Grade Students of SMP Negeri 2 Kalasan Yogyakarta Through Missing Lyric Songs in the Academic Year of 2013/2014*. 84.

Nurvia, S. (2016). *Using Song in Teaching English Speaking Skills for Young Learners (a Qualitative Research at One of Madrasah Ibtidaiyah in Kota Cirebon)* [PhD Thesis]. IAIN Syekh Nurjati Cirebon.

Nyagah, G., & Irungu, N. M. (2013). *Determinants of Academic Performance in Kenya Certificate of Secondary Education in Public Secondary Schools in Kiambu County, Kenya*. http://erepository.uonbi.ac.ke/handle/11295/81725

Ogembo, J., Otanga, H., Rehema, & Yaki, N. (2015a). Students' and Teachers' Attitude and Performance in Chemistry in Secondary Schools in Kwale County, Kenya. *Global Journal of Interdisciplinary Social Sciences, 4*, 39–43.

Ogembo, J., Otanga, H., Rehema, & Yaki, N. (2015b). Students' and Teachers' Attitude and Performance in Chemistry in Secondary Schools in Kwale County, Kenya. *Global Journal of Interdisciplinary Social Sciences, 4*, 39–43.

Ogidi, C., & Ojukwu, E. V. (2020). Entertainment-Education Through Folk Songs as Vital Tool in Teaching and Learning Process. *Journal of African Studies and Sustainable Development, 3*(1), Article 1. https://acjol.org/index.php/jassd/article/view/jassd_v3n1_5

Prensky, M. R. (2012). *From Digital Natives to Digital Wisdom: Hopeful Essays for 21st Century Learning*. Corwin Press.

Rabinowitch, T.-C., & Meltzoff, A. N. (2017). Joint Rhythmic Movement Increases 4-Year-Old Children's Prosocial Sharing and Fairness Toward Peers. *Frontiers in Psychology, 8*, 1050. https://doi.org/10.3389/fpsyg.2017.01050

Rambli, D. R. A., Matcha, W., & Sulaiman, S. (2013). Fun Learning with AR Alphabet Book for Preschool Children. *Procedia Computer Science*, *25*, 211–219. https://doi.org/10.1016/j.procs.2013.11.026

Rogoff, B., & Chavajay, P. (1995). What's Become of Research on the Cultural Basis of Cognitive Development? *American Psychologist*, *50*(10).

Schunk, D. H. (2014). *Learning theories: An educational perspective*. Pearson.

Sharma, G. (2017). Pros and cons of different sampling techniques. *International Journal of Applied Research*, *3*(7), 749–752.

Sithole, A., Chiyaka, E. T., McCarthy, P., Mupinga, D. M., Bucklein, B. K., & Kibirige, J. (2017). Student Attraction, Persistence and Retention in STEM Programs: Successes and Continuing Challenges. *Higher Education Studies*, *7*(1), 46. https://doi.org/10.5539/hes.v7n1p46

Skinner, B. F. (2014). *Science and human behaviour*. Pearson Education, Inc. http://www.bfskinner.org/newtestsite/wp-content/uploads/2014/02/ScienceHumanBehavior.pdf

Skinner, B. F. (2016). *The Technology of Teaching*. B. F. Skinner Foundation.

Somji, R. (2018). *Teaching Strategies for the 8 Different Learning Styles* [Educational]. Virtual Speech. https://virtualspeech.com/blog/teaching-strategies-different-learning-styles

Stephens, S. S. (2013). *Enhancing second language acquisition and recall with music and prosody*. https://scholarworks.calstate.edu/downloads/s7526d01v?locale=en

Structure and Bonding Song—YouTube. (n.d.). Hands on Chemistry. Retrieved July 28, 2021, from https://www.youtube.com/watch?v=M0qOI_2WnGE

Stutchbury, K., & Fox, A. (2009). Ethics in educational research: Introducing a methodological tool for effective ethical analysis. *Cambridge Journal of Education*, *39*. https://doi.org/10.1080/03057640903354396

Taat, M., Abdulbaki, K., & Al-Saqqaf, A. (2020). The Impact of Lecture and Interactive Methods on Student's English Competency. *International Journal of Emerging Technologies in Learning (IJET)*, *15*(20), 255–267.

Taetle, L., & Cutietta, R. (2002). Learning theories as roots of current musical practice and research. *The New Handbook of Research on Music Teaching and Learning*, 279–298.

Too, F. (2019). 2019 KCSE Chemistry (233) KNEC Report. *Teacher.Co.Ke*. https://teacher.co.ke/2019-kcse-chemistry-233-knec-report/

Toppel, K. (2015). Enhancing Core Reading Programs With Culturally Responsive Practices. *The Reading Teacher*, *68*(7), 552–559. https://doi.org/10.1002/trtr.1348

Ullah, A., & Anwar, S. (2020). The Effective Use of Information Technology and Interactive Activities to Improve Learner Engagement. *Education Sciences*, *10*(349), 349. https://doi.org/10.3390/educsci10120349

Vladusic, R., Bucat, B., & Ozic, M. (2016). Understanding ionic bonding—A scan across the Croatian education system. *Chem. Educ. Res. Pract.*, *17*. https://doi.org/10.1039/C6RP00040A

Vygotsky, L. S. (1978). *Mind in Society: The Development of Higher Psychological Processes*. Harvard University Press.

Vygotsky, L. S. (1981). *The Instrumental Method in Psychology*. Armonk.

Wandera, D. B. (2013). What to do when Teens say" Amka Ukatike": An Exploration of Agency in Teen Oral Literacy Performed Through Kenyan Hip Hop. *African Journal of Teacher Education*, *3*(1).

Wangari, F. (2011). *Barriers to the Implemementation of General Science Curriculum in Secondary Schools in Kangundo District*. 111.

Wertsch, J. (1992). *Voices of the Mind: A Sociocultural Approach to Mediated Action*. *105*(3). https://www.jstor.org/stable/pdf/1423207.pdf?refreqid=excelsior%3Ab5c1ebe4c5b7bc17811d2ae5e320ff80

Whitehead, J., & McNiff, J. (2006). *Action Research Living Theory*. SAGE Publications. https://mthoyibi.files.wordpress.com/2011/04/action-research_living-theory_jack-whitehead-and-jean-mciff-2006.pdf

Windschitl, M., Thompson, J., Braaten, M., & Stroupe, D. (2012). Proposing a core set of instructional practices and tools for teachers of science. *Science Education*, *96*(5), 878–903. https://doi.org/10.1002/sce.21027

Yadav, A., Shaver, G., & Meckle, P. (2013). *Lessons Learned: Implementing the Case Teaching Method in a Mechanical Engineering Course*. *99*(1). https://login.research4life.org/tacsgr1onlinelibrary_wiley_com/doi/epdf/10.1002/j.2168-9830.2010.tb01042.x

Yee Pinn Tsin, I. (2015). Composing Songs for Teaching Science to College Students. *Universal Journal of Educational Research*, *3*(10), 724–726.

Yoon, J. (2017). Science Song Project: Integration of Science, Technology and Music to Learn Science and Process Skills. *K-12 STEM Education*, *3*, 235–250. https://doi.org/10.14456/k12stemed.2017.9

Zulirfan, Z., Iksan, Z. H., Osman, K., & Mohd Salehudin, S. N. (2018). Take-Home-Experiment: Enhancing Students' Scientific Attitude. *Journal of Baltic Science Education, 17*(5), 828–837. https://doi.org/10.33225/jbse/18.17.828

Appendices

Appendix A: Lesson observation protocol

Name of participant (Pseudonym) _____ Class: _____

Number of students: _____

Lesson Topic: _____ Lesson sub-topic: _____

Date: _____ Time: _____

Aspect	**Observation criteria**	**Remarks**
Teacher preparedness for the lesson	Lesson plan availability	
	Lesson objectives stated and they are SMART	
	Lesson activities well planned prior to the lesson	
	Availability of Teaching and learning resources	
Lesson presentation	Strategies used to engage the learner.	
	Learner activities that enhance their participation	
	Teaching resources used and their ability to engage learners	
	Do the teaching/ learning strategies used spark learner interest	
Lesson evaluation	Do the learners respond appropriately to the formative questions asked after the lesson?	

Appendix B: Document analysis protocol

THE AGA KHAN UNIVERSITY

Institute for Educational Development, East Africa

Document	**Document source**	**Document purpose**	**Instructional strategies on ionic bonds**	**Evidence of reflective practice on remarks column**
K.I.E chemistry syllabus				
Secondary chemistry book two				
Schemes of work				
Lesson plan				

Appendix C: Entrance interview guide

THE AGA KHAN UNIVERSITY

Institute for Educational Development, East Africa

Date: _____

Institution: Secondary school

Interviewee: Collaborating Teacher

Preamble

Today, I am here to have a talk with you since I am conducting a study aimed at teaching and learning the sub-topic "ionic bonds," under the topic "structure and bonding." I would therefore request to interview you for 30 minutes. The interview aims at acquiring information the current pedagogies in ionic bonds and how they engage the learners.

Kindly note that our conversation will be recorded, transcribed and used to fulfil my dissertation requirements. If you have accepted to take part in this interview, then please sign below;

Participant's Name…….

Sign…….

Should you feel uncomfortable with the interview, you are free to request for termination.

I would kindly request you to share with me information regarding your profession as a teacher.

Section A: Teaching experience

1. Briefly Share with me your experience in the teaching profession. [Probe he/she on the experience as a secondary school teacher]

2. What is your experience in teaching of chemistry as a subject? Why? [Probe for the experiences encountered in teaching of ionic bonds, and other theoretical chemistry areas]

3. Have you attended any professional training in chemistry? [Probe for level of qualification]

Teachers' pedagogical skills in Ionic bonds

1. Briefly Share with me the teaching methods you prefer to use while teaching ionic bonding [Probe for reasons for use of the methods given]

2. Which strategies do you use teach very theoretical concepts of ionic bonding? [I mean those areas of ionic bonding that do not require laboratory experiments? Probe for the resources used alongside the strategies]

3. In a very honest opinion, do the strategies and resources named engage the learners fully while learning ionic bonding?
    a) If yes, how to they engage the learners? What are the indicators of learner engagement?
    b) If no, what strategies can help engage the learners
4. What challenges do you experience with the strategies you are currently using to handle ionic bonding?
5. How do you perceive the use of songs as one of the strategies in teaching theoretical concepts like ionic bonding?

Thank you for your time and active participation in this study

Appendix D: Exit interview guide

THE AGA KHAN UNIVERSITY

Institute for Educational Development, East Africa

Interviewee: collaborating teacher

Preamble

Having participated in a lesson instructed through songs as teaching resources, I would request to ask you some questions concerning teaching ionic bonds and other general concepts of chemistry through songs. Our discussion will be recorded and everything we discuss here will be treated with top-notch confidentiality. Please feel free to speak your thoughts. Should you feel uncomfortable with the interview, do not hesitate to request for a termination.

Kindly note that our conversation will be recorded, transcribed and used to fulfil my dissertation requirements. If you have accepted to take part in this interview, then please sign below;

Participant's Name…….

Sign…….

Should you feel uncomfortable with the interview, you are free to request for termination.

I would kindly request you to share with me information regarding your profession as a teacher.

Questions

1. Having taken part in teaching through songs, what differences do you see between teaching using songs and teaching through other instructional strategies like lecture, demonstration, e.t.c ?

[***Probe the teacher to share what he/she liked about the lesson and what he/she disliked***]

2. I know you would have taught using songs differently. Kindly Share with me what you would have done differently if you were to use songs as teaching resources.

   [***Probe the teacher to give reasons for what he/she would have done differently***]

3. During your observation of our lesson using songs, did you notice remarkable things about the lesson?

   [***Probe for reasons why the teacher feels that remarkable thing occurred***]

4. In your sincere opinion what do you think of the learners' reactions to the use of songs in teaching ionic bonds?

   [***Probe for further explanation on the opinion whether the impact was positive or negative***]

5. What would you say about songs capability of improving learner engagement while teaching ionic bonds?

[***Probe for more explanations on whether songs can improve engagement during the lesson and with the concepts being taught***]

6. Having gone through the intervention, how do you perceive the use of songs in teaching and learning chemistry concepts like ionic bonds?
   [***probe the teachers to share his or her perceptions concerning use of songs and whether the strategy should be implemented or not***]
7. What challenges are you likely to face while using songs in your classroom regularly?

[***Probe for more explanations on the challenges the teacher might face if he opts to use songs in teaching***]

Thank you for your time

Appendix E: Focus group discussion protocol

THE AGA KHAN UNIVERSITY

Institute for Educational Development, East Africa

Preamble

In our class we have learnt how songs can help us to understand the concept of ionic bonding. I am happy to discuss with you at this time, the benefits of using songs in teaching and learning chemistry, with focus on ionic bonds. I would request all of us to contribute freely during this discussion, remembering that the information from the discussion will not be shared to any other person apart from being used for purpose of this study. The information you share will be handled the confidentiality it deserves and all of you will be treated as anonymous. None of you will be harmed and should any of you feel uncomfortable with the discussion, you have the right to quit.

This discussion should last approximately 40 minutes and each of us has been granted the opportunity to freely share their opinion.

Questions

1. Kindly Share with me what you enjoyed during the learning session when songs were used in teaching and learning ionic bonds [**Each of the students should be given a chance to say what they enjoyed and reasons should be probed**]
2. Is there anything that you disliked about using songs in learning of ionic bonds? [**Each student to be granted a chance to say what they disliked during the lesson and explanations to be probed**]
3. Kindly Share with me what you think about learning chemistry through songs in comparison to learning chemistry minus songs. [**each student to give opinion freely but reasons should be probed for and against**]

4. What do you feel about learning chemistry frequently through songs? [**Each student to give their feeling concerning the potential of songs to change their attitude and performance**]
5. Kindly share with me the difficulties you experienced while learning chemistry through songs [**each learner will be given the opportunity to share difficulties experience]**
6. Having learnt through songs, what are some of the challenges you are likely to experience if taught consistently through songs?

Thank you so much for your time and participation

Appendix F: Head of Institution's Information Sheet

THE AGA KHAN UNIVERSITY

Institute for Educational Development, East Africa

Study Title: Use Of Songs In Teaching And Learning Ionic Bonds: A Case Of A Secondary School In Vihiga County, Kenya

Name of Researcher: Omollo Daniel Odhiambo

Sponsor Institution: Aga Khan University, Institute for Educational Development, East Africa

Purpose of the Study: To make teaching and learning non-practical chemistry contents more interesting through the use of content songs as a pedagogical strategy

Nature of the Study:

The study will be a participatory Action Research lasting about 4 weeks. The participants will be me, two form two teachers of chemistry and a form two stream. From the form two stream, five students will be randomly selected to participate in a focus group discussion. Working with the participating teachers, we will collaboratively teach the selected stream during the study.

Additionally, I will analyse Schemes of work, reference books used, chemistry syllabus and the collaborating teachers' lesson plans.

I will collect information from the participants through interviews, which will be recorded using audio recorders. Data obtained from the study will be used strictly for the purpose of the study and will be treated with utmost confidentiality. Participating in the study will be purely voluntary.

Reciprocity:

I will share the findings with chemistry teachers and the school management. Additionally, I will teach some classes during study period.

Sign of the Researcher…….....
Date…….

Appendix G: Consent form to be signed by the principal on behalf of parents to participating students

THE AGA KHAN UNIVERSITY

Institute for Educational Development, East Africa

I, Omollo Daniel Odhiambo, is conducting a research study entitled use of songs in teaching and learning ionic as my dissertation project in a master of education course at the Aga Khan University.

I would kindly request to work with your child as a participant in the study. The study will not interfere with your child's activity in school. During the study, your child will participate in learning during normal classroom hours. Your child will also take part in a focus group discussion, which will be recorded using an audio recorder.

It is my assurance that the study will not cause any harm to your child and that your child's identity will be protected. In addition, the data obtained will be strictly confidential and will only be used for the purpose of the study.

Researcher's signature…… Date…….

Principal's signature on Behalf of Parents……Date……

Appendix H: Principal's informed consent form

THE AGA KHAN UNIVERSITY

Institute for Educational Development, East Africa

I, Omollo Daniel Odhiambo, is conducting a research study entitled use of songs in teaching and learning ionic as my dissertation project in a master of education course at the Aga Khan University.

The information sheet with a brief description of the study has been attached. I am kindly requesting to conduct the four-week study in your institution. Data collection for the study will include;

- Audio Recording interviews with the participants
- Lesson observation
- Analysis of documents like syllabus, schemes of work, course books and lesson plans
- Focus group discussion with five students

Kindly Note that the data obtained will be used strictly for the purpose of the research. The data collected will be treated with utmost confidentiality and the participants' identity will be maintained.

Be assured that none of your students or teachers will be harmed or inconvenienced in any way during the study.

Should you agree to let the study be conducted in your institution, Kindly sign the consent form below.

Thank you.

Researcher's Signature……. Date: ……

CONSENT FORM

☐ I accept that this study be conducted in my institution.

Principal's signature: ……. Date: ……...

In case of any breech of ethics, kindly inform the Chairperson of Aga Khan University Ethical review committee though the contact information below.

Dr. Fortidas Bakuza,

P.O Box 125 Dar es Salaam.

Tel: +255 22215229 / 2150051

E-mail: Fortidas.bakuza@aku.edu

Appendix I: Participants' FGD assent form

THE AGA KHAN UNIVERSITY

Institute for Educational Development, East Africa

I have read the information sheet for participants and deeply comprehended its contents. Additionally, the objectives of this study have been explained to me by Daniel Omollo, a masters of education student at Aga Khan University. Therefore, I accept to participate in this study since the information that I will give will be confidential and will strictly be used only for the purpose of the research. It has also been made clear to me that I have the right to withdraw from the discussion in case I feel uncomfortable or sense that I am likely to get harmed during the study.

(Please tick the check boxes below if you agree to take part in this study)

☐ I agree to participate in this study

☐ I agree to participate in Audio Recorded Focus group discussions

Class teacher's Signature on behalf of students ……
Date……

Appendix J: Informed Consent Form for the Collaborating Teachers

THE AGA KHAN UNIVERSITY

Institute for Educational Development, East Africa

I, Omollo Daniel Odhiambo, is conducting a research study entitled use of songs in teaching and learning ionic as my dissertation project in a master of education course at the Aga Khan University.

The information sheet with a brief description of the study has been attached. I am kindly requesting to work in collaboration with you in this study that will last four weeks. Data collection for the study will include;

- Audio Recording interviews with you
- Lesson observation
- Analysis of documents like syllabus, schemes of work, course books and lesson plans

Kindly Note that the data obtained will be used strictly for the purpose of the research. The data collected will be treated with utmost confidentiality and the participants' identity will be maintained.

Be assured that you will not be harmed or inconvenienced in any way during the study.

Should you agree, Kindly sign the consent form below.

Thank you.

Researcher's Signature……. Date: ……

CONSENT FORM

Please tick the check boxes below if you agree to take part in this study

- ☐ I agree to participate in this study as a collaborating teacher.
- ☐ I agree to participate in Audio Recorded interviews.
- ☐ I agree to take part in a Lesson observation
- ☐ I agree to submit the syllabus, schemes of work, course books and lesson plans for analysis

Signature of participant: ……. Date: ……...

In case of any breech of ethics, kindly inform the Chairperson of Aga Khan University Ethical review committee though the contact information below.

Dr. Fortidas Bakuza,

P.O Box 125 Dar es Salaam.
Tel: +255 22215229 / 2150051
E-mail: Fortidas.bakuza@aku.edu

Appendix K: AKU ethical clearance certificate

THE AGA KHAN UNIVERSITY

Ref.: *AKU-IED, EA/2021/168/fB* **Date:** *August 16th, 2021*

Omollo Daniel Odhiambo,
Aga Khan University,
Institute for Educational Development East Africa (IED EA),
P.O Box 125,
Dar es Salaam,
Tanzania.

ETHICAL CLEARANCE CERTIFICATE

Dear Omollo Daniel Odhiambo,

This is to certify that your research project entitled ***"Use of Songs in Teaching and Learning Ionic Bonds: A Case of a Secondary School in Vihiga County, Kenya"*** undertaken as part of the dissertation project in the master of education program at IED EA has been approved for Ethical Clearance.

Yours Sincerely,

Dr. Fortidas Bakuza
Chair ERC - Tanzania

Cc: Dissertation Supervisor: Dr. Winston Massam

Salama House, 344 Urambo Street, P.O. Box 125, Dar es Salaam,
Tanzania Tel: +255 22 215 2293, 22 215 0051, Fax: +255 22 215
0875; Email: iedea@aku.edu www.aku.edu

Appendix L: NACOSTI research licence

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **335565**

Date of Issue: **23/August/2021**

RESEARCH LICENSE

This is to Certify that Mr.. DANIEL odhiambo OMOLLO of Aga Khan University, has been licensed to conduct research in Vihiga on the topic: Use of Songs in Teaching and Learning Ionic Bonds: A Case of a Secondary School in Vihiga County, Kenya for the period ending : 23/August/2022.

License No: **NACOSTI/P/21/12545**

335565

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

NOTE: This is a computer generated License. To verify the authenticity of this document, Scan the QR Code using QR scanner application.

Appendix M: County director of education authorization

MINISTRY OF EDUCATION
STATE DEPARTMENT OF EDUCATION

Telegrams: .....
Telephone: (056) 51450
When replying please quote

COUNTY EDUCATION OFFICE,
VIHIGA COUNTY,
P.O. BOX 640,
MARAGOLI.

REF: CDE/VC/ADM/VOL.2/100/60

25TH August, 2021

TO WHOM IT MAY CONCERN

RE: AUTHORITY TO CONDUCT RESEARCH
Mr. DANIEL ODHIAMBO OMOLLO

Reference is made to your letter **Ref No. NACOSTI/P/21/12545** dated 23RD August, 2021.

Permission is hereby granted to the above named student from Agakhan University to conduct research on **"Use of songs in teaching and learning Ionic Bonds a case of a Secondary School in Vihiga County ,Kenya"** to enable him write a project as required by his Institution.

Kindly note, in order for the office to be informed a copy of the same be shared with the County Education office for intervention purposes upon completion of the research.

THE COUNTY DIRECTOR OF EDUCATION
25 AUG 2021
P. O. Box ... MARAGOLI

Hellen Nyang'au (Mrs)
County Director of Education
VIHIGA COUNTY

Cc
County Commissioner
VIHIGA

Appendix N: County commissioner authorization

REPUBLIC OF KENYA

THE PRESIDENCY

MINISTRY OF INTERIOR AND COORDINATION OF NATIONAL GOVERNMENT

Email: vihigacc1992@gmail.com
Telephone: vihiga 0202574852
When replying please quote

COUNTY COMMISSIONER
VIHIGA COUNTY
P.O. BOX 75-50300
MARAGOLI.

VC/ED.12/1 VOL. III (162)

25th August, 2021

All Deputy County Commissioners,
VIHIGA COUNTY.

RE: RESEARCH AUTHORIZATION: MR. DANIEL ODHIAMBO OMOLLO

This is to introduce to you Mr. Daniel Odhiambo Omollo of Agha Khan University to conduct research on the topic ***"Use of Songs in Teaching and Learning Ionic Bonds"*** in Vihiga County to enable him write a project as required by his institution for a period ending ***23rd August, 2022.***

Kindly accord him the necessary assistance.

COUNTY COMMISSIONER
25 AUG 2021
SIGN. EDWIN
P.O Box 75-50300, MARAGOLI

pp **FLORENCE SITAWA**
FOR: COUNTY COMMISSIONER
VIHIGA COUNTY

Cc. Mr. Daniel Odhiambo Omollo