Investigating the effect of role play on Grade 10 learners' conception about the human circulatory system, at a selected township school in the Western Cape

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Declaration

I declare that *"Investigating the effect of role play on Grade 10 learners' conception about the human circulatory system, at a selected township school in the Western Cape"*,

is my own work, and that it has not been submitted for any degree or examination in any other university. All the sources I have used and quoted have been indicated and acknowledged by complete references

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DATE: November 2021……..

SIGNED: *Edith Mlauzi* ……..

Acknowledgment

Firstly, I dedicate this thesis to my lovely children, Oprah, Otrah and Oratile who gave me all the support and love throughout my study, and also to my husband who made it possible for me to undertake this study. Thank you for all the support you gave me.

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Abstract:

Role-play is a teaching strategy which is very useful in enhancing the acquisition of knowledge and conceptualisation of some topics in Life Science. According to the theory of constructivism, learning science is a process in which learners construct understanding of the materials. Role-play and constructivism are intertwined, yet role-play as a teaching strategy lacks classroom application in the teaching of Life Sciences. Role-play is not often used in the teaching of Life Sciences, and to be specific, in the teaching of the circulatory system.

The study is motivated by learners' misconceptions of the circulatory system. The study is undertaken to determine the effect of role play on the learners' conception about the human circulatory system. Random sampling resulted in the selection of one out of 6 grade 10 classes with 49 learners in each from one school in the Metro East District in Cape Town. The research design was a quasi-experimental design. Qualitative and quantitative methods were used in this mixed-methods research approach. In line with the qualitative method, the researcher made use of open-ended questions, and a questionnaire and semi-structured interviews. Constuctivism was used as a theoretical framework to analyse the results. A description of the role-play activities were outlined, some examples were given and this was followed by some discussion.

The results showed that through discussion some learners became more confident and showed improvement in their communication skills during small group discussions. The findings obtained from this study, showed that role-play was more effective in the teaching of the human circulatory system.

Keywords**: role-play, constructivism, heart, vein, artery, valve, deoxygenated blood, conception, circulatory sytem**

1 CHAPTER 1: RATIONALE OF THE STUDY

1.1 Introduction to study

This chapter contains the introduction to the research study on the effect of role-play in the teaching of the human circulatory system as found in the South African national Life Sciences syllabus. It also provides a background and rationale for the study. It highlights the context in which the study is conducted, it describes the research problem, research question, significance, and limitations of the study.

Researchers indicate that science is considered an abstract and challenging subject to learn by learners (Nieswandt, 2001; Chittleborough, Treagust & Mocerino, 2002). The researcher experienced many challenges in finding a practical, and comprehensive method for teaching the human circulatory system. Use of models and computer simulations are some of the teaching methods that the researcher used but with no success. Having a strong foundation for life sciences from a lower level can positively impact learners. In most cases, learners come to grade 10, holding some misconceptions regarding the circulatory system. For example, most learners had difficulty understanding the functioning of the heart. Most of the learners' confusion was due to failing to differentiate between pulmonary and systemic circulation. Theoretically, learners could not understand how the blood can pass twice through the heart. They had an assumption that blood originated from the heart where it is made. This incorrect conception might have emanated from learners' beliefs, which was worsened by the use of ineffective teaching methods.

From past experience in the teaching of the circulatory system, the researcher noticed that most learners were challenged when it came to understanding the movement of blood around the heart. Even after trying to explain multiple times, it seemed difficult for them to conceptualise. Also, some learners came to grade 10 with the perception that the human circulatory system topic is difficult for them, and they always confused the left side parts of the heart with the right side. Students also have several misconceptions about the heart's shape and function (Fokides & Mastrokouko, 2018).

During class discussion, some grade 10 learners would switch back confusing the left and right sides. Learners held the misconception that the veins are the only blood vessels that carry blood

in the circulatory system. Hence, this indicated that maybe the circulatory concept was ineffectively taught at grade 9 level.

The circulatory system is a core concept in the biology curriculum and is judged to be a complex topic to learn (Alkhawaldeh, 2012). My motivation to carry out this study emanated from my observations and experience of misconceptions and difficulties experienced by grade 10 learners relating to the human circulatory system.

Role-playing is a teaching strategy that may be very useful in enhancing knowledge and understanding of some topics in the Life Sciences. This view is supported by Blatner (2000), who acknowledged role-play as a strategy that seeks to capture the interest of learners, thereby involving them in understanding concepts in a way that develops communication and team spirit. In role-play, learners are assigned roles that allow them to act and they are encourage to share experiences of the content under study (Altun, 2015). Aliakbari and Jamalvandi (2010) indicated the benefits of the role-play teaching strategy. Among the benefits are the introduction of variety in the classroom and opportunities for understanding terminology.

According to the theory of constructivism, learning science is a process in which learners construct an understanding of the materials in relation to how best it can actively be taught. The application of constructivism enables the educator to consider what learners already know and allows knowledge to be put into practice (Mvududu & Thiel-Burgess, 2012). Therefore, teaching through role-play supports constructivism as learners act and share to enable them to construct an understanding of the subject matter.

The teaching and learning of life sciences, more especially the human circulatory system, is proving to be a significant challenge as learners seem to hold different perceptions, and pre-conceived ideas (Ozgur, 2013; Alkhawaldeh, 2012). The challenges associated with the teaching of the human circulatory system has drawn the attention of researchers for the past years, (Lokayut and Srisawasdi, 2014), since it is a topic loaded with a lot of content. According to the DoE (2011), in the Curriculum and Assessment Policy Statement (CAPS) document, learners are briefly introduced to the circulatory system topic in Grade 9. The circulatory system is a concept in which learners come to class with preconceived ideas about the subject. Therefore, it calls for an effective teaching strategy, which fosters greater understanding.

According to the above outline of role-play and constructivism, the current study focuses on role-play in the effective teaching of the human circulatory system. Recently researchers have

focused on the human circulatory system basing on the challenges faced in effective teaching of the content (Ozgur, 2013; Kurt, Ekici, Aksu & Aktas, 2013), with little or no attention paid to the effective teaching of the human circulatory system topic through the role-play strategy. Therefore, the study focuses on role-playing as a teaching strategy in the effective teaching of the human circulatory system compared to the traditional chalk-and-talk method.

1.2 Background to the study

South Africa is a multicultural country consisting of people with various belief systems. These cultural beliefs are brought into the classroom by learners. The cultural background has a more significant effect on learning than does the subject content (Okebukola, 1985). This implies that learners' cultural beliefs of a particular concept might negatively influence the correct conceptualisation of the scientific explanation of the concept (Okebukola, 1985, Ozgur, 2013). In support of this, Michael (1998) pointed out that a student's prior ideas can be an obstacle to learning when those ideas conflict with the science content taught in class. This may create misunderstandings in learners about a certain idea. Teachers are encouraged to implement ways that promote conceptual understanding in learners to encourage meaningful science learning.

Therefore, conceptual understanding can be achieved by using various teaching strategies. The constructivist learning view supports the use of different teaching methods, to ensure learners become active participants. This will in turn help to eradicate the existence of misconceptions. Various researchers pointed out the significance of the conceptual change approach in overcoming learners' misconceptions of scientific ideas (Okebukola, 1985; Michael, 1998 & Ozgur, 2013).

The National Curriculum Statement (NCS), Grades R-12, introduced in 2012, replaced the Revised National Curriculum Statement (RNCS) Grades R-9 and the NCS Grades 10-12, which were used prior to 2012. This was due to criticism of the previous curriculum. The NCS is seen as a more comprehensive and clarified curriculum in South African education. The Curriculum and Assessment Policy Statement (CAPS) is mainly focused on the curriculum and assessments. The CAPS document provides educators with comprehensive guidelines on the content to be taught and the required assessment types for each learning area. This helps to reduce the teacher load and guarantees uniformity during teaching. Since the CAPS document provides the same subject guidelines countrywide, this enables a smoother transition and continuation for learners who might have transferred from one school to another. The principles

of the NCS (Grades R-12) are active and critical learning; encouraging an active and critical approach to learning, rather than rote and uncritical learning of given truths (DoE, 2011). In addition to the principles in the NCS Grade 10-12 document, there are also specific aims that reflect what learners must achieve in the life sciences subject. The three specific aims for life sciences are:

(i) Aim 1, which relates to knowing the subject content ('theory').
Obtaining knowledge for life sciences concepts may help learners to be able to relate their conceptions and thoughts. Therefore, a better understanding of the circulatory system concept by learners, may enable them to apply their knowledge in new situations. This can be incorporated in assessment events when learners may be expected to predict or make a comparison.

(ii) Aim 2, which relates to doing science or practical work and investigations.
This aim relates to the principle of active and critical thinking, which are some of the fundamentals of role-play as a teaching strategy (Altun, 2015). In active thinking, learners can become active participants when demonstrating the movement of blood in the human body through role-play.

(iii) Aim 3, which relates to understanding the applications of Life Sciences in everyday life, as well as understanding the history of scientific discoveries and the relationship between indigenous knowledge and science (DoE, 2011)

This researcher was drawn to the second aim mentioned above. The researcher decided to use role-play as a teaching strategy because learners can incorporate active learning by participating in role-play activities. Other learners who are observers can become exposed to some questions that may require them to think critically.

> The NCS Grades R-12 aims to produce learners that are able to identify and solve problems and make decisions using critical and creative thinking;
> work effectively as individuals and with others as members of a team (DoE, 2011:5).

The researcher realised that most learners at the particular school become motivated and focused during singing and dramatizing. Being prompted by this, the researcher decided to incorporate singing and drama in the teaching of the circulatory system. The main intention of

including role-play was to motivate learners to see the fun in science and become more motivated.

In the current curriculum in South Africa, Life Sciences is a subject in the Further Education and Training (FET) phase, from grade 10 to grade 12. Grade 10 Life sciences comprises four strands, namely life at molecular, cellular, and tissue level; life processes in plants and animals; environmental studies and diversity, change, and continuity. Therefore, the circulator system is a component of the strand for life processes in animals. Natural Science which is taught from primary level up to grade 9, lays the foundation for most of Life Sciences topics. Therefore, learners are exposed to the concepts of the circulatory system from as early as grade 9.

1.3 Rationale for the study.

The circulatory system concept is of great importance to learners, as it transports nutrients and oxygen to the body cells and removes carbon dioxide and waste out of the body cells. Therefore, learners need to understand how this system works and how it is interconnected to other body systems.

The researcher's experience in teaching the circulatory system at grade 9 and 10 showed her that most learners do not perform well in achievement tests on the circulatory system. The low performance of learners in the topic could be due to teaching strategies that yield little or no impact in learner understanding. The school where the study was counducted received a lot of support from the government. The school has well-equipped school laboratories with sufficient apparatus, and extra lessons for science learners during weekends. Science teachers receive support via curriculum refresher courses through the focus on science as a learning area.

The circulatory system is also presented in grade 12, as it forms part of the blood group concepts. Therefore, learners need to have an underlying understanding of this concept. Hence, if learners' misconceptions on the circulatory system are not addressed at a lower level, it will be carried over to higher levels (Grade 12). This might impact the NSC results. Therefore, this study aimed to determine the leading cause of learners' misconceptions in the circulatory system and try to find a possible solution.

Due to some of the above-mentioned reasons surrounding learners' underperformance in some of the Life Sciences concepts, the researcher decided to conduct this study to identify the

conceptions that Grade 10 learners hold concerning the human circulatory system. Since learners come from diverse cultural backgrounds, their preconceived ideas about the circulatory system could also be different. If learners' existing conceptions about the circulatory are identified earlier, this might shed light on how to address them using a different teaching strategy.

1.4 Statement of the Problem

My learners experienced challenges in understanding the circulatory system. Generally, the quality of Grade 12 Life Sciences results are not very impressive, as shown in Table 1.

Table 1. Western Cape Life Sciences Pass Rate at 40%:(Source: DoE, 2018)

Year	2014	2015	2016	2017	2018
Pass rate at 40%	50.7	54.4	53.8	54.4	52.5

From the table above, almost half of the province's learners had a percentage pass rate of 40 and above. This raises some concern, as it can those who passed at 50% and above is less than half. Hence, there is a need to improve learners' understanding of life science concepts to improve the pass rate, by using effective teaching strategies.

Table 2: Life Sciences Pass Rate at 30%, (Source: DoE, 2017)

Year	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Provincial pass rate at 30 %	72.7	76.6	77	74.5	74.7	66.3
National pass rate at 30%	73.8	70.4	70.5	74.4	76.3	72.3

Table 2 is a true reflection that most of the passes in Life Sciences are at 30%, which is a very weak pass. This indicates that some concepts are not well understood by learners, hence weakening the quality of results.

According to the DoE's NSC result analysis for the 2016 life sciences exam, the question on blood groups was part of the questions where learners performed weakly. Hence, this weak

performance may be attributed to the misconceptions of the circulatory system that might not have been well addressed in grade 10. In addition to this, in the grade 12 life Sciences exam paper 2 in 2019, part of the question 4 essay was based on blood grouping. Based on learners' performance, the pass rate was 18,2% which reflected a very low performance. The majority of learners showed some confusion between blood grouping and DNA profiling. This resulted in learners failing to explain how blood grouping can be used to determine the child's paternity. The table below shows the trend in learners' performance in life sciences between 2018 and 2019.

Table 3: Life Sciences Provincial subject performance: 2018 vs 2019, (Source: DoE, 2019)

Exam	Pass % at 30%	Pass % at 40%	Pass % at 50%	Provincial average %
2018	74.8	52.5	35.1	44.1
2019	66.3	46.6	31.3	41.5

Table 3 shows that the Western Cape pass rate at 30% dropped from 74,8% in 2018 to 66.3 in 2019. Generally, there was a decrease in the quality of passes for life sciences**.** There was a decrease from 44.1% to 41.5 % in the provincial average percentage. Therefore, a decrease in the learners' performance in life Sciences could indicate a lack of a stronger foundation in the subject content.

The outcome-based education was in use since 1997, but it was then replaced by the RNCS Grades R-9 and the NCS Grades 10-12 (2002). Due to some constant re-visiting of the curriculum, the NCS Grades R-12 was the latest to be introduced in 2012. Since the implementation of the NCS Grades R-12 in 2012, some of its principles include active and critical learning and high knowledge and high skills. This move aimed to bring the education system up to par with other countries.

Despite the availability and use of various teaching strategies, teaching the human circulatory system within the new CAPS curriculum remains a challenge, especially among the grade 10 learners. According to Ozgur (2013) and Alkhawaldeh (2012), the teaching of the human circulatory system topic is a cause for concern among students. Research on the human circulatory system can be found in the extant literature (Ozgur, 2013; Alkhawaldeh,2012;

Ozgur,2013; Kurt, Ekici, Aksu and Aktas 2013). The researcher could not find research studies conducted on the use of role-play in the teaching and learning of the human circulatory system as a topic in life sciences.

1.5 Aim of the research

1.5.1 Aim:

This research aims to explore learners' understandings and experiences of the circulatory system using role play as a methodology, and how the findings can help to inform methodological practices for the teaching of this specific topic.

1.5.2 Objectives

1. To analyse the efficacy of role-play as a teaching and learning methodology in the sciences.
2. To provide recommendations to teachers and coordinators so that teaching strategies may be varied in the teaching of Life Sciences topics.

1.6 Research Questions

This study set out to explore the effects on learners' conceptions of the Circulatory system using role-play, specifically:

1. What conceptions do grade 10 learners hold about the human circulatory system before and after role-play?
2. What were the experiences of learners during role-play about the circulatory system?
3. How effective was role-play in developing learners' understanding of the circulatory system?

1.7 Significance of the study.

- The research findings obtained from the teaching of the circulatory system using role-play, will be beneficial to Life Sciences and Natural Science educators. These educators may use it to help direct them in their lesson planning. Recommendations from this research may be applied by educators in their daily teaching to vary their teaching strategies.
- The researcher and newly qualified educators may find this study's findings to be beneficial to them since the circulatory system is the topic where some learners present with their preconceived ideas. Hence, this might help new educators effectively plan their lessons to address the existence of learners' preconceived ideas beforehand.

- The use of role-play as a teaching approach helps learners to see the connection between drama and learning, and learning from the known to the unknown. Hence, role-play assists learners in making them aware that learning can take place through play and drama. Therefore, science lessons must be multi-strategic, allowing learners to express their science ideas through singing and acting.
- The research approach was an additional teaching strategy in the teaching of the circulatory system. Therefore, this research can be used in urban and rural schools to ensure learners understand better.
- Findings obtained from this research will help raise the awareness of the Curriculum advisors and the Western Cape Education Department, of the challenges faced by educators in the teaching of the circulatory system. This may assist the Curriculum specialists in conducting workshops. Remedial classes will be held in order to assist the participants in some parts of the topic, where they showed a lack of understanding.
- Some awareness will be raised to textbook writers for life sciences, of the challenges faced by learners in understanding the topic. More activities on teaching using role-play, needs to be included in the science textbooks to promote effective implementation. This will help them have resources that will incorporate various quality teaching strategies in presenting the topic. A positive link must be seen between the teaching strategy used and the information from the textbooks.

1.8 Role play as a teaching Strategy

Glover (2014) defined role-play as a technique that allows students to explore realistic situations by interacting with other people in a managed way. They develop experience and trial different strategies in a supported environment. This implies that role-play is a more learner-centred activity, where learners' actions simulate a particular concept. The role-play concept is further supported by Van Ments (1989) who defined role-play as one particular type of simulation that focuses attention on the interaction of people with one another. Learning by doing and communicating during role-play lays a strong foundation for effective learning. Therefore, role-play is a strategy meant to involve and encourage learners' participation to understand the concepts. Role-play is a way of bringing real-life situations into the classroom (Doff, 1990). To bring role-play into the classroom, learners used drama, games, or simulations (McSharry & Jones, 2000 in Kucuker, 2004).

Role-play, as a teaching strategy, accommodates all learners with different learning approaches. This is inclusive of learners who prefer visual, auditory, verbal, or active learning. Visual learners prefer the presentation of information in diagrams, pictures, and symbols; they use color and layout to enhance knowledge. Students with an auditory learning style prefer having information explained to them. These learners benefit from hearing information in various verbal presentation types, including lecture, discussion, or debate (Nilson, 2003). Therefore, role-play is a more effective teaching method as it helps learners have a common understanding of the same concept, but using different senses. This will help to enhance a deep understanding of the concept. Role-play helps learners to become actively engaged in learning.

Role-play incorporates different senses together, hence, accommodating learners with various learning preferences. Role-plays using given roles or simulated and improvised enactments, are claimed to improve learning of concepts, understanding the nature of science, and appreciation of science's relationship with society (Ødegaard, 2001). Generally, learners use the sense of sight, touch, or hearing during learning. With such sensory functions involved in role-play, the PBL can adopt role-play as an innovative learning activity, which makes the class more dynamic through various verbal and non-verbal acts of students on the one hand. On the other, their cognitive process is required to understand, interpret and analyse, and make meanings of the role-play (Chan, 2012).

1.9 Stages of role play.

Cherif & Somervill 1998 identified the following four stages of role play:

(i) Preparation and explanation of the activity by the teacher

The teacher, as a facilitator, prepares the stage. This is done by giving a brief description of what needs to be done and allocating particular roles to learners. Learners then become aware of what they have to do during role play.

(ii) Student preparation of the activity

Learners who are the key participants in the role-play, come together to find a way to present their play. Some learners record their scripts on paper to remember them.

(iii) The role-playing

Learners perform the roles assigned to them. This will enable the teacher to assess if the play can be completed within the given time. If the play proves to be taking longer than expected, then learners have to adjust and summarise some

of their script writings. But if the role play is completed earlier than the time given, then there will be some additional lines or script.

(iv) The discussion or debriefing after the role-play activity

This stage is very significant, as it assists learners to reflect on role-playing. It is accompanied by some questioning and discussions, in which each character explains why they took particular roles, and whether they benefited from the acting. Therefore, the responses coming from learners will indicate whether successful learning has taken place or not.

1.10 Constructivist nature of role play

Though there are various types of constructivism, such as cognitive and social constructivism, this study is underpinned by Vygotsky's social constructivism, which was used to analyse the results. The constructivist nature of role-play is that learners are active participants during role-playing.

1.11 Delineation of the research

This study's main focus was on the effect of role-play on grade 10 learners' conception of the human circulatory system at a selected township school in Kraaifontein which falls under Metro East District, Cape Town. However, the study did not cover all the grade 10 learners in the district. Since this research was a case study, only grade 10 learners from one class in the district, participated in the study. Therefore, conclusions made from this research were obtained from a restricted sample.

The school is composed of 1800 learners and 45 teachers. Though the school is a Maths-Science focus school, most of the learners are fearful of doing science subjects, as they have a perception that science subjects are challenging. Most people from the area work in the neighbouring farms and some as domestic workers. Since most people are poorly paid, they mainly depend on their childrens' grants as a supplement. Parents work long hours, and in most cases, children spend most of the time on their own. Due to this frequent parental absenteeism, there has been an increase in gangsterism cases and teenage pregnancies. Weekend nights are characterised by full-blast music, congested informal shebeens, and street-fights. Kraaifontein is an over-populated, high-density area, and most learners live in shacks and are underprivileged. The environment is not conducive for learners to study.

1.12 Structure of the thesis

This thesis consists of five chapters.

Chapter 1 focused on the introduction to the study of the effect of role play on the teaching of the human circulatory system to grade 10 learners. The background to the study was outlined and the context in which the study was conducted was presented. Other components of the study that were discussed in the chapter include the research problem, research objectives and the significance of the study. The research questions for the study were also discussed.

Chapter 2 focuses on the review of literature based on role-play as a teaching strategy. Theoretical frameworks that are in support of the use of role-play in learning are also discussed. The setting in which the role-play method is used is. The research was underpinned by the theory of constructivism and role-play stages as implemented by Cherif & Somervill (1998). These role-play stages used were: (i) preparation and explanation (ii) student preparation (iii) the role playing activity (iv) discussion or debriefing.

Khataibeh (2008) identified as one of the bases of Constructivism theory the fact that learners build meaning on their own using their cognitive mechanism. This meaning does not flow from the teacher to the learner, but, it is formed in the learner's mind due to association with the external world and past experiences. According to constructivism theory, factors influencing learning originate internally from the learner, emanating from cases such as previous experiences, memory skills, and the inner drive to learn. If these internal factors are fulfilled, then learning becomes successful.

Chapter 3 is about research methodology and research design. The use of the mixed-method approach, in the form of qualitative and quantitative methods, is also discussed. The chapter also focuses on the types of instruments used to collect data, and explains the sample size used for the study.

Chapter 4 presents the findings based on the data collected during the study. Synthesis and discussion of the results are found in the chapter.

Chapter 5 presents the conclusions drawn and also gives some recommendations for future research. These findings were based on the results obtained from the pre-test, post-test, and questionnaire. The way in which learners interrelated with one another and the role of the

educator during the lessons, were also discussed. Hence, the chapter summarises the results that were a response to the three research questions.

1.13 **Conclusion**

This chapter is the introduction of the study. It highlights the significance of the study, the background, rationale, research aims, research questions and the limitations of the study. The next chapter looks at the extant literature in order to provide a justification and framework for the current study.

2 CHAPTER 2: LITERATURE REVIEW

This chapter is a review of the extant literature on role-play (RP) and cognate topics. The review consists of literature from books, accredited journals, policy documents, and websites. This study aimed at answering the following research questions:

1. What conceptions do grade 10 learners hold about the human circulatory system before and after role-play?
2. What were the experiences of learners during role-play about the circulatory system?
3. How effective was role-play in developing learners' understanding of the circulatory system?

Yoon (2006) introduced two types of drama in science: the one with scripts and the other without scripts. The first type includes some scripts provided to students by the teacher or student-created scripts . Then the students act-read the script. The second type includes role-play and improvisation. In role-play, the context or the role is described to students then they act according to their roles. In the improvisation, the context or the task is given to students then they may act in non-verbal presentations like mime or gesture or movement.

Najami et al. (2019) classified role-play as a type of Drama-Based Pedagogy (DBP). Some of the characteristics of this DBP are:

- they are teacher-facilitated, led by a teaching artist, or other facilitators trained in the DBP.
- They are aimed at academic and/or psychological outcomes for the participating students.
- They focus on process-oriented and reflective experiences.
- They draw on a broad range of applied theatrical strategies.

Bracha's (2007) study revealed that students who have learned science through drama have shown a greater understanding of scientific concepts and preferred learning science through creative drama. The study conducted by Dorion (2009) looked at teachers who used drama to convey abstract scientific concepts through role-play and pantomime. Dorion's study stressed the power of drama in developing students' visualization abilities. Saricayir (2010) used physical simulations to investigate the effect of using drama on seventh-grade students'

understanding of the scientific concepts related to electrolysis of water. The results showed that drama group students understood the target concepts better than students of the control group. In a qualitative research study, Alrutz (2004a) found that drama-based science teaching motivated students in learning science, boosted their enthusiasm for learning science, and solidified their understanding of science content. Moreover, Alrutz pointed out that drama suits students' learning styles.

The literature shows that employing creative drama is an effective strategy in enhancing students' conceptual understanding of scientific concepts (Albliwi, 2008; Al-Taweel, 2011; Hendrix, Eick, & Shannon, 2012). BouJaoude, Sowwan, and Abd-El-Khalick (2005) pointed out that employing drama in science teaching has the power of developing students' understanding of the nature of science. Moreover, other studies uncovered the positive effects of drama-based science teaching on developing students' science processes (Al-Taweel, 2011), scientific thinking skills, and scientific attitudes (Albliwi, 2008).

2.1 Studies in role play

Various research studies focused on the use of role-play as a teaching strategy in different fields. Role-playing activities are not often used in science education. However, in cultural education or in social disciplines, such methods are of great interest mostly because they help students understand things from another person's perspective (Craciun, 2010). Adams (2002) also supports the fact that role-play is not a commonly used teaching method.

2.1.1 The use of role-play to develop conceptions in Science (RQ 1)

Various studies have been conducted concerning the use of role-play in the science field. Role-play in the form of drama helps learners become active participants in learning and assist them in conceptualizing information faster (McGregor, 2012). Also, as a multi-educational teaching method it helps cater to all learners, irrespective of their various learning strategies (Alrutz, 2004).

Najami, Hugerat, Khalil and Hofstein, (2019), carried out a study to investigate the effect of learning chemical reactions, on light and photosynthesis, through the use of drama. The participants involved six classes of a mixed group of 180 grade 10 learners in Israeli. Three classes were taught using drama, while for the other three, conventional teaching was used. Pre-test, post-test, questionnaire, and semi-structured interviews, were used as the research

instruments. Therefore, the research approach was both quantitative and qualitative. The results obtained from the study indicated that use of drama increased learners' performance and motivation in studying chemistry. The use of drama improves learners' scientific thinking skills and attitudes towards learning (Al bliwi, 2008). The study recommended the inclusion of drama in teaching as it helps in children's intellectual development. Teachers need to attend more teacher-development workshops to equip them with drama-teaching strategies. In another related study in Turkey, learners who were taught electrolysis through drama performed better than those exposed to the chalk-and-talk method (Saricayir, 2010).

Furthermore, Crowthera, McFadden, Fleming, & Davis (2016) studied the impact of music videos with Science-based lyrics on content knowledge and attitudes in a three-part experimental research study. The study consisted of a sample size of 1000 learners in K-12. Results obtained indicated that learners' results were higher on questions related to the video, whereas there was low performance on unrelated questions .

Bose and Seetso (2016) carried out research on science and mathematics teaching through local games in Botswana preschools. The study aimed to explore the preschool teachers' knowledge regarding mathematics and science concepts embedded in the local games played by preschool children. Another aim was to develop a resource book of local games to empower them to teach these concepts in preschools.

A qualitative approach was incorporated, using a case study design. Participants in the study included twenty-five (25) preschool teachers from around the country. The teachers were engaged in two workshops. From the results obtained, it was shown that most teachers had an understanding of the content but required pedagogical knowledge. To overcome this challenge, a resource book consisting of local games, was designed to teach Science and Maths.

Cabello (2017) carried out a study based on role-play to teach science ideas. The sample size consisted of 38 in-service science teachers from Chilean universities. These teachers role-played as learners, evaluators, and educators. Therefore, from the qualitative analysis of the results it was found that role-play accompanied by clarifications are more effective in teaching science.

In support of Cabello's idea , Sukstrienwong (2018) also carried out a study using the Animo math approach which is a role-playing computer game. This computer game was used to teach mathematics to learners aged between 5-7 years old. During the role-playing game, learners

choose an animal cartoon that resembles them. Brightly-coloured cartoons are used in Animo math to draw the children's attention and motivate them to learn. From the questionnaires answered by the parents it was concluded that Animo maths was interesting for learners. Most parents showed support for this type of learning method, as it it is full of fun and helps learners to conceptualise faster. The recommendation given by parents was for the game not to be played on computers only, but that cell phones be used as well.

Finally, Ferrero, Bichai & Rusca (2018) carried out research in which they used role-playing games to raise awareness among various stakeholders to get involved in Water Safety Plans (WSP). This study was conducted at the IHE Delft Institute for Water Education in Delft, Netherlands. The participants were Masters students at Urban Water and Sanitation at IHE Delft, and the researchers of the Dutch National Institute for Public Health. The role-players acted as representatives of various stakeholders during a strategic meeting to bring a positive change in the provision of quality water to the town. The meeting was meant for participants to share ideas openly. Kolb's experiential learning cycle, which comprises of concrete experience, reflective observation, conceptualizations, and active experimentation, was implemented in this study. The main activity involved in this role-play activity was a decision-making process made up of various stakeholders divided into two groups. One group comprised of people with less interaction, whereas in the second group, there was more interaction during decision-making.

Before the role-play activity, participants were first assigned the characters. This was followed by a scenario, in which they were expected to simulate. Therefore, the role-players got time to practise for the act or play. There was always a discussion at the end of each role-playing game, to reflect on the activity completed, and to check if the objectives were achieved. From the after-discussions the participants admitted that they gained more knowledge about the significance of stakeholders working together to allow for effective execution of WSP. Most participants indicated some willingness to participate in the future to strongly support the WSP on administering water usage. Thus, it can be deduced that role-play does motivate learners.

2.1.2 **Experiences of learners using role-play (RQ 2)**

Role-play permits the learner to experience various learning styles in an accustomed, supportive and safe environments (Kasper & Youn, 2018). Puyate and Motsi (2017) carried out a study to determine if there is any difference in students' performance between those

taught the same concept using simple blueprint reading through role-play, and those taught the same reading material through the lecture method. A sample size of 22 learners from Gbarainowei Secondary school in Bayelsa state, Nigeria participated in the study. Purposive sampling, from a population of 122 learners was used. The type of research design used was quasi-experimental. From the two classes used for the research, one was the experimental group that was taught by the role-play method. The second class was the control group and they were taught through the lecture method. A test comprising 13 multiple-choice questions based on Blue print Reading was used as a research instrument for both groups. Each question consisted of five choices from which learners would select answers. Some close analysis of the research hypothesis was done. From the results obtained, learners whose lessons were conducted through the use of role-play on blue print reading performed better than those taught through the lecture method. As a result, teachers were advised to implement role-play in their daily teaching, as it does improve learners' performance.

In a different context, Souhila (2016) carried out a study to explore role-play in teaching students speaking skills. Learners were involved in role-play, with the aim of helping them to be able to improve their confidence and English communication skills. The research design used for this investigation was a qualitative method, using questionnaires as a research instrument. Learners, teachers, and some second-year university students were surveyed. The questionnaires comprised of 20 questions in form of closed ended and open-ended questions. This study was conducted at the University of Biskra, in Algeria. Fifty learners of mixed gender, and five teachers from Biskra University, Algeria, participated in the study. From the results obtained from the questionnaire responses, it was concluded that role-play contributes significantly in English teaching. There was a vast improvement in learners' communication skills. There was great support towards the use of role-play by both teachers and learners.

Rojas & Villafuerte (2018) explored the effect of using RP to improvelearners' English speaking skills. They found that using RP helps to improve how learners communicate. Learners actively participated and developed a significant level of confidence during RP

In addition to role play studies, Chaursiya (2012) investigated the effectiveness of role-play in teaching dialogue during an English class. The sample size was 30 grade ten learners of Durga Secondary school, Rajbiraj, Saptari. Three types of oral tests were given: before, during, and after teaching using the role-play strategy. A total of 50 marks was allocated for the test. The

findings supported the idea that role-playing is a useful strategy for improving speaking skills and confidence. Hence, both Souhila (2015) and Chaursiya's findings support the idea that role-play contributes to improved communication skills in learners.

Sharing the same view with Chaursiya (2012), Nopiani (2014) studied speaking skills through role-play in an English class with seventh-grade students. The research instruments were pre- and post-tests, and data were collected by means of a questionnaire. Nopiani (2014), came to the same conclusion: that role play does improve learners' speaking skills.

Moreover, in line with the researchers mentioned above, Alabsi (2016) investigated the Effectiveness of Role Play Strategy in Teaching Vocabulary at a secondary school. The researcher used a quasi-experimental method. From the post-test administered to learners, the experimental group taught through role-play out-performed the control group. Therefore, role-play did improve learners' vocabulary skills performance.

Role-playing is an interesting example of an active learning and teaching strategy. It can incorporate drama, simulations, games, and demonstrations of real-life cases related to any topic (Erturk, 2015). Role-play can hence use a variety of different forms. Furthermore, Erturk (2015) carried out a study at a tertiary institution in New Zealand, incorporating Information Technology (IT) diagrams as part of role-play activities for two Bachelor's degree classes. The two classes focused on either Data Flow Diagrams(DFD) or Activity Diagrams. In the DFD, students use computers to analyse a case through drawing diagrams. Drawing through the use of computers was done individually, in pairs, and then in larger groups. In the Activity Diagrams, students had to simulate information from the DFD, by dramatizing it to reflect on how systems work in the library.

The role-play activity should not come immediately before or right after an exam because the exam can cause stress for the students and negatively influence this activity's effectiveness (Case & Cheek-O Donnell, 2015). Therefore, this research was done at the right time, far from the exam time. Constant feedback was given by some class mates after watching the role play. Teachers need to consider the numerous factors successful student learning depends on: needing/wanting, doing, digesting, and feedback (Race, 2010). These are alsosome of the components of an effective and successful role-play. In most cases, feedback was given in the form of discussion with a friend, or sometimes the teacher interviewed the learner to check the

degree of understanding. From the findings obtained, role-play increases active participation and confidence in learners (Alabsi, 2016; Nopiani, 2014; Chaursiya, 2012, Rojas & Villafuerte, 2018). Therefore, teachers need to involve learners in hands-on activities rather than the chalk-and-talk method that can be boring to learners.

Unlike the others who focused on one learning area (Souhila,2015; Puyate & Emeli, 2017), Rao and Stupans (2012) used role-play in four different learning applications. The latter included a culturally-diverse class, class of history, primary mathematics teachers, and the pre-service primary teachers. In the culturally-diverse class activity, 100 teachers acted as role-players. The aim was to simulate the power inequalities that exist in society. The participants' various roles were placed in an envelope and handed over to the respective people. Some of the roles included workers, policemen, shop keepers, and social workers, representing the components of a society. A follow-up interview was conducted after the role-play to find out the learners' feelings concerning the activity. From the debriefing questions about 75% of the participants were willing to repeat role-play in future. Hence, this is an indication that they enjoyed it.

Another study about role-playing was conducted in a primary mathematics methods class with in-service teachers. The topic was frames of numbers in the teaching of mathematics. Some of the role-play activities used online and board games. The findings showed that using games in maths teaching can be fun and interesting, as it helps students develop a positive attitude towards the subject. Role-play sustains children's interest more than the lecture method, and in turn, interest stimulates learning (Osuafor, 2001). Therefore, it is clear that the researchers support the idea that role play does increase motivation, confidence, and conceptualisation (Puyate and Emeli, 2017; Souhila, 2015 & Rao & Stupans, 2012).

Stevens (2015) carried out a study in a history lesson based on role-play and student engagement, and reflections from the classroom. There were 144 students engaged in this role-play lesson. After the task, they were asked to reflect on whether they benefited and enjoyed it. The results obtained showed that most of the students indicated that they benefited a lot from the activity.

Craciun (2010) investigated the effect of role-playing as a creative method in science education. The research site was a Physics class and the topic was matter and abstract physics

phenomena. The sample size consisted of twelve Physics learners. Constructivism theory was used as a theoretical framework. According to the findings obtained, role-playing is helpful in improving the learners' confidence, scientific ideas, creativity, confidence, communications skills, and leadership skills.

2.1.3 **Effects of role-play in Science learning (RQ 3)**

Yoon & Kim (2017) carried out a study to determine the effect of the science song project on teacher candidates' understanding of science processing skills and their attitudes towards science. The sample size was 45 science teachers who were involved in a Grade Six Early Childhood teacher programme. These teachers were from a Texas public research University. Pre-test and post-test in the form of self-efficacy tests were the research instruments. The findings obtained showed that songs enabled teachers to practice science concepts and develop constructive attitudes towards science. Hence, concerning learning, it is clear that Science songs helped learners to memorise concepts easier and enabled better comprehension.

In a study by Abed, (2016) on the effect of drama-based science teaching on students' understanding of scientific concepts, the study also investigated their attitudes towards science learning. A sample size of 87 grade seven learners from two classes at a school in Amman-Jordan, participated in the study. The research design used was quasi-experimental. Drama was used to teach the concept of 'heat' and 'matter'. Learners had to dramatize various states of matter when heat was applied. The Scientific Concepts Test (SCT) and Attitudes towards Science Learning Scale (ATSLS), developed by Abed (2005), were the two instruments used for the study. Results obtained showed that learners taught through drama developed a positive attitude towards science and a more improved conceptualisation of science. Role-play encourages 'accommodation' learning, which is an effective form of learning (Adams, 2002). Therefore, these findings were similar to that of Najami et al. (2019) and Yoon & Kim (2017). Bulunuz (2013) also investigated kindergarten children's understanding of science concepts when experiencing science through play versus direct instruction. Concepts taught included colours, living/non-living things, gravity, magnets, the existence of air and air-related phenomena, floating and sinking, and the phases of water. Two classes were used for the research which was a quasi-experimental design. The research instruments used was a semi-structured interview schedule, coded according to a rubric. Similar to Abed's (2016) findings, the results obtained showed that learners who were taught science through play had a better

conceptualisation of science concepts than those led by direct instruction. Thus, teaching science through play is more effective in improving learners' understanding.

Another study in science education by Colucci-Gray (2004), investigated the use of role-playing in the science lesson: a study on discussion and conflict resolution. Participants were learners between 14-15 years of age. Questionnaires and discussion transcripts were the research instruments. In line with other researchers' findings, the results obtained indicated that role-play helps to improve learners' intellectual and emotional development.

Finally, Taylor, Dlamini, Khanyile and Mpanza (2012) explored role-play in a school-based programme to reduce teenage pregnancy. The research participants were Grade 8 learners from eight different high schools in KwaZulu-Natal. The main theoretical framework was Bandura's theory of Social Cognitive development. From the results obtained, it was found that role-play helped develop learners' self-efficacy in issues related to sexual behaviour. Hence, this study contributed to the reduction of pregnancy amongst girls who participated in the study.

From most of the research studies mentioned above, it appears that, regardless of the field in which role-play is used, it always results in improved development of skills, motivates, and allows for the retention of more information. Role-play is a diversified teaching strategy that can be used in any learning area. The only challenge is whether teachers can implement it successfully.

Due to these positive findings resulting from role-play (Bulunuz, 2013; Erturk, 2015; Colucci-Gray; 2004 & Abed, 2016), the researcher decided to use role-play to improve learners' understanding of the circulatory system. Although many studies were carried out to investigate the usefulness of role-play in the teaching of various topics in English and science (Nopiani, 2014; Chaursiya, 2012; Bulunuz, 2013 & Erturk, 2015), none of the studies have focused on role-play to teach the circulatory system. Therefore, the present study will make a contribution to the literature because it focuses on Grade 10 learners from a township school in Cape Town, South Africa.

2.2 Other uses of role play

Even though RP has been widely used in various fields, some researchers recommend that RP is more effective when it is used in a practical-based activity (Lee, et al., 2007), to increase engagement of learners (Clark & Choi, 2005; Wishart, et al., 2007); to improve interpersonal

skills and to create a fear-free environment (Alkin & Christie, 2002). Besides the use of RP in the teaching of Science and English, role-play can also be used for other purposes. Some of these uses include:

- **Use of RP in Information and Communication Technology (ICT)**

Moreno-Guerrero, A, Rodríguez-Jiménez, C., Gómez-García, G & Navas-Parejo, M.R. (2020), carried out a study based on the effect of using Role-Playing and Educational Video on the teachers' attitude and practical skills towards Information and Communication Technology (ICT). The sample size was 138 Masters of Education students in Spain divided into control and experimental groups. From the results obtained, it was concluded that RP's use did improve learners' attitudes and hands-on skills. There was an increase in motivation, originality, and teamwork on the students' side.

- **Therapeutic use of RP**

A study was carried out in the Medical field by Ronning & Bjorkly to investigate the effect of using clinical RP on students' theraupetic skills development. The students in training were used to role play as patients and therapists, using knowledge obtained from their personal experiences. Based on the findings, RP does improve therapeutic and communication skills of students. Some other studies related to the use of RP in medical studies include the use of RP to teach clinical communication (Hill and Gleason: 2015); RP activities concerning auditory hallucinations (Fossen & Stoeckel: 2016), and the use of RP to conduct psychiatric interviews, (Wolff & Miller, 1994). Also, RP has been used in the medical field to improve the communication skills of nurses, which assists them to manage patients' feelings (Greco, 2009).

- **Use of role-play in Psychology**

Grose-Fifer, J (2017), used RP in Psychology to promote critical thinking about Ethics. Before the RP lesson, students were asked to study the Tuskegee Syphilis story, which was the concept that was going to be role-played. The prior study gave students the opportunity to gain a deeper understanding of the story. After being divided into smaller groups, students then discussed and chose a role they wanted to role-play. After performing this RP activity, students showed an improved teamwork spirit, communication skills, and conceptualisation.

2.3 Advantages and Disadvantages of role-play

2.3.1 Advantages of using role-play

As a widely used teaching strategy across multiple learning areas, RP has bothadvantages and disadvantages. Some of the benefits of RP are:

- **Allows learners to think critically**.

DeYoung (2003) describes critical thinking as the interaction between individuals and the reflective, open, and generative external world via engagement of ideas and people, curiosity, appreciation of contextual influences, and awareness of one's value, and the broadness of one's mind. This implies that critical thinking involves discussing ideas, arguments, and reflection on what was learned. Through argumentation, learners can disagree or to reach a common understanding about a particular concept. Hence, learners reason critically during argumentation. Critical thinking is an important attribute in an individual's intellectual development (Moore & Parker,2012). Discussions after role-play help to clarify some complex ideas to give a better understanding. Also, some learners become more confident and improve their communication skills during small group discussions.

A positive tone in the class, maintaining positive levels of student interaction, course design, and learning activities can all influence learning motivation (Herington & Weaven, 2008). Hence, when learners are internally and externally motivated, they will work harder to achieve their goals. Achievement of these goals, accompanied by better understanding, may improve the pass rate. Therefore, role-play can be significant in actively engaging learners in the learning process.

McCord and McCord (2010) suggested that when a student participates more, an increase in performance outcomes is seen. It means that educators must constantly look for ways to involve students and make them active participants in learning (as cited in Chan, 2012).

- **Promote creativity.**

Through the use of role-play, learners can develop new ideas and ways of thinking. Learners can express and support their opinions freely during role-play. The confidence gained during role-play can help learners to evaluate the correctness of their ideas, and assimilate new ideas. Role-play reflects the fact that learning new ideas is a continuous process, which reinforces

learners' understanding. Couger (1995) mentioned that the effect of creativity is to bring together different concepts or elements in a new context with the added value. Therefore, to be classified as creative, an improvement must be new or unique and have some value.

Teaching is more effective when it is learner-centered. While learners are engaged during role-play, the lesson objectives can best be achieved if learners understand the concept that will be demonstrated through role-play. Role-play helps decrease talking done by the teacher, but instead, it might bring excitement to learners as they discover how exciting learning is.

Felman (2001) pointed out that using metaphorical roles and masks to enact teaching can enable better learning for students and improve the lecturer's inner feelings (as cited in Baruch, 2006). The above statement implies that learners are intrinsically motivated when they take part in role-play. For role-play to bring a positive change, learners need to perform roles that match with their characters. While acting through role-play may improve learners' understanding. The whole class must get a sense of what is acted in the drama.

Kase-Polisini (1992) and Carr & Flynn (1993) pointed out some of the advantages of role-play in science teaching as:

- encourages students to create their own reality;
- develops the ability to interact with other people;
- increases students' motivation;
- engages shy students in class activities;
- makes students self-confident;
- helps students to identify and correct misunderstandings;
- it is fun;
- shows students that the real world is complex and problems that appear in the real world cannot be solved by simply memorizing information.

2.3.2 **Disadvantages of role-play.**

One of the limitations of this method is the unfairness that it can cause amongst learners. Since learners already know one another well, this might result in a biased interaction amongst themselves (Shindel, Baazeem, Eardley & Coleman, 2016).

Also, the use of RP may result in a lack of class control on the side of the teacher, which might negatively affect the learning process. Role-play is, of course, open to the potential of unruly behaviour, because in some cases**,** it is quite difficult to teach (simulations in particular). It demands a great deal of judgement, skill, and sensitivity to group dynamics (McSharry & Jones, 2000).

Roleplay requires the teacher to introduce new rules to learners, for example, good behaviour of learners. The teacher's lack of class control might decrease the learners' commitment, resulting in learners acting ineffectually. This might reduce the effectiveness of the lesson's objectives and confuse learners. Also, role play is more time-consuming, as time is needed to prepare, assess, and examine the role-play. The fruitful role-play depends on the type of learners who participate, hence making the outcome unpredictable (Kucuker, 2004).

2.4 **Theoretical Model for learning science through drama.**

Abrahams and Braund (2012) recommended a model to outline the shortage of theorisation based on drama-in-education as a procedure in the teaching of science. Their model of learning science through drama, was obtained from Brook's concept of theatre as an 'empty' space. The model consists of three phases, namely the learner's world of learning, experiential (drama) space and the science world of knowing, as shown in Figure 1.

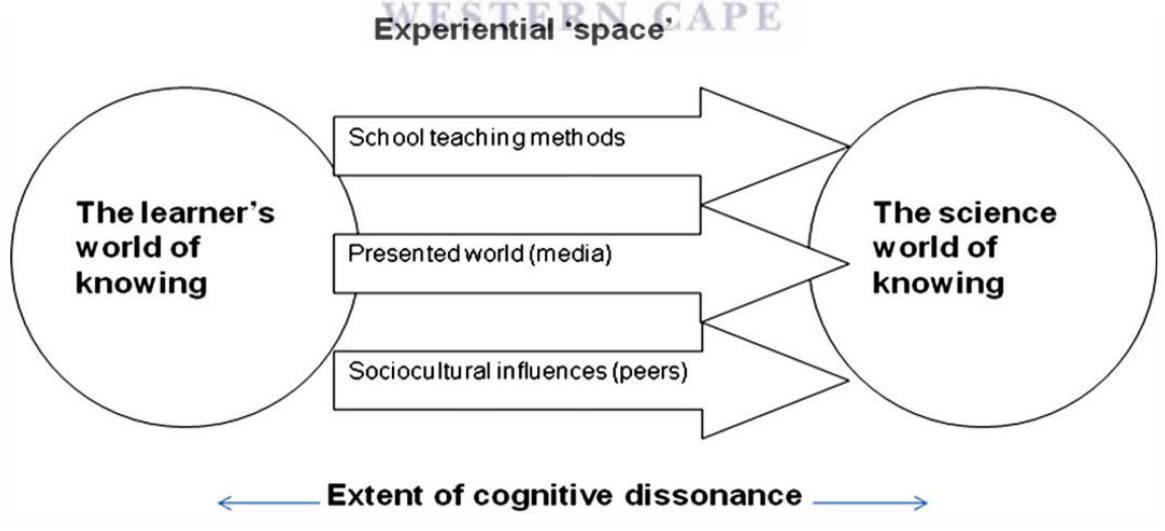

Figure 1: Braund's model for learning science through drama (Abrahams & Braund, 2012, p. 123)

The general model was modified by replacing experiential space with 'drama space'. Cognitive dissonance is the gap between learners' preconceived ideas and what they have assimilated

after administering the intervention. In this research study, drama is represented by the role-play method, as shown in Figure 2.

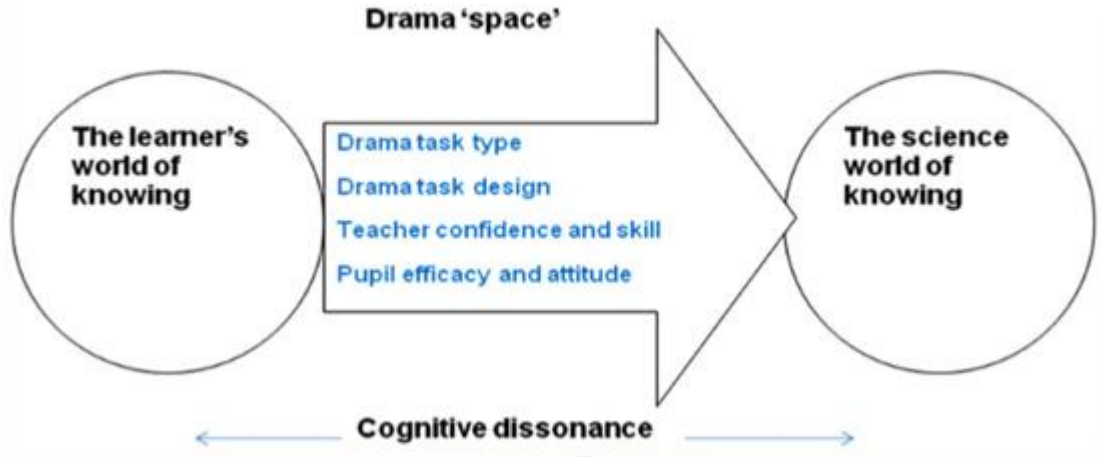

Figure 2: A model for learning science through drama, (Braund, 2014)

(i) The learner's world of learning.

Learning science is a process of streamlining between two worlds of knowing; the learners' and the scientists'. The learners' world is built from their daily experience, commonly used expressions and language, together with what has been gathered from science as offered in newspapers and from school. The learners' world draws on everyday experience, commonly used terms and language and what has been gleaned from science as presented knowledge from media, family, friends and school (Braund & Reiss, 2006). The pre-test administered to learners, acts as a way of assessing learners' world of learning.

(ii)The science world of knowing

The scientists' world of knowledge, which is the final goal for learning, has balanced justifications for the sphere centred on claims of conceptions and principles facilitated through observation. It determines the level of understanding that has been obtained, since it involves the incorporation of ideas learnt and theories. According to this model, 'cognitive dissonance' is the 'distance' between the two worlds of knowing namely the learners' world and the science world of knowing. The science world of knowing is the scientific knowledge assimilated by learners, after being exposed to role-play. This science world of knowing is reflected in the learners' performance in the post-test.

(iii)The experiential space (drama space)

The 'experiential space' (in this case filled by drama) is the nature of activity and effort, put by the teacher, to reduce dissonance and close the gap between the learners' world of knowing and the science world of knowing (Abrahams and Braund, 2012). Concerning this current study, the use of role-play in teaching, designing role-play activities and preparing learners for role-play by the teacher, are some of the efforts of the teacher to reduce the cognitive dissonance space. Also, this stage is characterised by some pre-conceived ideas that learners bring from reading other materials like newspapers, television, or by information obtained from friends. Learners' beliefs and approach towards learning also form part of the experiential space. The word 'drama' in the second stage of the model could be substituted with hands-on work or group activity, or practical activity. The 'space' part is not empty since learners come to class with pre-conceived ideas obtained from their homes.

The teachers' teaching methods, their self-confidence and ability to use them, together with learners' opinions and approaches to drama as a learning method, are 'space' components. Learners' level of understanding information during teaching is determined by the types of activities and the teaching method used to teach them. The current research study incorporated Braund's model of learning science through drama using role-play.

A study of three pairs of primary school pupils being taught science using drama (acted plays) showed that two of these pairs had significantly shifted from their negative expectations of science learning and had come to see science as an enterprise embracing creativity. Thus an essential part of the (empty) space at the pedagogical level is what the teacher does to address cognitive dissonance and how effective methods are at rationalising between the learners' and scientists' worlds (Shanahan & Nieswandt (2009), in Braund 2014). Therefore, combining the mentioned components may lead to effective teaching methods. Drama, as a term indicated on the second phase, can be demonstrated in the form of 'hands-on' work or any learner activity.

2.5 Constructivism

Constructivism is a theory that equates learning with creating meaning from experience (Bednar, Cunningham, Duffy, & Perry, 1991). "Constructivism is not a theory about teaching…it is a theory about knowledge and learning… the theory defines knowledge as temporary, developmental, socially and culturally mediated, and thus, non-objective" (Brooks & Brooks, 1993). Mvududu and Thiel-Burgess (2012) stated that constructivism is widely

touted as an approach to probe for children's level of understanding and to show that understanding can increase and change to a higher level of thinking. Hence, constructivism basically looks at the increase in the level of thinking, as an indicator to show that learning has taken place. The teaching method used together with learners' previous experience, plays a role in constructivism. Constructivist teaching is based on the belief that learning occurs as learners are actively involved in a process of meaning and knowledge construction as opposed to passively receiving information (Bhattacharjee, 2015).

When people experience new things, they try to get meaning by connecting it with what they already know. This could result in new information replacing the old, or sometimes the new information may be rejected if it is found to be incorrect. Therefore, the constructivism theory and role-play have in common that both support the involvement of learners in the learning process. One of the misconceptions of constructivism is the notion that because individuals make meaning based on their prior experiences, that anything and everything counts equally as knowledge, (Jones & Brader-Araje, 2002).

Khataibeh (2008) identifies three tenets of Constructivism:

- Learners build meaning on their own using their cognitive mechanisms, and this meaning does not flow from the teacher to the learner, but, it is formed in the learner's mind due to association with the external world and past experiences.
- The formation of meanings is a mental process that needs active intellectual effort.
- The mental structure of the learner is unaffected by change.

According to constructivist theory, factors influencing learning originate from within the learner, such as previous experiences, memory skills, and the inner drive to learn. If these internal factors are fulfilled, then learning becomes successful.

Since there is diversity in how learners master information, both the learner and the teacher must compromise until they reach common ground. Active learning motivates the learner to have the mental determination to search for information to find solutions to the challenges given.

The main ideas of constructivism, as stated by Taber (2006), are:

- Knowledge is actively constructed by the learner, not passively received from the outside. Learning is something done by the learner, not something that is imposed on the learner.
- Learners come to the learning situation with existing ideas about many phenomena. Some of these ideas are *ad hoc* and unstable; others are more deeply rooted and well developed.
- Learners have their individual ideas about the world, but there are also many similarities and common patterns in their views. Some of these ideas are socially and culturally accepted and shared, and they are often part of the language, supported by metaphors. They also usually function well as tools to understand many phenomena.
- These ideas are often at odds with accepted scientific concepts, and some of them may be persistent and hard to change.
- Knowledge is represented in the brain as conceptual structures, and it is possible to model and describe these in some detail.
- Teaching has to take the learner's existing ideas seriously if they want to change or challenge these.
- Although knowledge in one sense is personal and individual, the learners construct their knowledge through their interaction with the physical world, collaboratively in social settings and in a cultural and linguistic environment.

2.6 The Constructivist learning model.

The Constructivist Learning Model concentrates on learning as being mainly learner-centred, where learners independently give predictions, search for information, investigate to get results, discuss, conclude (Qarareh, 2016).

2.6.1 Stages of the Constructivist Learning Model.

Zaitoon (2007) identified the four stages of the constructivist Learning Model as:

(i) Engagement or Invitation Stage

At the initial stage of learning, the teacher introduces the concept to learners by posing questions to get them into the learning mood and trigger them to think. This helps the teacher evaluate the cognitive level of learners for that concept, to teach from the known to the unknown.

(ii) Exploration Stage

The teacher divides the learners into different groups. Each group is assigned a different activity such as gathering information, sorting it, predicting, inquiring, finding

solutions, conclusions, interpretation, and evaluating findings. The teacher only facilitates the lesson and can raise questions.

(iii) Explanation Stage

At this stage, learners give explanations, recommendations, propose solutions, and test the validity of these solutions based on their new experiences, as they learn new knowledge and relate it to the previous one, or change the previous knowledge, and the teacher has to encourage learners to convey their findings, give them enough time to put forward suggestions and interpretations, help learners, and assist the learning process.

(iv) Decision-Making Stage (Problem Solving)

This step involves finding the appropriate solution to the problem and implementation of such a solution. The cognitive incorporation process occurs between the new and previous concepts, which leads to the formation of broader and better concepts. Hence, this results in the building of new knowledge by learners and they can apply the new knowledge in novel circumstances.

2.7 Types of Constructivism.

Though there are various types of constructivism, such as cognitive and social constructivism, this study used Vygotsky's social constructivism as an analytical framework.

2.7.1 Social Constructivism.

Vygotsky (1978) is the leading theorist behind social constructivism. Both Piaget and Vygotsky share the same view of pre-existing knowledge as the driving force behind effective learning and understanding of the concept. Vygotsky believed that learning occurs in two stages, firstly through the individual's association with others and then the learner's cognitive development.

- Every function in the child's cultural development appears twice: first, on the social level, and later, on the individual level; first, between people (interpsychological) and then inside the child (intrapsychological). This applies equally to voluntary attention, logical memory, and the formation of concepts. All the higher functions originate as actual relationships between individuals (Vygotsky, 1978: 57).
- Unlike Piaget, Vygotsky focuses on language and culture as playing a major role in shaping a person's growth. Culture stems from the family's beliefs and the surrounding environment. An individual's culture determines how thinking occurs. From the very first days of the child's development, his activities acquire a meaning of their own in a system

> of social behaviour and being directed towards a definite purpose, are frequently refracted through the prism of the child's environment. The path from the object to child and from child to object passes through another person. This complex human structure is the product of a developmental process deeply rooted in the links between individual and social history (Vygotsky, 1978: 30).

Vygotsky also explains the importance of giving support to individuals to allow them to reach their full potential. Hence, this concept is the Zone of Proximal Difference (ZPD). The zone of proximal development is defined as the intellectual potential of an individual when provided with assistance from a knowledgeable adult or a more advanced child (Jones & Brader-Araje, 2002). Vygotsky (1978) defines the zone of proximal development as the level of development that the learner can reach under the guidance of teachers or in collaboration with peers.

The primary concern of the ZPD is that learners understand and retain new concepts better when working together in groups than as individuals. Roosevelt (2008) points out that the main objective of education from the Vygotskian perspective is to keep learners in their own ZPDs as often as possible. This could be achievedby giving them exciting and culturally meaningful learning and problem-solving tasks that are slightly more difficult than what they do alone. They hence will need to work together with another more competent peer or with a teacher or adult to finish the task. The ZPD is helpful, as it reflects the degree of an individual's thinking capacity, instead of the achievements only. It helps to improve an individual's conceptual understanding, therefore, leading to better performance of learners. Figure 3 and Figure 4 show an individual's intellectual level before and after using the ZPD, as adapted from Shabani, Khatib, & Ebadi, (2010).

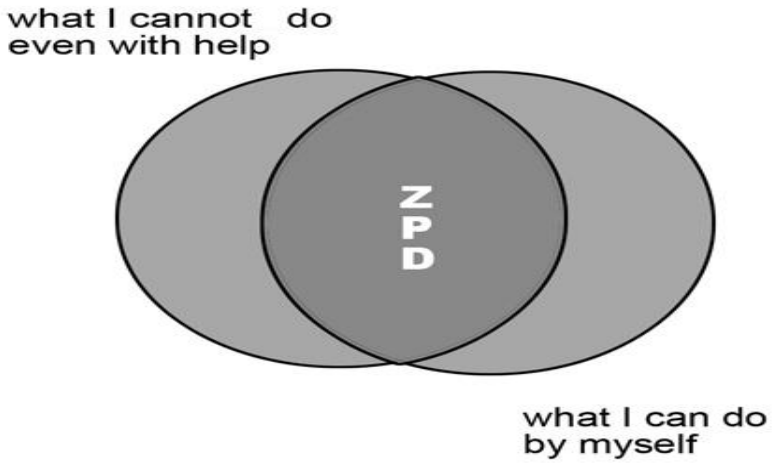

Figure 3:The Zone of Proximal Development: Adapted from Shabani, Khatib, & Ebadi, (2010).

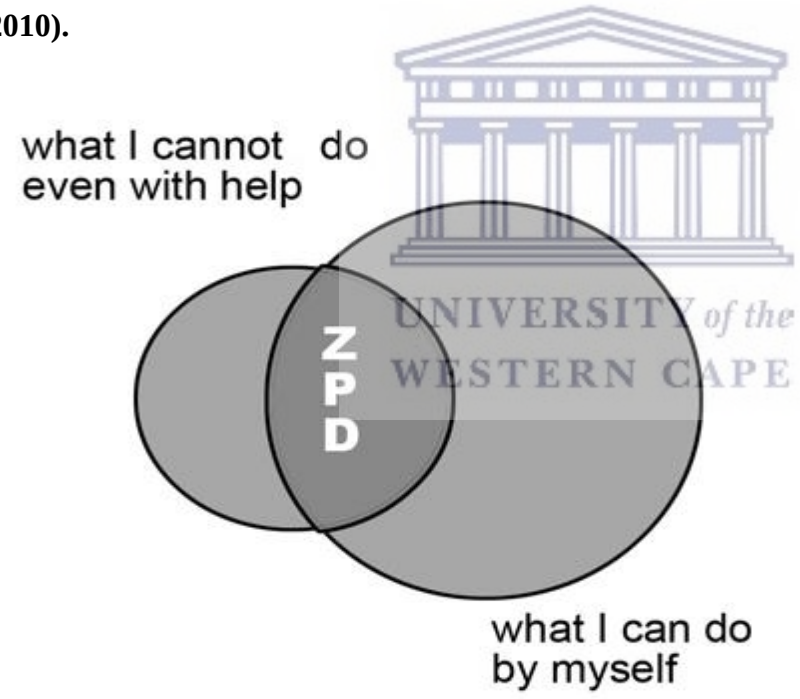

Figure 4: The ZPD after Teaching Has Occurred: Adapted from Shabani, Khatib & Ebadi, (2010).

The diagrams above show that before implementing the concept of ZPD, the concepts that an individual cannot do with help are equivalent to those that can be done without help. But after implementing the ZPD, there is an increase in the amount of concepts that can be done without help, and a decrease in what cannot be done with help. Therefore, the use of ZPD does improve

the learner's performance. Some individuals need assistance from others to complete their work. Vygotsky uses the term scaffolding to refer to the assistance given to individuals to be able to complete the work independently. This research uses Vygotsky's Constructivism theory in analysing the results obtained.

2.8 Conclusions

This chapter provided a review of the extant literature and explained the use of social constructivism as a theoretical framework underpinning the study. The next chapter reports on the research design and methodology. It discusses the mixed-methods approach and various data collection methods that were used in this study. Other chapter components are: research design, sample size, sampling method, research instruments, ethical consideration, reliability, and validity.

3 CHAPTER 3: RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction.

The previous chapter presented the literature review, which included earlier studies on role-play and it presented the theoretical framework, namely, constructivism. This chapter focuses on the mixed-method approach. Both quantitative and qualitative data collection methods were employed in the study. The chapter also expounds on the research design, sample size, sampling method, research instruments, ethical consideration, reliability, and validity. The research stages was as follows:

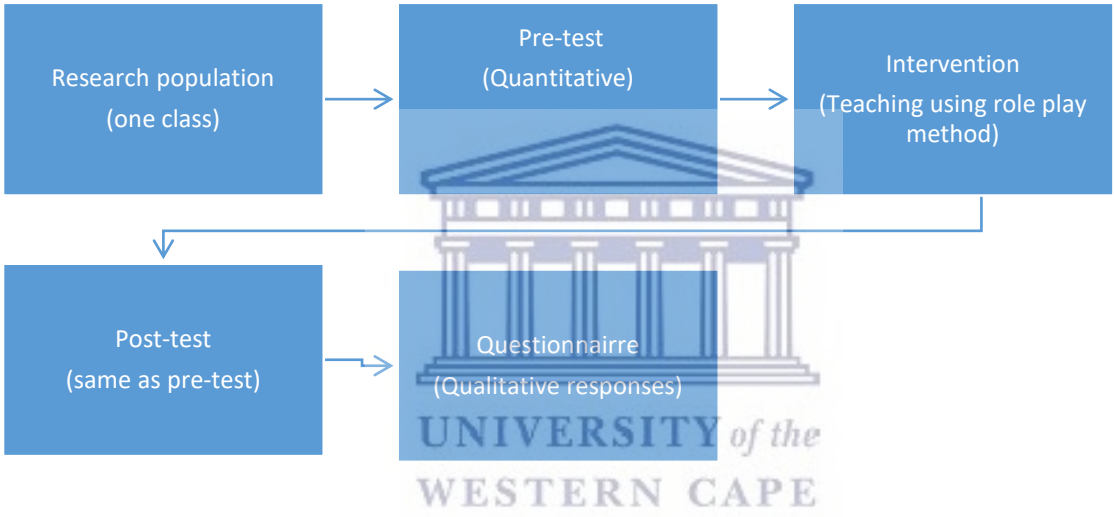

Figure 5: The research outline flow chart

3.2 Research design.

The research design relates to defined structures within which a study is implemented, and it assists the researcher to plan, enhancing the chances of gathering data that will be in line with the situation on the ground (Burns & Grove 2001). According to McMillan and Schumacher (2001), the research design is a plan for selecting data collection procedures to answer the research question. Research methodology is the analysis and rationale for using a particular procedure, method, or technique incorporated during research design implementation (Kothari, 2004).

3.2.1 **Case Study**

This study design is a case study, which uses a sample from one school only. It involves a mixed-method approach that incorporates both qualitative and quantitative techniques. Verschuren (2003) defines a case study as the study of one single case, such as a school class or a particular social group, rather than as a way of doing research. A case study is also defined as an investigation concentrating on the description, conceptualising, forecasting monitoring of the individual (Woodside, 2010). Yin (2009), however, defines the case study research method as an empirical inquiry that investigates a contemporary phenomenon in depth and within its real-life context, especially when the boundaries between phenomenon and context are not evident. Yin admits that, even though case studies are widely used in research, they have their strengths and weaknesses. In this present study, the case study consisted of only one grade 10 class.

There are some advantages and disadvantages of using a case study. Zainal (2007) suggests some advantages: (i) variations in terms of inherent, contributory, and combined/ approaches to case studies allow for both quantitative and qualitative analyses of the data; (ii) the comprehensive qualitative accounts often produced in case studies not only help to discover or designate the data in realistic environments, but also helps explain the difficulties of real life situations that may not be accessible through investigational or survey research.

Flyvbjerg (2006), however, pointed out the following as the disadvantages of a case study: (i) it is challenging to summarise some of the case studies; (ii) case study contains some bias towards verification; (iii) The case study is most helpful in creating predictions, whereas other methods are more suitable for testing the predictions and constructing principles; (iv) One cannot generalize from a single case.

Mixed-methods research represents research that involves collecting, analyzing, and interpreting quantitative and qualitative data in a single study or in a series of studies investigating the same underlying phenomenon (Leech & Onwuegbuzie, 2008). This gives an in-depth understanding of the sample under study. Mixed-methods research is an approach with philosophical assumptions that guide the direction of the collection and analysis of data, and the mixture of qualitative and quantitative data in a single study or series of studies (Creswell & Clark, 2007). A mixed-methods study involves qualitative and quantitative data collection and includes explaining how the two types of data were mixed, merged, connected, or embedded (Creswell; Plano Clark, 2011). Therefore, mixed research methods do not substitute

quantitative or qualitative research, but it aims to filter the advantages and remove both methods' disadvantages.

Greene, Caracelli, & Graham (1989) identified the following as the purposes of mixed-methods research:

- Triangulation. Triangulation is the use of multiple methods while answering a particular research question to analyse the same feature of a research problem. Therefore, it helps to answer a single question through various methods. It examines the reliability of the findings acquired through different instruments. To triangulate the results of this study, various research instruments were used in this study including pre-test, post-test, questionnaire, interviews, and lesson plans. Hence, this helps to add rigour to the research.
- Data sources are complementary. It is not based on results obtained from one method only. The use of both qualitative and quantitative data helps to give a complete, comprehensive conceptualisation of a research problem.
- Initiation. It analyses some resemblances, inconsistencies & new viewpoints

Neal, Hammer, and Morgan (2006) outlined the purpose of using mixed-methods to combine different strengths of different techniques, through convergent findings, comprehensive coverage, and connected contributions. Creswell & Plano Clarke (2011:12) summarised the following as advantages for mixed research methods:

- provides more comprehensive evidence for studying a research problem than either qualitative or quantitative research alone.
- helps to answer questions that cannot otherwise be answered by quantitative or qualitative approaches alone.
- It is "practical", as the researcher is free to use appropriate methods, skills, and thinking to address a research problem.
- enables the use of an all-encompassing paradigm, such as pragmatism.

Quantitative research investigates relationships and studies cause-effects phenomena, and results are more readily analysed and interpreted (Schumacher & McMillan, 1993). The results can be mathematically quantified. It is dominated by the use of closed-ended questions, that have precise answers. A quantitative approach is highly formalized, and more explicitly

controlled than the qualitative approach, with a range that is more precisely defined and that is relatively close to the social sciences (Kumar, 2011). In this present research, both the pre-test and post-test o represented the quantitative approach. The intention for using pre-test and post-tests was to acquire learners' pre-conceived ideas about the circulatory system.

In line with qualitative methods, the researcher used a questionnaire, which consisted of closed and open-ended questions. The qualitative research techniques can help learners develop more ideas related to the issue because it builds knowledge. Qualitative research is described by its aims, which relate to understanding some aspects of social life and its processes that use words, rather than numbers, to analyze the given data (Rotchford, Rotchford, Mthethwa. & Johnson, 2002). It is holistic ,and its main aim is to understand social life and the meaning that people attach to everyday life (Schurink, 1998). The qualitative method also helps the researcher to understand learners' concepts about the circulatory system. According to Pasick et al. (2009), qualitative methods allow for the identification of previously unknown processes, explanations of why and how phenomena occur, and the range of their effects.

According to Best and Kahn (1993), qualitative research describes events without numerical data. It allows the learner to express ideas open-endedly, unlike the quantitative method. Tuckman (1994) pointed out that qualitative methods provide the opportunity to have direct contact and get closer to the learners. Through learners' responses, the researcher will be able to see their strengths and weaknesses and then find ways to address them.

Creswell (2009) outlined the features of qualitative research as:

- It is usually conducted in natural settings. Natural settings (such as classrooms, schools, and sports fields) are the overwhelming preference for qualitative studies.
- The extensive use of descriptive data. Qualitative researchers are likely to describe a phenomenon with words rather than with numbers.
- The emphasis is on process rather than on product.
- It is often based on inductive logic: going from the specific to the general.

3.3 Sampling

Polit and Hungler (1999:37), supported by Welma and Kruger (2002:46), refer to population as an aggregate or totality of all the objects, subjects, or members that conform to a set of specifications.

In this study, the sample was forty-nine grade 10 learners in one class who attend a government school within Metro East District in Cape Town. This study took place at the school where the researcher is employed since it was more convenient. A classroom was used for the research. This is a natural, typical learning environment for the learners. The classroom as natural environment enabled the researcher to have a complete, accurate picture of learners' behaviour within their natural learning context. The reason for not studying the whole population of grade 10 learners at government schools in Cape Town is the extended time and high costs associated with completingsuch a research project.

It is advantageous to use the largest sample possible in a research study because the larger the sample, the more representative it will be. Smaller samples will produce less accurate results because they are likely to be less representative of the population (LoBiondo-Wood & Haber, 1998). With the help of a Raosoft Calculator, the researcher used a 5% margin of error with a confidence level of 95%, basedon an estimated population of 49 learners in grade 10 and using a response distribution of 50%.

This research used a sample of one class in a school where the researcher worked, located in Kraaifontein, Cape Town. The class consisted of 49 learners, consisting of both boys and girls. Table 4 shows the demographic information for the learners.

Table 4: A table showing participants' demographic information(n=49)

Gender frequency		**Parents/ guardian, they live with.**				**Parents' educational level (%)**			**Reading frequency per week (%)**	
Male	Female	mother	Father	Both	Other	Sec.	Dip.	Degree.	Once	Daily
17	32	29	4	14	6	81	13	6	72	28

In this study, a class of 49 learners participated. Seventeen were males, and 32 were females. Hence, there were more girls used in the study as compared to boys. Learners were between 15-16 years of age, and they all had isiXhosa as a home language. Of the 49 learners, 29 lived with their mothers only, 4 with their father, 14 with both parents, and 6 with other relatives. Eight one percent (81%) of the learners' parents had secondary school education as their

highest level reached, whereas 6% had reached a degree level. Seventy two percent (72%) of the learners indicated that they studied only once a week, whereas 28% said they studied daily.

3.4 Sampling methods

Simple random sampling requires that each member of the population have an equal chance of being selected (which is the main goal of probability sampling). A simple random sample was selected by assigning a number to each member in the population list and then "use a random number table to draw out the members of the sample" (MacNealy, 1999). Based on the sample size of 49 grade 10 learners, random sampling assisted in selecting participants. Out of 6 classes of 49 in each class, one class of grade 10 was randomly selected. Each class was assigned a unique number and the numbers were thrown in a hat. This class was picked at a township school in Cape town for consideration in the research study.

3.5 Research instruments

A number of research instruments were used for the study, including a pre-test, post-test, and questionnaire.

3.5.1 The Pre-test (See Appendix A)

A pre-test was administered when schools opened for the third quarter in July, 2019. The timing was fair enough since learners did not have any school assessment tasks to do. Learners were still fresh from the holidays, with less pressure, and willing to participate in the research. Learners were informed well in advance about the date for the test. They hence had learners enough time to prepare. Before the pre-test, learners were informed that only name codes would be used, instead of their real names.

Annum (2016) defines research instruments as tools used to collect data. This research made use of tests, observations, and questionnaire schedules as research instruments. A pre-test was administered to learners, which consisted of a multiple-choice section and one-word and open-ended questions section. This pre-test was mainly based on work covered at grade 9, and helped to assess any misconceptions and the learners' conception levels of the human circulatory system. Some of the content challenges reflected by learners in the pre-test, were addressed by the researcher during learning interventions. Before writing the pre-test, learners were informed that the test was not part of their term's assessments but was intended for research purposes.

This was meant to reduce stress on the learners and to prevent them from panicking. Learners wrote the test under controlled exam conditions. Pre-test questions are found in Appendix A.

At the end of the pre-test , the question papers and the learners' answer scripts were collected for safekeeping by the researcher. This prevented learners revisiting the test questions since they would use the same test as a post test. For easy analysis of learners' performance, a memorandum was used to mark the pre-test. The learners' total marks for the correct responses was given out of 50, and converted into a percentage. The results obtained were summarised in the form of a graph. To get a deeper understanding of learners' performance, the results were analysed individually per question. This helped to evaluate the existence of any variations in learners' performance to different questions.

Drama intervention lessons were then developed based on the information obtained from the pre-test. The intention was to help improve learners' understanding of the circulatory system. The drama lessons were based on the components of the circulatory system, structure, and functioning of the heart. The Table below shows the research instruments and plan used to collect data.

Table 5: A Table showing the research instrument plan.

Type of research question.	Method	Research Instrument.	Participants.	Analysis.
3.5.2 **What conceptions do grade 10 learners hold about the human circulatory system before and after role-play?**	Pre-test and post-test	Test	Grade 10 Learners	Memorandum.
	Observation of lesson	Lesson plan based on: - components of the circulatory system, - structure and functioning of the heart - heart diseases	Grade 10 Learners	Assessment sheet
1. What were the experiences of learners during role-play about the circulatory system?	Questionnaire	Questionnaire	Gr 10 Learners	Categorised checklist

2. How effective was role-play in developing learners' understanding of the circulatory system?	Post-test	Test	Grade 10 Learners	Memorandum.

A pre-test was used to obtain learners' pre-conceived ideas about the circulatory system. Most of the questions set were obtained from textbooks and past exam papers. These test questions were developed in line with Bloom's taxonomy levels for quantitative analysis as shown in Table 6. The complete achievement test is found in Appendix A.

Table 6: Table showing the analysis grid for the test using Bloom's taxonomy levels

Question	Marks allocated	Bloom's cognitive levels		
		Lower order (40%)	Middle order (45%)	Higher order (15%)
1	10	√		
2	5		√	
3	10	√		
4.1-4.3.	9		√	
4.4.	3			√
5	5			√
6	5		√	
7	3			√
Total marks	50	20	19	11

The pre-test and post-test questions consisted of ten questions and a total of fifty marks. The type of questions asked included true-false, one-word, and open-ended questions. The test questions were in line with the percentages of Bloom's taxonomy levels.

A memorandum served as a marking guideline. From a sample size of 49 learners, only 42 learners wrote the pre-test, and seven learners were absent. Marks obtained from each learner

were then converted into a percentage. The types of questions asked included true/false, one-word, and application questions, based on the circulatory system.

3.6 Role-play as Intervention

Role-play lessons were taught by implementing McSharry and Jones' (2000) role-play activities of memory games, simulations, science play, and reflection, together with the role play stages of Cherif & Somervill (1998). A post-test was administered after lesson deliveries. Components of the post-test were the same as those of the pre-test. After the post-test, participants responded to the questionnaire. When corroborative evidence results from multiple sources, the quality of evidence is enhanced (Anderson and Burns, 1990). Therefore, the use of different research instruments helped to reinforce the triangulation of the current study.

3.6.1 Role-playing activities used in science classes (from McSharry and Jones (2000)

Experiential learning occurs when knowledge is acquired through concrete experience, reflective observation, abstract conceptualisation, and active experimentation (Kolb, 1984). Therefore, to include experiential learning activities during role-play, the lesson activities used were in line with McSharry and Jones' role-play activities. The following steps were followed in teaching the circulatory system through role play:

- A simple role-playing game activity
- Card and stick game.

The teacher introduced the topic. Selected learners were given name cards that had a name of the part of the heart. Each of the selected learners introduced themselves to the class, thereby giving the characteristic of the part they represented. For example: "My name is vena cava. I am the biggest vein. My function is to carry deoxygenated blood to the heart". The role-play strategy was used for this research because it helps to promote thinking, understanding, social and communicative skills among the learners (Lawless, 2019).

3.6.2 Memory game.

Each selected learner introduced themselves by giving only a function of the part of the heart. The other learners then provided the correct answer for that part. For example: "I am the biggest artery in the heart, and I carry oxygenated blood to different parts of the body. What is my name?" This assisted the researcher to assess if learners memorized what they were taught.

3.6.3 **Simulations.**

Learners were provided with a blue and red rope representing deoxygenated and oxygenated blood. They were also given some sweets, and a table. They had to simulate the movement of blood in the heart. One learner ran along the blue rope, but when he got to the centre where there were sweets (representing lungs), he left blue sweets. Another learner then picked a red sweet, ate it, and then ran along the red rope. This indicated oxygenated blood. The learners shaped the two ropes to represent the structure of the heart.

3.6.4 **Science play.**

Learners performed a short play to show the structure and function of blood vessels and demonstrate causes of heart diseases.

3.6.5 **Reflection.**

Discussion followed each role-play activity. The teacher who was the facilitator, asked questions related to the activity completed. This helped to check if learners could relate the role-play activity to the respective concept of the circulatory system. Also, each activity's advantages and disadvantages were evaluated to give room for improvement.

McSharry and Jones (2000) identified the following as the reasons for using role-play:

- A narrative method to communicate science content, discoveries and controversies.
- A sense of ownership of their learning especially when they are involved in construction and science drama performance.
- Frameworks for and ways into debates and discussion about moral and ethical issues that might otherwise be too sensitive for pupils to discuss.
- A physical experience through which abstract content is made more comprehensible than through conventional learning methods.

3.7 **Post-test**

Post-test questions were the same as those for the pre-test. The post-test was administered after using role play as a teaching intervention. This allowed the teacher to evaluate the effectiveness of the role-play method in learners' understanding of the circulatory system. The following

were the research instruments used after the post-test. Post-test questions are found in Appendix A (the same as the pre-test questions).

3.8 Questionnaire

After the post-test, participants responded to a questionnaire (Appendix B). The questionnaire was based on the participants' experiences during role-play and how it affected their understanding of the circulatory system concept. There was no time limit for questionnaire responses to allow participants to respond fully. Learners responded individually. The questionnaire included both closed and open-ended questions. Learners' responses were categorised, and interpreted. A few answers written in isiXhosa were translated by the researcher into English. Learners' responses were analysed qualitatively, by looking for any similar responses or variations (codes) and constructing categories. Some responses that did not suit any of the categories, were classified under the 'other' category.

Prior to the questionnaire, the procedural steps were made clear to the participants. The questionnaire interpretations were made available to the participants.

3.9 Data collection and analysis.

Data collection was done through the use of pre-test, questionnaire, and a post-test that was given after the use of the teaching interventions. A pre-test was an initial research instrument that was administered to the participants. The use of a pre-test was meant to gauge what concepts learners did not know in relation to the circulatory system. Hence, this reflected the initial stage of Vygotsky's ZPD concept. This was followed by some role play activities as an intervention strategy, which were then accompanied by discussions, explanations and some observations. Role-play activities used reflected such activities used in science classes, from McSharry and Jones (2000), and also addressed Vygotsky's ZPD concept.

The participants were given coded names. For example, L1 was a code for learner 1. All 49 participants were coded from L1 up to L49. The same codes were used for both tests and questionnaire administered.

The participants' test results were used as a measure to determine their level of understanding of the concepts taught. After collecting the results, the pre-test and post-test results were quantitatively analysed using frequency counts. Each type of response was converted into a percentage to make the comparison of results easier. A mean mark was calculated for each test

on both the experimental and control group. The analysis was performed per question to be able to compare learners' responses in pre-test and post-test, as shown in Table 7.

Table 7: A Table showing a format for test Results

Test	**Question.**	**Learner Performance.**		**% of response.**
		Learner	Mark.	
Pre.	1	L1		
	2	L2		
Post.	1	L1		
	2	L2		

The Table above was used for recording learners' marks in the pre-test and post-test. The results from the table were then presented in the form of a double bar graph, where each learner's marks were compared for both the pre-test and post-test. The learners' raw marks were converted into a percentage to measure if there was a change in the performance on the two tests.

3.10 **Ethical consideration**

Ethics is defined as a system of moral principles that govern the connections between people with mutual respect for all parties involved. They affect how people make decisions and lead their lives (Resnik, 2011). Ethics is concerned with what is good for individuals and society and is described as moral philosophy. Ethical considerations mean undertaking research while considering how humans may feel about the potential outcomes of the research (Polit & Hungler, 1999).

In carrying out research, human dignity and respect must be considered. Do not offend or cause physical or psychological damage to participants (Dunn, 2010). To prevent unethical research studies that have negative consequences for research participants, researchers are

encouraged to be well aware of their obligations and responsibilities (Bless et al., 2006). In line with what the above authors have suggested, the researcher followed ethical guidelines while conducting the research. She considered the participants' rights and interests, and learners' names remained anonymous by using learner codes. The ethical clearance process was as follows:

3.10.1 **Clearance and authority letters (See Appendix C)**

Ethical clearance was obtained from the Western Cape Education Department. To get permission to undertake the research study at the selected school, consent letters were distributed to the parents and the school where the research took place. The consent letters stated the conditions and guidelines between the participants and the researcher during the research period. The nature of the study and associated benefits were explained to the participants so that their participation would be based on informed consent. The research instruments used were verified by the UWC Research Ethics Committee who granted permission to conduct the investigation. The research instrument used emphasised the need for voluntary participation.

3.10.2 **Voluntary participation**

Before the research, the researcher explained what the study was all about, together with the types of research instruments used and the benefits of the research to the education sector. Participants were informed that their participation is voluntary and they were free to withdraw from the study whenever they wished. Consent letters were then given to the participants to obtain parental permission and signatures. Participants were given two days to return the signed consent letters, but there were a few who took almost a week to return them.

3.10.3 **Anonymity and confidentiality**

Participants were informed that their identities would remain anonymous throughout the study. Hence, to ensure this, the participants were told not to use their names, but instead they were given name codes. Codes of ethics should inform the researcher how to protect the participants' identities and those of research locations (Christians, 2005). Terms of confidentiality were also made clear to the participants. They were informed that their responses would never be made known without protecting their identity. Their names would never be revealed. The researcher kept the answer scripts and research instruments in a sealed envelope in a locked room.

3.10.4 **Reliability and Validity**

There is no measurement instrument that is one hundred percent perfect. Researchers are encouraged to evaluate the reliability and validity of data collection instruments. According to Bless et al. (2006), the only way to perfect a measurement instrument is to ensure its reliability and validity.

A reliable data collection method is relatively free from measurement error (Polit and 1999; Flick, 2011). In a way, it examines whether you are obtaining consistent information (Bless et al., 2006). Polit and Hungler (1999) defined reliability as the degree of consistency with which the instrument measures an attribute. Both the pre-test and post test questions were set in line with Bloom's levels of quantitative analysis. We can only establish the reliability of a measuring instrument if it can provide the same results in more than one trial.

The triangulation method is achieved when both quantitative and qualitative methods are used together to improve the validity of the investigation. In this study, triangulation by method was obtained by the using the pre-test, post-test, and a questionnaire as research instruments. Validity is a measure of truth or falsity of the data obtained using the research instrument (Burns & Grove, 2001:226). The instrument's validity is the extent to which "… the instrument reflects the abstract construct under examination" (Burns & Grove, 2001:814). Hair, Underson, Tatham, and Black (1998) argue that the validity of an instrument can only be verified if a panel on a specific topic or field is allowed to evaluate the questions for their suitability to measure what they argue against measuring (as cited in Mwangi, 2011, pp. 88).

The researcher's two science teacher colleagues moderated the research tests set for learners to check if it was in line with the curriculum requirements. The supervisor further evaluated the contents of the research instrument and other associated statements to ascertain their alignment to the stated objectives. A dramatic arts teacher from the researcher' work place moderated the role-play activities and ensured that they met the expected standards in the drama field. All research questions used were verified as linked to the literature of the study under investigation. For the study's validation, the research title was clearly stated. There was a connection between the research questions and the respective instruments used to collect data. The data were collected over two and a half weeks. The latter meant that the study was conducted over a continuous period hence ensuring the validity of the study.

3.12. Conclusion.

This chapter discussed the methodology of the study, which was underpinned by qualitative and quantitative approaches. Numerous data collection methods used to obtain the results were also explained. Ethical considerations, reliability, and validity were also discussed. The next chapter focuses on the analysis and discussion of the results obtained from the research study.

4 CHAPTER 4: RESULTS AND DISCUSSIONS

4.1 Introduction.

This chapter discusses the results obtained from the current research. A pre-test and a post-test were used as quantitative insttruments. These two tests helped reflect the amount of information that learners held before and after learning. They assessed the effect of the intervention used on the learning process. A questionnaire was the research instrument used to obtain the qualitative data. The main aim of this chapter is to answer the following research questions:

1. What conceptions do grade 10 learners hold about the human circulatory system before and after role-play?
2. What were the experiences of learners during role-play about the circulatory system?
3. How effective was role-play in developing learners' understanding of the circulatory system?

4.2 What conceptions do Grade 10 learners hold about the human circulatory system?

A pre-test (See Appendix A) was used to obtain learners' pre-conceived ideas about the circulatory system. The test questions were set in line with Bloom's taxonomy levels for quantitative analysis as discussed in Chapter 3. The pre-test also assessed their academic performance. The test, out of 50, consisted of questions on the heart's structure and functioning, blood vessels and types of heart diseases. The type of questions in the pre-test included true or false questions, terminology, fill-in the missing words, labelling a diagram and open-ended questions. The Table below shows the results obtained in the pre-test.

Table 8: Learners' Pre-test results (n = 39)

Mark range (%)	% Number of learners
0-29	67
30-39	21
40-49	6
50-59	6

From the results shown in the Table, 67% of the learners obtained marks below 29, which indicates a very low performance. This was followed by 21 % of the learners who obtained marks of between 30-39. Only 6% of the learners scored 40-49 and 50-59. Therefore, 94% of the learners performed below the 50% mark, with only 6% of them obtaining above 50%. This, clearly reflects a deficient performance in the pre-test. Hence, this low performance might be due to learners' lack of sufficient knowledge about the assessed content.

4.2.1 Question by question anal ysis of learners' responses in the pre-test

The learners' marks obtained from the pre-test were converted into a percentage. Also, an average mark was calculated for each question to see learners' performance in different questions. The learners' average mark (percentages) per question is found in the Table below.

Table 9: Learners' average mark (percentages) per question

Question	Learners' average mark (%)
1	52
2	29
3	23
4	6
5	37
6	31
7	35

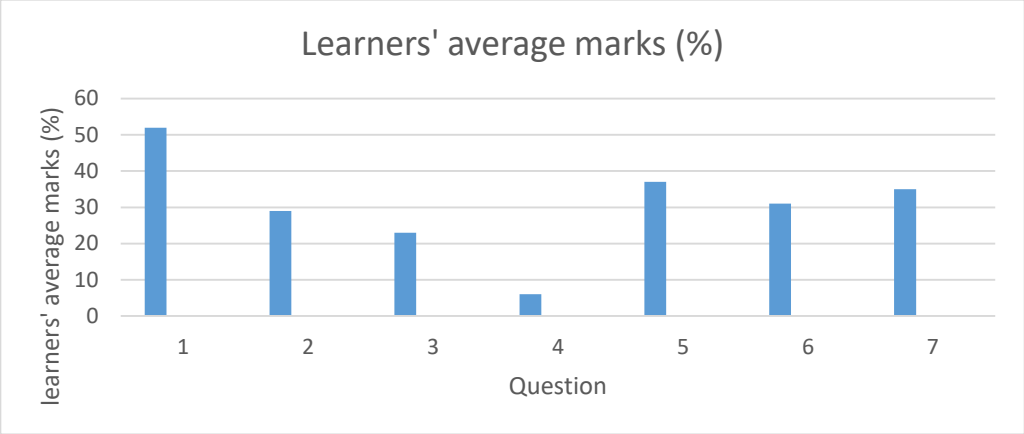

Figure 6 : Learners' average marks per question

The learners' average marks were then represented graphically in the graph (Figure 7).

The results shown in Figure 7 above show that learners performed the best in question 1, obtaining an average mark of 52%. All the other questions had an average percentage mark of less than 40 %, with question 4 having the lowest average mark of 6%. A thorough analysis of learners' responses per question is reported on in the following section.

The graph in Figure 7 illustrates the percentage of learners who responded correctly, and those who provided the incorrect answers in the pre-test. Furthermore, learner performance was based on individual question analysis as indicated in Figure 8.

Learners' correct responses in pre-test marks

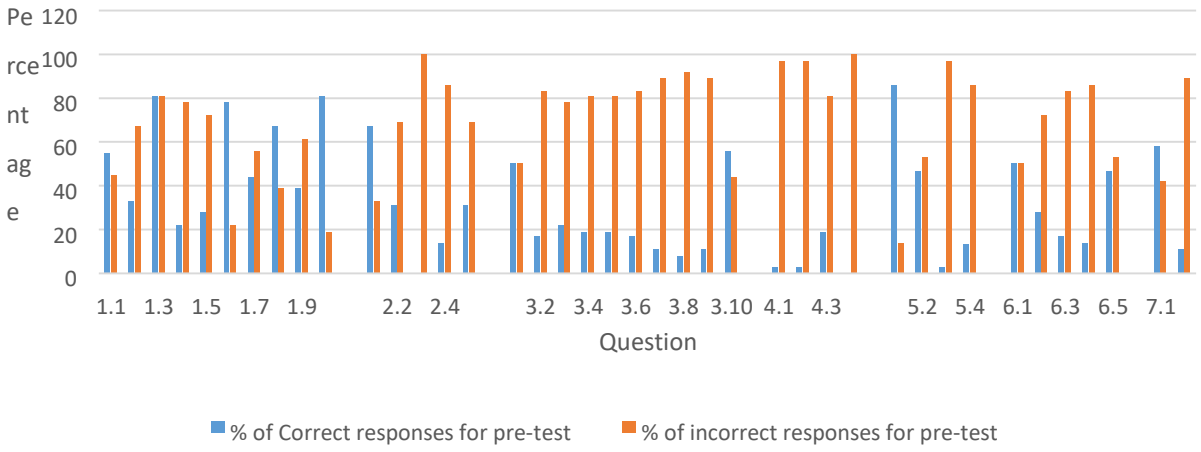

Figure 7:Learners' pre-test responses

Thirty nine of the 49 participants in the pre-test completed the pre-test representing an 18% absenteeism rate. The results from Figure 8, indicates that in almost all the test questions, the percentage of learners with correct responses was less than those with incorrect responses.

Question 1 was a true or false question, based on ten items. The average pass rate for this question was 52 %. In Question 1.3, learners were asked to indicate whether it is "'true', or "'false' that "deoxygenated blood is carried on the right side of the body and oxygenated blood is carried on the left side of the 'body'. Fifty percent of the class obtained the correct answer (true). The items for which the number of correct responses were greater than the one for incorrect responses included questions 1.1 and 1.10. An average pass rate of above 50% was obtained on questions 1.1 (58%), 1.6 (78%); 1.8 (68%) and 1.10 (80%). Question 1.1 and 1.10, which were "true/false questions, stated that, "All veins contain deoxygenated 'blood', and "The atrium is the upper chambers of the heart", respectively. Also, an average of less than 40 percent was obtained in questions 1.2, 1.4, 1.5, and 1.9. Since question one was a closed-ended question, it was not clear whether learners genuinely got correct answers or were guessing.

Question 2 was a terminology question consisting of five components, and learners obtained an average pass rate of 29%. For question 2.1, learners had to name the organ that pumps blood. Only 68% correctly mentioned the heart , and 32% gave incorrect responses. Some of these responses given by learners were:

Learner 48:	Alviolo
Learner 49:	Deoxygenated
Learner 14,4:	No answer
Learner 25, 20,36,45:	Capillary
Learner 18:	Circulation
Learner 9	atrium
Learner 31, 34	artery
Learner 30:	Pulmonary

Based on learners' responses above, it is clear that some learners like L49 and 18 might not have understood the question very well since 'deoxygenated' and 'circulation', have nothing to do with the organs. The fact that four learners (L25, L20, L36, L45) wrote 'capillary' as their answer might indicate the existence of some misconceptions. They failed to differentiate between the function of the heart and capillary. Two learners (L4, L14) did not answer this part of the question. Their response during the interview was that they did not

know what to write. In question 2.2, learners had to name the largest artery in the body. Only 70% of the learners correctly identified the aorta. Some of the responses given were:

Learner 14,18,25,36:	Heart
Learner 49:	Atom
Learner 9,12, 42, 43:	Capillary
Learner 5:	Calpimonary
Learner 24, 40:	Veins
Learner 31	In the body
Learner 3:	Nutron

It is evident from the responses given above that learners L49 and L3 had insufficient information about the blood vessels since the answers given (atom, nutron) had nothing to do with arteries. Learner L5' s answer did not provide any meaning, since it was not clear what he intended to write. Also, the fact that five learners pointed out capillary as the largest artery does reflect some misunderstanding that learners might hold about arteries and veins.

Therefore, the results given above reflects that most learners (L14,18, 25, 36, 45) thought that the heart was the largest artery. Hence, this might be a sign of a misconception that needs to be addressed by the researcher during teaching. As for learner L49, the Learner lacked some knowledge about arteries, as the answer given namely, 'atoms' was not related to the question asked. The three learners (L9, L12, L43), who gave capillary as an option, indicated a great need for the researcher to explain more about the blood vessels during lesson delivery. However, the fact that a higher percentage of learners indicated 'vein' and 'capillary' as the largest artery alerted the researcher that she needed to clarify the differences between these three blood vessels.

In question 2.3, learners were requested to give the name of the structure that directs blood flow. The correct answer was 'valve'; none of the learners gave the correct response. Based on question 2.3, sixteen learners mentioned the 'veins' as the answer, 7 learners wrote 'capillaries' as their preferred choice, and some did not report any response. Below were some of the responses:

Learner 26: Circulation

Learner 18: Capillaries

Learner 32: Vein

Learner 38: Chamber

Learner 39: No response

.

Question 2.4 required learners to name the blood cells that carry oxygen. The answer was red blood cells, but only 12% of the learners gave the correct answer, whereas 88% of the learners gave various responses. Some of the responses given were:

Learner 18, 25; 36, 45:	Oxygenated blood
Learner 40:	Deoxygenated
Learner 8,9, 24, 30, 49:	Arteries
Learner 12, 22, 34	Ventricles
Learner 5:	White blood cells
Learner 32:	Respiratory

From the learners' responses above, it is clear that the six learners (L7, 18, 25, 36,45, 40) lacked the knowledge to differentiate between blood cells and the types of blood (e.g. oxygenated blood is not a blood cell). Also, for learner 32 to refer to 'respiratory' as a type of blood cell shows that maybe the learner confuses the respiratory and circulatory systems. Learners L8 and L12 seem to have mixed-up the blood vessels and blood cells, since arteries are a type of blood vessels.

In question 2.5, learners were required to name the blood cells that fight germs. The expected response was white blood cells, but only 30% of the learners responded correctly. Other answers given by learners were:

Learner 38, 48:	atrium
Learner 24, 34, 30:	alveoli
Learner 9, 40, 49:	oxygenated blood
Learner 7, 18:	deoxygenated blood
Learner 4, 20, 29, 46	No answer
Learner 32:	red blood cells
Learner 43:	muscles

From all the incorrect answers given, only learner L32's response, 'red blood cell', was closer to the expected answer. The rest of the answers showed learners' lack of knowledge concerning the circulatory system. Hence, this was seen in Learners L9 and L7, who mentioned 'the types of blood', whereas L43's mentioning of 'muscles' shows some lack of

knowledge about the circulatory concepts in learners. This was reinforced by some learners' (Learner 4, 20,29, 46) failure to provide an answer.

In question 3, learners were expected to fill in the correct term by choosing the answer from the ten options given. Only 23% of learners provided the correct responses. The lowest correct response was obtained by 10% for item 3.9.. Question 3.5 required learners to mention the type of circulation that sends blood from the heart to the other body parts. Only seven learners provided correct responses, and 32 learners (81%) failed to mention 'systemic circulation' as the right answer. Some of the learners' answers included:

Learner 5: Veins

Learner 27: Hypertension

Learner 24: Chambers

Learner 42: Atria

Learner 13: Alveoli

Learner 2: Veins

In question 3.8, learners were asked to name the structure that connects arteries and veins. From the responses given, only two learners gave a correct response; 33 learners (92%) failed to identify the capillary as the correct blood vessel. Four learners did not even attempt to answer the question. The reason for not answering the question was revealed by learners during intervention. They highlighted lack of knowledge as the main reason. Some of the responses given were:

Learner 4: Hypertension

Learner 18: Arteries

Learner 26: Alveoli

Learner 30: Atria

Learner 20: No answer

Therefore, the failure rate of 92% might indicate that learners had little understanding of this concept. Hence, there was a need to emphasize the concept during teaching. Learner 4's answer was irrelevant as it was a type of heart disease, but not a structure.

Question 4 had the lowest pass rate of 6 %. Learners were asked to label the mentioned blood vessels (pulmonary vein, vena cava, aorta) and indicate the direction of blood flow, on the given circulatory system diagram (that is, question 4.1 and 4.2, respectively). The majority of the learners failed to label the diagrams correctly, except 4% of the learners who partly labelled the diagrams. In question 4.4, learners had to explain the effect of a hole between the heart's right and left ventricles. Instead of mentioning that the oxygenated and deoxygenated blood will mix, some learners indicated that the person might suffer from heart problems or tuberculosis. Below is a summary of some of the learners' responses:

L38: Deoxygenated blood is carried on the right side of the body, and oxygenated blood is carried on the left side of the body.

L30: Right and left ventricles of the heart, the right is bigger than the left ventricle

L20: That is a spectum that divides the left and the right side of the heart

L9: It is when a person there is something wrong on his chest that is a Tb

L42: The person will be suffering to take out the baby so that they must do operations

L26: The person will suffer from a heart attack or suffer from stroke

L4: No response

L29: Hole between right and left ventricle

None of the learners gave an appropriate response. Learner L38 and L20 had some idea about the heart's functioning, as they mentioned the types of blood and existence of a septum (even though learner L20, wrote 'spectum'). Learner L9 showed a lack of knowledge about diseases affecting the circulatory system. TB does not affect the circulatory system, but is a respiratory disease. Learner L42 also lacked some knowledge to distinguish between the circulatory system and the reproductive system. A hole in the heart does not affect the child's birth. Some learners, like L29 duplicated the question without answering, and others, like L4, did not respond. More attention needed to be paid to the teaching of this concept because learners lacked understanding of the concept or failed to remember relevant concepts.

There was an average pass rate of 31% for question 5, which was based on the blood cells and their functioning. On the first part of 5.1., learners were given a diagram showing the two

types of blood cells, and they were required to identify the blood cells that were the largest. In response to question 5.1, a larger number of learners (83 %) managed to correctly identify the white blood cells as the answer, whereas only 15% of learners mentioned the red blood cells. One Learner (L24) did not respond, and another learner (L48) indicated that she did not know the answer. Some learners' responses are given below:

L6: White blood cells

L45: White blood cells

L32: Red blood cell

L24: No answer

L48: I 'don't know what blood cells

In part 5.3. learners were asked to give a reason why the red blood cells were so abundant in the blood. Only one learner (L6) gave the correct answer, while the rest of the class gave invalid responses, as mentioned below:

Learner 36: It is because the blood cells are indicated as white blood cells and red blood cells; that's why we can see the largest and many blood cells

Learner 5: Because they are surrounded by a circle, so they are many inside, so they are largest ;they have oxygen.

Learner 30: because the red cells are small and many blood cells

Learner 39: Because the diagram shows white blood are bigger than red blood cells and red are many

Learner 6 : Because red blood cells carry oxygenated blood and they are important in the person's body.

Out of the whole class, only learner L6 gave a relevant answer, and other learners showed that they did not understand the question. For example, learner L30, ncorrectly thought the smaller size of the red blood cells made them more abundant. Even learner L39 failed to give

a relevant response, as they still attributed the reason due to the smaller size of the red blood cells.

Question 7 consisted of two parts, and the average pass rate was 35%. In 7.2, learners had to explain whether exercise will decrease or increase the heart rate. Fifty eight percent of the learners obtained the correct answer (exercise does increase the heart rate). Furthermore, 42 % of the learners indicated that exercise decreases the heart rate. Learner's responses were:

L26: It will increase, because the heart is getting pressure and it will start to pump the blood more faster and much warmer.

L6: It will decrease, because the more you exercise the more the functions of your body will function properly.

L38: It will decrease, because the more you axcise the more the heart decrease.

L24: Increase, we must exercise everyday to be fit our life and our body.

Learner L26 gave an appropriate response, whereas L6 gave a wrong answer and failed to clarify the functions of the body that were referred to. As for learner L24, it is wrong to measure a person's fitness by their increase or decrease in a heartbeat. Hence, this alerted the researcher that there was a need for learners to practically determine their own heartbeat during various activities to clarify some misconceptions.

Generally, learners had difficulty answering questions 2, 3 and 4, resulting in an average pass rate of 38%; 23% and 6%, respectively. Question 2 focused on terminology, where learners had to give the correct biological term for the five descriptions given. For the third question (question 3), learners were asked to fill in the ten descriptions given by choosing words from the word bank provided. Question 4 was a diagrammatic representation of the circulatory system, whereby learners were asked to label and show the direction of blood flow using arrows. Only 20% of the learners correctly indicated the direction of blood flow, while 80% of the learners failed to show this. This could be due to learners misunderstanding the content. Learners performed better in question 1, a true/false question, with the percentage mark for correct responses ranging between 20% to 80%.

4.2.2 **Discussion of the pre-test results**

Findings from this present research revealed that 94% of the learners performed below 50% in the pre-test, with only 6% of them obtaining above 50%. This reflected very poor performance. There were a few cases in which some respondents failed to answer some of the questions. Hence, this was attributed to the learners' lack of sufficient knowledge about the assessed content. However, the learners' answers indicated some existence of pre-conceived ideas.

Gooding, Swift, Schell, Swift & McCroskery (1990) pointed out that prior knowledge is the most powerful forecaster of scientific accomplishment. This implies that the performance of learners in science is strongly determined by their pre-conceived ideas. Learners come to the learning situation with pre-existing ideas about many phenomena. Pre-conceived ideas may emanate from the learner's environment. Lave and Wenger (1991) acknowledged that learning does not occur in a vacuum but is socially constructed in a dynamic physical environment. According to the constructivist theory, knowledge is viewed as temporary, developmental, socially and culturally mediated, and thus, non-objective (Brooks & Brooks, 1993). Therefore, some of these ideas are *ad hoc* and unstable; others are more deeply rooted and well developed (Taber, 2006). Hence, the eradication of a misconception depends on its degree of deep-rootedness. This implies that a deep-rooted misconception might require a very strategic and effective teaching method, to make the learner conceptualise and memorise better.

The fact that learners underperformed in the pre-test shows that they failed to recall information learned from their previous grade. This might have been due to the chalk-and-talk method used during the last grade. Hence, there was a need to use a more effective teaching method to address concepts that were difficult to recall. One of the proposals about misconceptions is their persistence and resistance to change using traditional instructional strategies (Wandersee et al., 1994).

When learners were asked to name the largest artery, some of them gave incorrect responses. Some of these respondents (L49, and L3), had insufficient information about the blood vessels since their answers (atom, nutron) had nothing to do with arteries. Also, the fact that five learners pointed out capillary as the largest artery reflected the the existence of misconceptions with regards to arteries and veins. These misconceptions appeared in other questions in which

most learners (L14,18, 25) thought that the heart was the largest artery. This entrenched a need for the researcher to address these concepts during teaching.

Also, in question 3.8, learners were asked to name the structure that connects arteries and veins. From the responses given, only two learners gave a correct response; 33 learners (92%) failed to identify the capillary as the correct blood vessel. Four learners did not even attempt to answer the question. Learners revealed the reason for not answering the question during intervention; learners highlighted lack of knowledge.

4.3 What were the experiences of learners using role-play

Role-play activities used for this research include simulations, memory games and songs. Mochocki (2013), pointed out that the literature concerning educational drama, simulation, game-based learning, and edu-larp are related. Role-playing helps participants discuss the similarities between their roles, share and analyse why, and what occurs during playing. Participants in role-playing were asked to answer the following question: what happens in role-playing? What did they feel during role-playing? Do you think that this meeting had a good result? (Warland and et al., 2012:2). Hence, the questionnaire used for this research consisted of the 'what' and 'why' questions, to get a better picture of the learners' experiences during role-play. A questionnaire was used to answer this research question, and the results are discussed in section 4.4. below.

4.3.1 Analysis of qualitative data from the questionnaire

A total of 40 learners participated in the questionnaire session. Table 10 shows learners' responses to the first two questions of the questionnaire.

Table 10: Learners' attitude towards role play

Question	Learners' response	No. of learners
1. How did you feel during role play?	Excited	39
	Confused	1
2. Did you like role play?	Yes	39
	No	1

The first question on the questionnaire asked learners about how they felt during role play. The given response option included excited, bored, confused, angry; shy, frustrated, and nervous. Out of 40 learners, 39 learners indicated that they were excited, whereas one learner felt confused. The second question asked learners whether they liked role-play. Interestingly,39 out of 40 learners indicated that they were in favour of role-play. One learner indicated a dislike towards role-play.

4.3.2 What did you like about role-play?

In response to the questions above, the main categories identified from learners' responses were: Understand better (U); focus (F); practical/hands-on (P) and other (O). Table 11 summarises the percentage of learners' responses under various categories.

Table 11: Learners' reasons for use of role-play

Category response	Number of learners
Understand better (U)	14
Focus (F)	3
Practical (P)	19
Other (O)	4

Of the 40 learners who answered the questionnaire, 14 indicated that role-play enhanced their understanding while three agreed that it helped them focus much better. Nineteen learners said they liked role-play because it was more practical, and a hands-on approach. Overall the majority of learners indicated that they liked the practical part of role-play. Responses that did not make sense were placed under 'other' category. Below are some responses with the category indicated at the end in brackets:

Learner 2: I like that when you learn during role-play, you understand very fast what are you learning- **(U)**

Learner 20: I liked that it makes me understand easy and it is fun- (U)

Learner 7: I like to play and am focused 'that's why I like to play -**(F)**

Learner 6: Some learners are not good at learning through writing and reading; they learn through visual samples, so the role-play gave everyone a chance to fully participate in the play- (F)

Learner 13: I liked the fact that everything was practical and that we were playing**(P)**

Learner 11: That we were playing but at the same time learning- (P)

Learner 48*:* I will did into the can that was that in the- **(O)**

Responses for learner 2 and 20 imply that role-play makes them easily understand the concepts that are taught to them. Learner 7's response shows that the learner is more interested in learning through play, making the learner concentrate more. Also, based on learner 6's response, it clearly points to some learners prefering role-playing as visual learning, which enables them to see what is happening unlike the chalk-and-talk method. Hence, learner 6 and learner 13's both view role play as stimulating that enables them to be active participants. Learner 11's answer implies that the learner liked role-play which made learning fun. However, as for learner 48, the researcher failed to get some meaning from the learner' s response. This was attributed to the fact that maybe the learner had difficulties in constructing sentences or articulating ideas.

It is evident from the Table above that most learners enjoyed role-play because it is practical. Most of the learners were actively involved during the learning process. The results from the above Table, were represented in the pie chart in Figure 9.

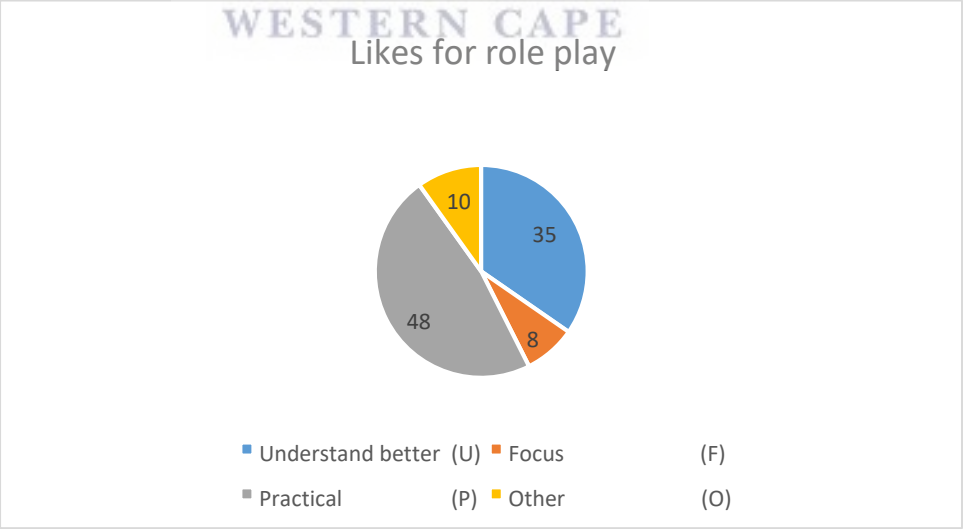

Figure 8: Learners' likes about role play

A graphic representation of the learners' responses is given in Figure 9. The percentage of the learners who indicated that role-play made them focus was 48%, 35% said it made them

understand better, and 8% were of the view that it gave them more focus. In an attempt to correlate quantitative and qualitative data, it was found that most learners who appreciated role play showed an improved performance in the post-test. The pre-test and post-test results for some learners who acknowledged role-play as a factor catalyst for improved understanding are shown below.

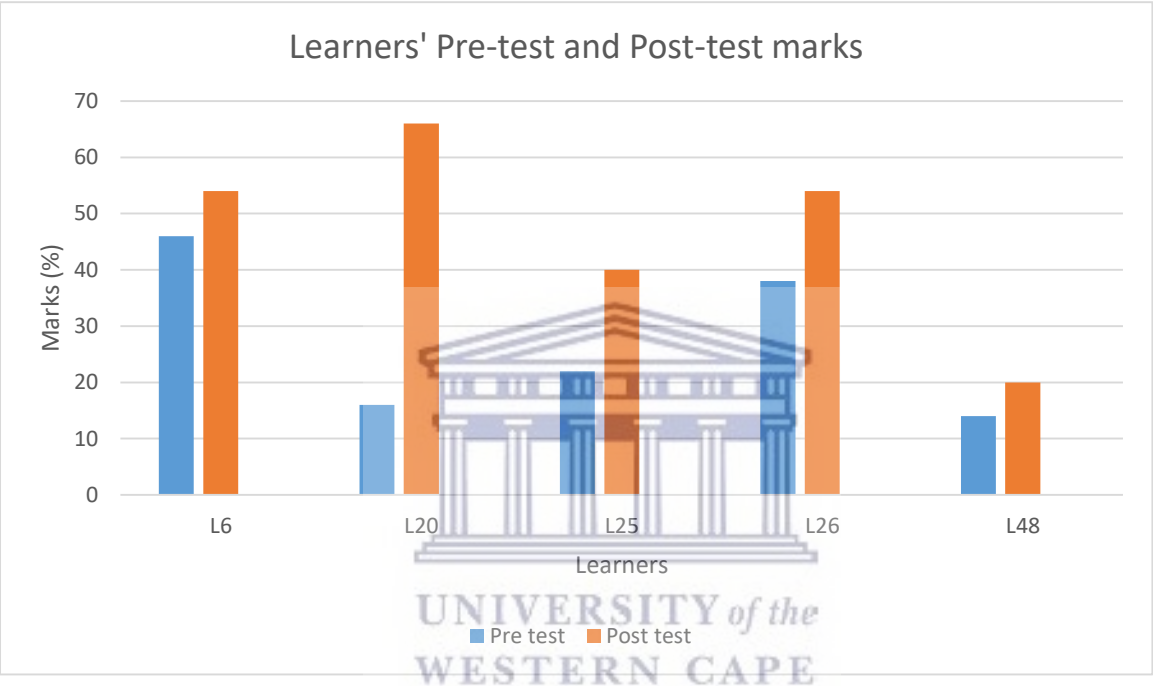

Figure 9: Learner performance on pre-and posttest

The responses that were made by the learners above, based on what they liked about role-play were:

Learner 20: I liked that it makes me understand easy and it is fun

Learner 25: I like that when people show us what they ready, makes us understand

Learner 26: What I like about role-playing is that it makes learning fun, and you get to understand things easily without wasting time.

Learner 20 and 26's responses imply that the fun part of role-play, made them understand better. In addition, learner 25's response shows that the learner understood better by observing others role-playing. Hence, these learners' responses, accompanied by a considerable increase in their post-test marks, shows that role-play impacted positively on the learners' understanding. Role-play had a positive effect as it helped to improve learners' performance. Therefore, by comparing learners' responses above, with their improved marks

in the post-test (Figure 10), it reflects that role-play made them understand better within a short space of time.

4.3.3 What did you not like about role-play?

To make it easy for the analysis of results, learners' responses were categorised as follows:

Intolerance (I), Nothing (N), learners' undisciplined (D) and Other (O).

The table below shows learners' responses to the above question.

Table 12: Learners' dislikes about role-play

Category response	% of learners
Intolerance (l)	40
Nothing (N)	22
Undisciplined (D)	19
Other (O)	19

Learners' responses were categorised into the following categories, namely: Intolerance (l); Nothing (N); undisciplined (D), and Other (O).

Based on the results analysed table above, 40% of learners were intolerant towards role-play; 22% disliked nothing; 19% disliked the indiscipline shown by their peers during the role-play activity, and 19% were classified as 'other'. Below is a list of some of the learners' responses and the respective categories:

Learner 2: I did not like people who laugh at other learners who cant explain what we were learning about- (l)

Learner 6: I didn't like the way that others are being judged when they make some mistakes, and most were not serious about the main reason for the play- (I)

Learner 26: The class tend to make a lot of noise, and it becomes hard for others to concentrate because others learn easily in a quiet place- (I)

Learner 13: I liked everything- (N)

Learner 35: Nothing at all- (N)

Learner 22: I 'didn't like when they were making noise- (D)

Learner 10: learners were noisy, and the were learners who think they are better than the others- (D)

Learner 19: Yes- (O)

Based on the learners responses above, it implies that learner 2 and learner 6 did not like the behaviour of peers who laughed at others during role-play. Hence, this was viewed as a way of undermining other learners. Learner 22 and 26 seemed to be more concerned about the noise level made during role-playing, and implied that it distracted their focus. Also, learner 10, felt that the noisemakers thought they were more superior than other learners, hence contributing to the learners' dislike towards role-play. Therefore, it is evident that most of the learners did not tolerate their peers' negative attitudes towards role-play.

Since 19% of the learners indicated their dislike towards their undisciplined peers, it is evident that maybe lack of classroom management might have been the root cause of the indiscipline. Also, the aims and importance of the role-play activity must be made clear to learners well beforehand to avoid some indiscipline issues. Some of the undisciplined comments emanating from the class audience made the participants feel shy and uncomfortable. Role-playing allows students to judge and evaluate themselves in terms of weaknesses and strengths when performing in front of their peers (Hoshmandi & Yousefzadeh, 2014).

4.3.4 Question: Would you recommend that role play be repeated next time?

Since most learners felt that they liked role-play, this matched with their response to question 5, in which 97% recommended repeated use of role-play strategy. Only 3% of learners disliked the repeated use of role-play in the future.

4.3.5 Give a reason on why you would recommend that role-play be repeated next time

To assess learners' understanding of question 5, learners were asked to motivate why role-play should be repeated or not. Three categories were used to classify learners' responses: Understand better (U), Motivation (M), and Other (O). The results obtained are shown in Table 12.

Table 13: Reasons for use of role play

Category response	% of learners
Understand better (U)	68
Motivation (M)	20
Other (O)	13

The results in Table 13 show that 68 % indicated that learners understood better through role-play, and 20% were motivated by role-play. Only 13% of learners' responses were classified as 'Other'; they provided incomplete answers, no answers, or the answer did not make sense. Examples of some of the learners' responses include:

Learner 3: Because when we do role play we understand more easily- (U)

Learner 5: I learn fast when we sing-(U)

Learner 11: We will keep things in mind everytime when we are playing-(U)

Learner 13: I experienced excitement- (M)

Learner 19: It makes me fell happy and I enjoy it-(M)

Learner 28: I enjoyed being part of the play-(M)

Learner 44: Role play is a game that gives you a- (O)

Learner 34: The want to prove it- (O)

Learner 48: Because of in they will can for in the will can that will like- (O)

Learner 3, 5 and 11, reflect that they would recommend role-play as it helps with faster conceptualisation of information. Based on responses for learners 13, 19, and 28, it seems role-play motivated them by stimulating happiness and enthusiasm. Learner 34 and 44 had incomplete responses, hence categorising their responses under 'other'.

4.3.6 Do you feel that your understanding of the circulatory system concept has improved?

The learners were expected to make a choice of either 'yes' or 'no'. The responses of learners are found in Figure 11.

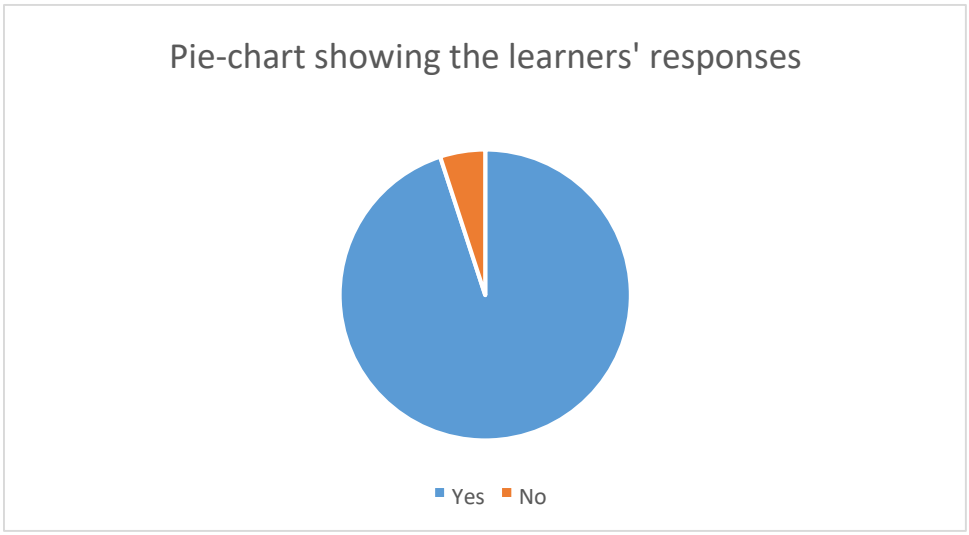

Figure 10: Effect of role-play on learners' understanding

In response to question 4.6.3, 95% of learners indicated that their knowledge of the circulatory concept improved during role-play, whereas 5% felt less appreciative of the role-play in enhancing their understanding.

4.3.7 How did role-play contribute to your understanding of the circulatory system?

In order to further assess the reliability of the learners' responses, they were asked to justify how their understanding had improved. Their responses were divided into three categories, namely: easy memory (M), increased understanding (U), and Other (O), as shown below.

Table 14: Contribution of role-play to learning

Category response	**% of learners**
Easy memory **(M)**	20
Increased understanding **(U)**	68
Other **(O)**	12

Based on the results above, 20% of the learners indicated that they could easily remember concepts learned through role-play, whereas 68% indicated that their understanding increased during role-play. Only 12% had incomplete or meaningless answers. Some of the learners' responses were as follows:

Learner 6: Yes, role-play played an important role in my understanding of the circulatory system and I learn through visual lessons. I used to struggle before with the understanding of a circulatory system now I fully understand- **(U)**

Learner 7: Yes, because I know many things about circulatory system and I understand very very better now. It contributed more *ulwazi ngaphezu koku bendinalo* (more knowledge on top of what I had)- (U)

Learner 14: Yes, because I understand everything now about circulatory system. It make me to have more understanding about circulatory system- (U)

Learner 19: Yes, because when I do it, it makes me feel happy. You in diexoge pass the right side at the heart and come back in left side- (M)

Learner 23: Yes, because I will always remember it because I have saw how does it move. It contribute by making moves and explaining at the same time- (M)

Learner 28: Yes, because I enjoyed being a part of the play. By the people who were busy doing the role play in front of the class (M)

Learner 44: Yes, it not my game at all. Because it talk about all the cecutory system- (O)

Learner 16: Yes, It improve. It contribute me- (O)

Since learners 7 and 14 pointed out that role-play made them understand better, this was confirmed by the learners' improved results in the post test. The response given by learner 23 shows that the learner will remember what was taught; memorisation and recall was hence improved. As for learners 16 and 44, their responses did not make sense.

4.4 **Application of the role-play method.**

The importance of role play method is to promote understanding of the circulatory system concept at different levels when teaching the topic. Cherif & Somervill's (1998) four stages of role play, together with McSharry and 'Jones' (2000) role-play activities, were used in this study**.**

(i) Preparation and explanation

In preparing the learners for the topic, the teacher had to first unload the topic. The teacher started by writing the topic, 'Human circulatory 'system' on the board. This was a way of engaging learners to think so that the teacher could elicit their prior knowledge. Brook and Reiss (2006) pointed out that the learners' worldview draws on everyday experience, commonly used terms and language, and what has they gleaned from science as presented by the media, family, friends, and school. Brook (1968) referred to these pre-conceived ideas of learners as an 'empty 'space'. In the second stage, the class identified the main words, and wrote them out separately, as 'circulatory' and 'system'. Learners had to provide the meanings of the main words. Initially, learners had to define the term circulatory. At first, they all were silent. The teacher asked them to name the source or root word from which 'circulatory' was derived. These were some of the learner responses:

Like round: [learner 7]

Circle: [learner 12]

Semi-circle: [learner 32]

Not straight: [learner 9]

Circulate: [learner 14]

Learners' responses were written on the board. Learners were given time to discuss the answers, and to select the correct responses. The class then agreed that the first two options were correct. The last option was ignored because it looked like a repetition of the word 'circulatory', but the teacher promised to revert to it and discuss it later. Hence, to fulfill this, the educator then asked learners to clarify the meaning of the word 'circulate'. In response to the question, the following responses were given:

Define the word 'circulate' [Teacher]

Circulate means circle: [learner 11]

It means round: [learner 4]

It is to move: [learner 36]

Around: [learner 9]

After a class discussion on the options given, irrespective of the fact that they are closely related, they agreed that the correct responses were the last two options. The teacher agreed that ‘circulate’ implies that there is movement taking place. This led the teacher to ask a general question, where learners had to name a substance that is constantly moving in the body via the circulatory system. The answers given were as follows:

Name one substance that always circulates in the body [Teacher]

Water moves: [learner 5]

Oxygen: [learner 17]

Gases: [learner 32]

Blood: [learner 22]

The teacher had to comment and emphasised that blood is the one that moves in the circulatory system, though this blood carries some oxygen and carbon dioxide. In the next part, the teacher asked learners to define the word 'system'. The responses were:

What is a ‘system’? [Teacher]

Two things: [learner 4]

Group of cells: [learner 18]

Parts of the body: [learner 16]

During the teacher-whole class discussion of the responses given, learners had to provide examples of ‘parts of the body’. Discussion encouraged most participants to communicate with one another. Many students expressed that this improved their relations with peers and could develop communication skills more than teaching focused entirely on traditional instructional methods (Bosse and et al., 2012).

The teacher wrote the body parts mentioned by learners on the board. Learners had to group the body parts according to the common function that they perform. Some of the responses given were:

Nose, lung for air: [learner 20]

Heart, veins for blood: [learner 3]

Kidney, bladder for urine [learner 12]

Uterus, ovary for baby [learner 36]

From the examples given by learners, the teacher explained that each group of organs represents a system. To summarise the discussions, the class concurred that a system was a group of organs with a specific function. The two definitions of the words ‘circulatory’ and ‘system’ were put together forming one definition. The teacher had to prepare learners' in advance, by informing them that they were going to learn about the circulatory concepts in the form of role-play.

The teacher, as a facilitator prepared the stage. A brief description of what needed to be done and allocating particular roles to learners started the process. Learners became aware of what they were expected to do during role-play. A brief explanation was given about the circulatory system and the parts of the heart. Since the circulatory system concept was first introduced at the previous grade, the teacher posed questions to learners to see what they already knew. A model of the heart was used as the teaching aid. Fifteen learners were selected, and they were allowed to pick name cards that had the name of the part of the heart. Each learner had to stick the card on the correct part of the heart. Some of the names written on the name cards were: vena cava; left atrium; septum; right ventricle; pulmonary vein; pulmonary artery. Only 5 out of 15 learners managed to identify the parts of the heart correctly. Some of the learners' incorrect responses were as follows:

Identified vena cava as a pulmonary vein [learner 2]

Identified the left atrium as the right atrium [learner 12]

Without giving the correct answers, a second group of learners was selected, to perform the same game. Only 7 out of 15 learners managed to label the parts of the heart correctly. The game activity was followed by a class discussion, in which the correct labels were provded. Learners' behaviour was observed during each activity.

(i) Student preparation for the memory game activity

During this stage, learners who are the key participants in the role-play, came together to discuss how to present themselves during the activity. Some learners wrote down their scripts on paper to memorise them.

After a recap of the card-and-stick-game lesson previously done, and a brief mention of some parts of the heart, learners were then introduced to the new lesson, that was based on the functioning of the parts of the heart. Functions of the parts of the heart were first discussed with the class. Learners were given time to prepare themselves for the memory game. After learners' preparations and clear instructions were given, the selected learners introduced themselves to the class, thereby giving the characteristic of the part of the heart that they represented. Some of the introductions made were as follows:

> My name is vena cava. I am the biggest vein. My function is to carry deoxygenated blood to the 'heart'.

Each learner selected introduced themselves by giving only a function of a given part of the heart. The other learners then gave the correct answer for that part. For example: 'I am the biggest artery in the heart, and I carry oxygenated blood to different parts of the body. What is my name?'. This assisted the researcher in assessing if learners do recall from memory what they were taught.

(ii) The role-playing activity

The role-playing activity was in the form of songs and simulations. Braund (2014) described role-playing as the drama space since it involves the type of role play used, the role-play design, together with the teacher and learner' roles. After being given enough time for preparation, learners had to perform the roles assigned to them.

Learners performed some songs related to the circulatory system concept. Each group was asked to compose its own song, and they were given time to sing in front of the class. Songs were performed in groups, and they were sung in isiXhosa and English. Most learners seemed to be comfortable when they sang in isiXhosa, rather than in English. The latter was noted

from the way in which their body language coordinated well with the song's lyrics. Drama can create a positive learning environment in the classroom and increase social interaction and self-esteem (Ariel, 2007). When learners are required to learn concepts in a second language, they are frequently confronted with literacy content problem; the grasping of the content of the topic becomes very challenging, thereby negatively affecting the learners' performance (Van der Poll & Van der Poll, 2007 in Ayano, 2018). The class was divided into seven groups, each made up of six learners. Learners were given five minutes to perform. Comments were given after each group performance. Most learners were excited during singing. A few who seemed to be shy at first. This might be due to stage fright. This enabled the teacher to assess if the role-play activity could be completed within the given time.

Simulations were also used. Learners had to simulate the pulmonary and systemic circulation of blood in the human body. This was presented in the form of simulations, as shown in Figure 11.

Figure 11: Simulations of circulatory system

Learners were given a blue and red rope to represent deoxygenated and oxygenated blood, red and blue circle-cards were used to represent oxygen and carbon dioxide, respectively. Learners had to simulate the movement of blood in the heart. One learner ran along the blue rope, but when he got to the centre (representing lungs) where there were red and blue circle cards, he left a blue circled card. Another learner then picked a red circled-card and then ran along the red rope. This indicated oxygenated blood. The two ropes were shaped to represent the structure of the heart, lungs, head, and legs.

(iii) Debriefing after the role-play activity.

Heyward (2010) mentioned that a detailed briefing period before and debriefing after an intervention is an effective way of assessing 'learners' understanding. Each role-play activity

was accompanied by discussion afterward, where the teacher, who was the facilitator, asked questions related to the activity. This helped to check if learners were able to connect the role-play activity done to the respective concept of the circulatory system. The Discussion was helpful since complicated concepts were simplified by the teacher through scaffolding. In a dialogue, unsystematic, disorganized, and spontaneous concepts of a child are met with the more systematic, logical, and rational concepts of the skilled helper (Mishra, 2013). Some of the questions asked with the responses, are listed below:

The following were some of the answers to the above question:

Teacher]	Which type of blood is represented by the blue rope?
[learner 14]	It represent blue blood
[learner 6]	It represent deoxygen blood
[learner 29]	It is dirty blood
[learner 32]	It is blood with carbon dioxide

The teacher had to write some of the options given, on the chalk board. After learners were given time to discuss, a question was posed to them to define the meaning of deoxygenated blood. It was then agreed that all the options above were relevant, except for the first option. In support of his answer, learner 29, said that since carbon dioxide is a waste product, this makes the blood 'dirty' since it contained a waste product (gas). The first option was ruled out based on the fact that no blood is blue. All blood is red, irrespective of whether it is oxygenated or deoxygenated.

The other question asked by the teacher was:

Teacher: If a learner picks up a red-circled card from the lungs, which type of blood does it represent?"

Learner 4: It is clean blood

Learner 18: It has no carbon dioxide

Learner 25: It is from the heart

Learner 10: It has no disease

Learner 40: There is oxygen

From the responses given, the first (learner 4) and last (learner 40) options were concluded by the class as the correct ones. The second option (learner 18) appeared to be incomplete since it only mentioned the type of gas absent but did not mention the type of gas present in the blood. The teacher and learners' comments and discussions clarified the answers. This helped the teacher to clarify and correct some of the 'learners' incorrect responses. 'Learners' responses in the discussions helped the researcher to evaluate whether successful learning has taken place or not. All learners were given time to evaluate the effect of the role-play activity on their understanding of the circulatory system concept. Also, the advantages and disadvantages of each activity were considered, to give room for improvement.

4.4.1 **Discussion and implications**

This present study revealed that most respondents liked role-play because of its practical nature, since it is a hands-on approach. From the overall results obtained, most learners indicated that they liked the practical part of role-play. This is supported by constructivist teaching, which states that learning occurs as learners are actively involved in the process of meaning and knowledge construction instead of passively receiving information (Bhattacharjee, 2015).

Some of the responses obtained showed that some learners were interested in learning through playing. It helped them to concentrate more. Some learners prefer visual learning, which enables them to see what is happening, as experienced in role-play. Dorion (2009) stressed the power of drama in developing students' visualization abilities. Hence, learner 6 and learner 13's responses both viewed role-play as a stimulant which enabled them to become active participants Some learners said they liked role-play because it helped to make learning fun. Hence, in support of this idea, Sukstrienwong (2018), noted that role-play was full of fun and made learners understand faster. Alrutz (2004a) pointed out that drama-based science teaching motivated students in learning, boosted their enthusiasm for learning science, and solidified their understanding of science content.

Similar to other researchers' findings, this current research study found that role-play helped learners to improve their understanding of the circulatory system (Bulunuz, 2013; Yoon & Kim, 2017; Bose & Seetso, 2016; Alabsi, 2016). An increase in the learners' post- test marks, as compared to the pre-test, shows that role-play impacted positively on the learners' understanding. Some studies revealed that employing creative drama was an effective

strategy in enhancing students' conceptual understanding of scientific concepts (Albliwi, 2008; Al-Taweel, 2011; Hendrix, Erick & Shannon, 2012). Role-play did have a positive effect as it helped to improve learners' performance. This was seen in the learners' questionnaire and post-test responses, which reflected that role-play made them understand better within a short space of time.

Some learners recommended use of role-play in future, because it helped them with faster conceptualisation of information. Role-play motivated learners, thereby stimulating happiness and enthusiasm. The use of drama increased learners' performance and motivation in studying chemistry (Najam, Hugerat, Khalil & Hofstein, 2019). Hence, this development of motivation in learners, resulted in them developing a positive attitude towards learning. Abed (2016) pointed out that learners taught through drama developed a positive attitude towards science and a more improved conceptualisation.

While most learners liked role-play, only a few learners (19%) indicated their dislike towards this method. They did not like how their peers were undisciplined during role-play. Stevens (2015), after teaching a history lesson through role-play, found that most learners benefited a lot, whereas a few showed little gains. It is therefore evident that maybe improper classroom management might have been the root cause for the indiscipline. Some of the undisciplined comments emanating from the class audience made the participants feel shy, uncomfortable, and less confident.

4.5 To evaluate the effectiveness of the use of role-play in developing learners' understanding of the circulatory system

This section aimed to explore whether learners were able to articulate the human circulatory system concepts correctly after they were engaged in role-play activities. A change in learners' understanding was reflected by how they performed in the post-test. The teaching of the human circulatory system was done through role play as a teaching strategy**.** Recent studies show that learners who learned science in the form of drama have a higher understanding of science concepts and are willing to learn science through creative drama (Bracha, 2007). Therefore, this indicates that drama can also motivate learners and help them conceptualise challenging tasks. Science learning through drama encourages learners to get involved in science activities and assist them to comprehend challenging ideas (McGregor, 2012; Braund & Ahmed, 2018).

A post-test was used to answer the research question mentioned in 4.1. Post-test questions were the same as the pre-test items, and in both cases, learners were informed on time about the tests. The total number of learners targeted for the tests was 49. Only 39 wrote pre-test while 41 wrote the post-test. Generally, there was significant improvement in learners' performance on the post-test. Results obtained from both the post-test and pre-test are shown in the Table below.

Table 15: Pre-test and Post-test results

Marks (%)	**% Number of learners**	
	Pre-test (n=39)	**Post-test (n=41)**
0 - 29	67	36
30-39	22	28
40 - 49	6	17
50 - 59	6	11
60 - 69	0	8

The number of participants who sat for the pre-test was 39 out of 49, while a higher number of 41 learners participated in the post-test. The results in the Table above show how learners' performance changed from pre-test to post-test. The results from the Table above were represented graphically as shown below.

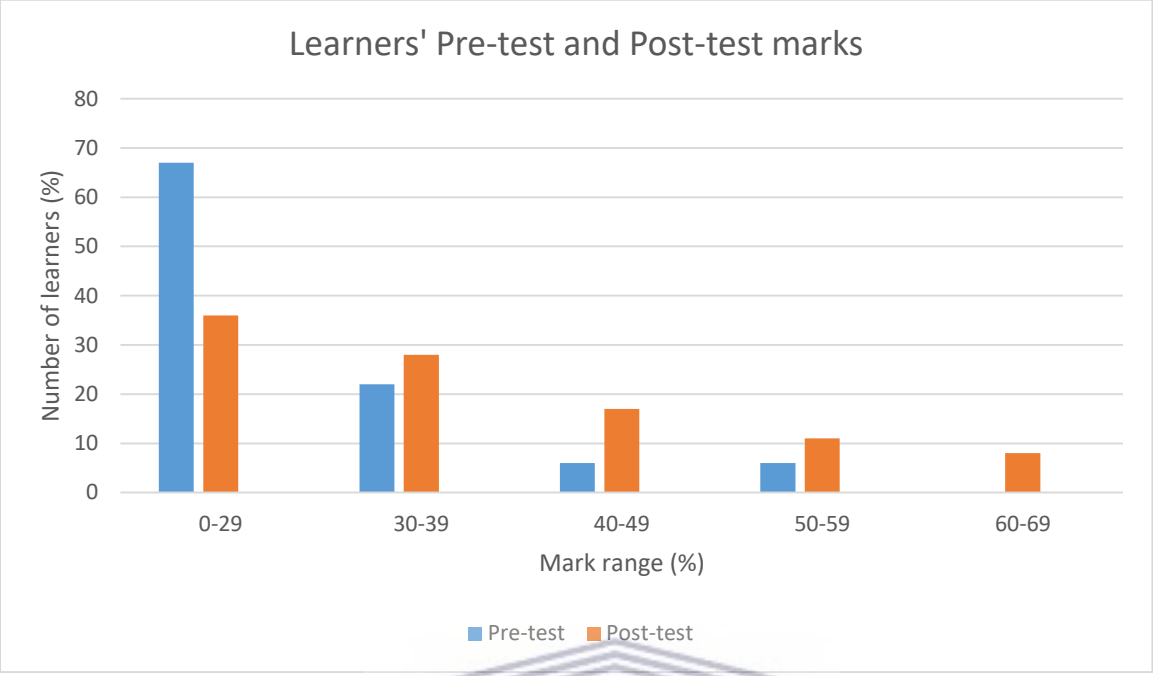

Figure 12:: Difference in performance, pre-rest to post-test

The graph in Figure 13, indicates a 31% decrease in the percentage for learners who scored between 0- 29; from 67% in the pre-test, to 36% in the post-test. Hence, this decrease in the number of learners indicated an improvement in the quality of results. Comparably, 22% of learners scored between 30-39 in the pre-test, against 28% in the post-test, resulting in a 6% increase. A considerable performance increase was seen in those who obtained between 40-49%; moving from 6% to 17%. Hence, the increase was by almost 150 %. In the percentage range of 50-59%, there was a change from 6 to 11%. The presence of 8% of the learners who got between 60% and 69% in the post-test, compared to none in the pre-test, shows a positive change in the quality of results. The number of learners who obtained 50% and above increased from 6% to 19 %, which shows an increase of 13%. Therefore, this reflected a considerable improvement in the quality of results in the post-test. There is an increase in learners' performance in the post-test in all percentage ranges, except the 0-29% range.

Even though there was an equal percentage of learners (6%) who scored between 40 – 49, and 50-59 in the pre-test, an increase of up to 17% and 11%, respectively, was seen in the post-test. These improvements in the quality of results could be attributed to the intervention method used in the study. Role-playing helped to scaffold learners and to reduce their ZPD. McKenzie (1999) pointed out the following as some of the reasons for scaffolding:

(i) It simplifies the content given to learners since the teacher provides the required guidelines for the activity that allows learners to achieve the objectives.

(ii) It helps learners to comprehend the reasons and significance of doing the required class activities.

(iii) It gives learners direction and various ways of reaching a particular decision.

4.5.1 **Post-test result analysis for learners' correct responses**

Figure 14 shows analysis per question, based on the percentage of correct responses for both the pre-test and post-test.

Generally, there was an increase in the percentage of learners' correct responses, from pre-test to post-test. Questions 3.8 and 4.1 were the exception, as the percentage for correct responses remained the same in both tests. Question 2.5. showed the highest increase by moving from 32% to 78%. Most learners were able to retain the knowledge that white blood cells do fight germs. Hence, there was a 46% increase. In this question, learners were asked to give the name of the blood cell that fight germs. Some examples of learners' responses to this question changed as shown in Table 16.

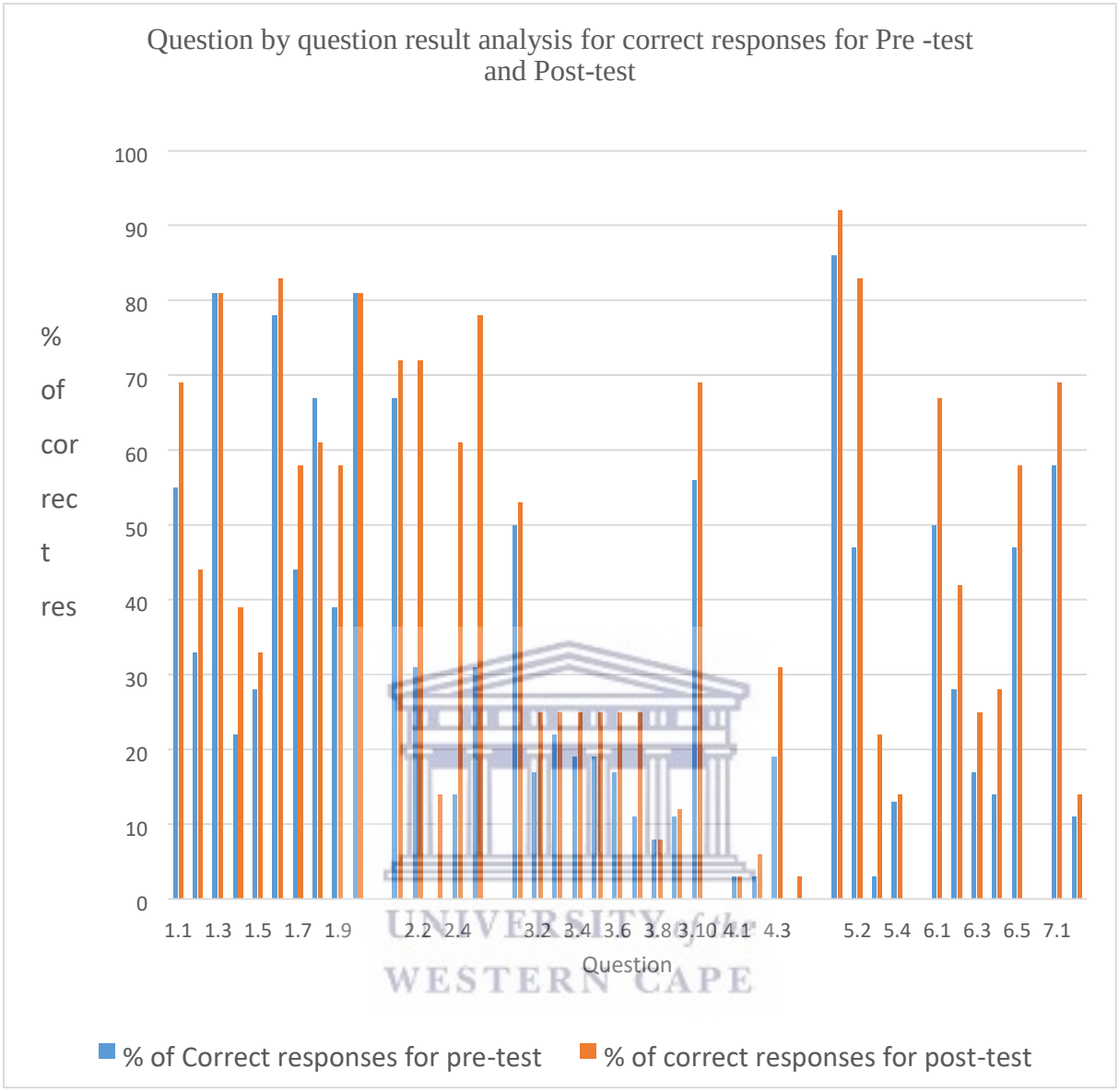

Figure 13: : Learners' correct responses for pre-test and post-test

Table 16:: Learners' responses to question 2.5

Question	Learner code	Response in Pre-test	Response in Post-test
2.5. Blood cells that fight germs are called---	L43	Muscles	White blood cells
	L18	Deoxygenated blood	White blood cells
	L30	Alveoli	White blood cells
	L14	Chamber	Red blood cells
	L32	Red blood cells	White blood cells

From the responses shown in the Table above, most learners who had initially given incorrect answers in the pre-test, like L43 and L18, could give correct responses in the post-test. An exception was learner L14, who wrote an incorrect answer in both the pre-test and post-test. Learner L14's response changed from 'chamber', in the pre-test, to 'red blood cells', in the post-test. However, even though both responses for learner L14 were incorrect, based on the response given in the post-test, it was evident that the learner had some idea that the cells that fight germs were a type of a blood cell. But, the learner still failed to remember the information taught accurately. Therefore, the correct responses given in the post-test by learners, does indicate an increased level of understanding. Generally, there was an improvement in the percentage of correct answers for all the questions.

4.5.2 Comparing Pre-test and Post-test results for problematic questions

There are some questions in which learners did under-perform in the pre-test. These questions include questions 2.3, 4.1, 4.2, 4.4, and 5.3. the graph below shows a comparison of learners' performance in both pre-test and post-test.

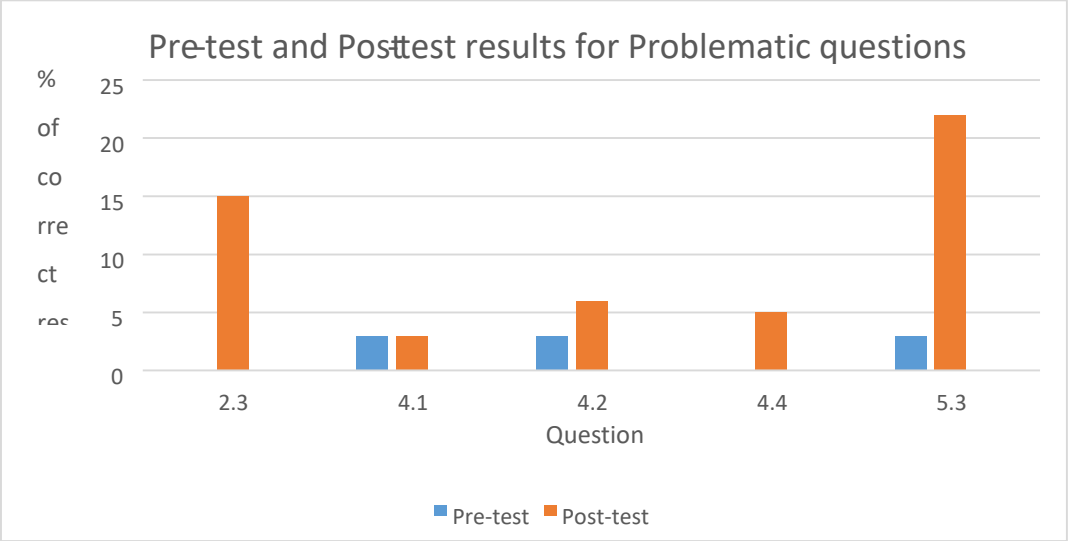

Figure 14: Pre-test and Post-test results for Problematic questions

According to the results shown in Figure 15, for question 2.3 the percentage of correct responses improved from 0% in the pre-test, to 15% in the post-test. Hence, this indicated a huge improvement in the results. In this question, learners had to name the structure that directs the flow of blood, and the answer expected was 'valve'. Some of the responses given by learners were:

Table 17:Responses in pre-and posttest for 'structrure directing blood flow'

Learner	**Learner's response in Pre-test**	**Learner's response in Post-test**
L7	Veins	Valve
L2	Heart	Valve
L41	Capillaries	Veins
L29	Veins	Veins
L20	Veins	Valves

The results above show that learner L7, L2, and L20 managed to give correct responses in the post-test. This indicates that the intervention used during teaching was effective. The responses for learner L41 changed from 'capillaries' (pre-test) to 'veins' (post-test), which proved to be incorrect. Hence, this shows that even after exposure to the role-play intervention method, the learner still gave a different but an incorrect response. Learner L27 maintained the answer as 'veins', in both tests, which was incorrect. This shows that the learner did not accommodate the new knowledge taught during role play, but instead, the learner still maintained his alternative idea. Hence, this might be a reflection that these learners still needed more intervention strategies to improve their understanding of the concepts.

In question 4.4, learners had to explain the effect on a person suffering from a hole between the heart's right and left ventricles. This question's pass rate changed from 0% (pre-test) to 5% (post-test), still indicating a low pass rate. Below are some of the responses:

Table 18: Learners' responses

Learner	Learner's response in pre-test	Learner's response in post-test
L43	The baby will die or it means it has disease called cancer	The baby will die
L39	The oxygenated blood will not move.	Oxygenated blood may mix with deoxygenated blood
L30	Right and left ventricle of the heart. the right ventricle is bigger than the left ventricle	Between the right and ventricle of the heart the different is that is not the same another is smallest and biggest
L9	It is when person there is something wrong on his chest that is TB.	There will be more chances about that person to live, because of his circulation stops and the person lost to many blood

Based on the responses above, learner L7 only mentioned in both cases that the child will die without explaining. This shows that the learner still lacks information concerning the concept. By focusing on the response for L30, it seems the learner did not understand the question since the learner mentioned that the ventricles are of different sizes. The response for L39 looks contradictory, as the first part implies that the person will survive, whereas the last part suggests that there will be no blood circulation, implies death. Learner L39 was a positive exception. The learner correctly mentioned that oxygenated blood might mix with deoxygenated blood, compared to the incorrect answer given in the pre-test. This might indicate that the learner has assimilated the new knowledge taught to them concerning the

circulatory system. Also, the low pass rate obtained for question 4.4, may be attributed to the fact that this was a higher-order question, and learners might have found it challenging.
A constant percentage pass rate of 3% was obtained in both tests, for question 4.1. Learners were required to label the pulmonary vein, vena cava, and aorta on the given circulatory system diagram. The labelling of the diagram was slightly challenging which might have attributed to learners' low performance. Most learners, like L49 and L31, incorrectly labelled the blood vessels.

Learners' pass rate increased from 3% to 6%, in question 4.2. However, most learners still failed to correctly indicate the direction of blood flow in the aorta and pulmonary artery. Besides this being a higher-order question, it was difficult for the learner to show the correct blood flow direction without knowledge of the position of the aorta.

Question 5.3 required learners to give the reason why the red blood cells are abundant. The pass rate increased from 3% to 23%, showing a considerable improvement in performance. Table 19 summarises the average percentages for the two tests administered.

Table 19: Average percentage for learners' test

Test	% Average
Pre-test	28
Post-test	36

The Pie Chart in Figure 16 represents the pre-test and post-test average percentages previously shown in Table 19.

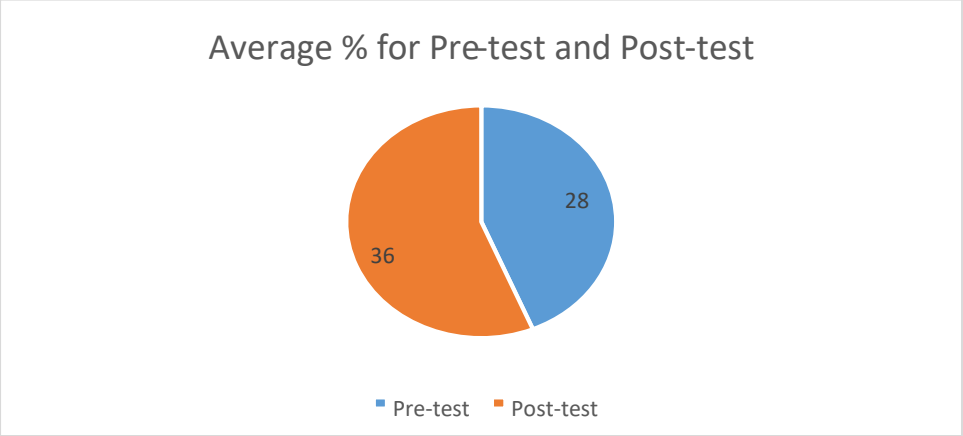

Figure 15: Average percentages for Pre-test and Post-test

Based on the results obtained from Table 19, learners performed better in the post-test than in the pre-test. This was seen by an increase in the mean average mark, from 28% in the pre-test, to 36% in the post-test. Therefore, this increase in the average mark in the post-test, does reflect that the role-play strategy helped to improve learners' understanding. Hence, role-play was an effective teaching method.

4.5.3 Discussion and implications

There was an increase in the percentage of learners' correct responses, from pre-test to post-test. Overall, there was an improvement in learners' performance in the post-test, in almost all percentage ranges, except for the 0-29% range. Learners' class average mark changed from 28% (in pre-test) to 36% (post-test). Hence, this increased the quality of the results. The findings obtained in this present research were supported by the extant literature. Students who have learned science through drama have shown a greater understanding of scientific concepts and preferred learning science through creative drama (Bracha, 2007, Saricayir, 2010 & Stevens, 2015).

Bulunuz (2013) supports the idea that learners taught through role-play conceptualised science concepts better than those taught by direct instruction. By comparing learners' post-test performance after teaching vocabulary, Alabsi (2016) supports the idea that learners taught through role play out-performed those exposed to a normal chalk-and-talk method. The out-performance of learners after role-play, might indicate how this teaching strategy has helped improve understanding of the concepts taught. Besides improving learners' performance, role-

play is effective in enhancing learners' communication skills. Role-play promotes thinking, understanding, and communicative skills among the learners (Lawless, 2019). In support of the skills developed during role-play, Craciun (2010) added scientific ideas, creativity, and leadership skills, as being improved during role play.

The present study found that there were still a few misconceptions that existed in some learners. Besides experiencing an improvement in learners' performance, there were a few where some learners wrote the same incorrect answers in both tests. The learner did not accommodate the new knowledge taught during role-play, but instead, the learners maintained their alternative conceptions. Hence, this might reflect that these learners still needed more intervention strategies to improve their understanding of the concepts. This supports the ideas that are not scientific can be converted into the desired ideas only to some extent with the mediation because they are very resistant to change (Bilgin & Geban, 2006; Duit, 2007). While this present research findings differ from Braund, Ekron & Moodle (2013), who said that there was no educational connection between the drama and science concepts, the researcher does support their recommendation for the inclusion of breakthrough discussions during role-play. This is a form of bootstrapping where breakthrough discussions could immediately address resistant misconceptions when noticed rather than delay resolving them until after the role-play. Verbal scaffolding and conversation (Wass, Harland & Mecer, 2011) between the teacher and learners would be necessary during the role-play exercise.This will also allow learners to achieve the zone of proximal development which results from supported or scaffolded learning.

4.6 **Learners' performance based on gender**

Although the research questions did not focus on gender, the results of the study point to a difference in gender when it comes to performance in this study. Based on the gender, of the 39 learners who wrote the pre-test, 28 were girls, and 11 were boys. Of the 41 learners who wrote the post-test, 31 were girls, and 10 were boys. Figure 17 represents the average percentage marks for both boys and girls.

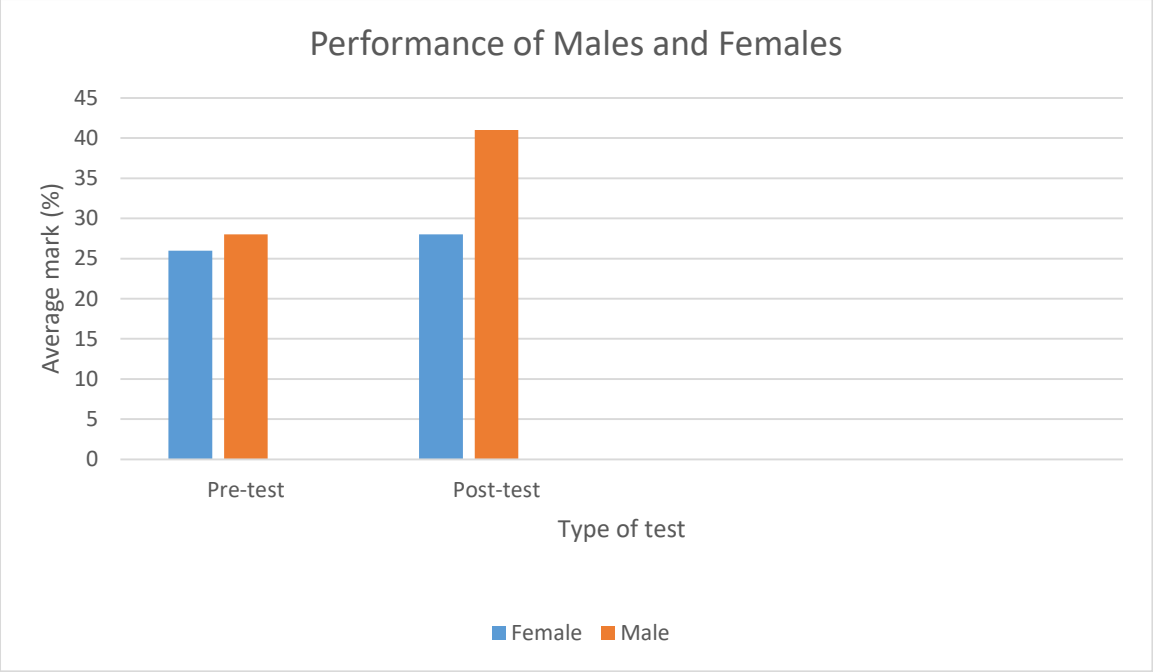

Figure 16: Average percentages for males and females

From the information shown on the graph above, the first bar on each test represent the females, whereas the second bar represents the males. In the pre-test, females obtained an average of 26%, and the males got 28%. This resulted in a difference of 2%, in the average percentages, with the males leading. For the post-test, the females obtained an average of 35%, and the males got an average of 41%, resulting in a difference of 6%. Therefore, from the two tests written, males generally performed better than the females in both tests. Since the percentage difference in the averages was higher in the post-test, it can be concluded that the role-play method used had a more significant impact on the males than the females in this current study.

4.6.1 **Discussion**

This finding is supported by other researchers (Levin, Sabar & Libman, 1991, Çakıroğlu, 1999 & Kelly,1985). According to the study of the science achievement carried out by the IEA (International Association for the Evaluation of Educational Achievement), it was found that gender differences exist in all the grades, with boys performing better than females (Çakıroğlu, 1999). Kahle & Meece (1994) suggested that these differences in boys and girls' performance can be attributed to the following factors: individual, intellectual, attitudinal, sociocultural, home and family, and educational variables.

Based on the sociocultural factor, the parents' lack of motivation and reinforcement towards the girl child's science education, demotivate girls towards science subjects and contribute to their low performance. Çakıroğlu (1999) described this negative socialisation of girls as 'stereotyped socialization', as it leads to 'girls' failure to conceptualise science topics.

These differences are more common in the science learning area. It was concluded that as the child's age increases, the gender difference also increases, especially between the ages of 9 to13. The degree of gender differences can be impacted by the learner's capability, school's physical position, and the learner's socioeconomic background (Levin, Sabar & Libman, 1991). In most schools, science is a male-dominated subject, negatively affecting the mindset of girls towards doing science. Hence, the term 'masculine science' was used to describe male dominance. Kelly (1985) pointed out three reasons why science is seen as a masculine subject:

(i) Science is mostly taught and studied by males

(ii) The syllabus has more preference towards males, both in its structure and presentation.

(iii) A male-biased pattern interaction contributes to the masculine image of science. According to Becker (1981), girls' low performance in science is due to the self-fulfilling prophecy created by the unfair treatment that learners receive from the teachers. Teachers' various anticipations based on gender make them give different treatment to the learners, leading to the different performance of the learners. Therefore, girls will then underperform to fulfill the teachers' expectations.

4.7 **Conclusion**

The study results show that role-play is an effective method of teaching the concept of the human circulatory system. Role-play helped to improve the learners' performance, understanding, and motivation. This increased performance of learners was seen in the higher average mark in the post-test compared to the lower average mark experienced in the pre-test. The fact that the percentage for learners' correct responses was higher in the post-test compared to the pre-test, was another reflection that the use of role-play in learning was more effective in enhancing understanding. The increased motivation of learners was seen in their excitement and willingness to participate freely during role-play activities. The findings for

this study are in support of those obtained by other researchers, previously discussed in the literature review (Najami et al., 2019, Yoon & Kim, 2017, Crowthera et al. (2015), Abed, 2016, Bose & Seetso (2016), & Bulunuz, 2013). Therefore, role-play can be implemented in the teaching of life sciences, as it helps learners easily conceptualise the content. The learners' prior knowledge of the topic contributes to their understanding during role-play. Also, based on gender performance, males were found to perform better than females.

The majority of learners reflected an understanding of the topic during role-play, with very few who still showed that they still held some misconceptions. This implies that since learners' ways of grasping knowledge are different, then various teaching strategies need to be implemented in the teaching process to accommodate everyone.

The next chapter will discuss the conclusion and recommendations for the study.

5 CHAPTER 5: CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

Chapter 4 focused on the analysis and discussion of the results for the study. This chapter summarises the findings, present the conclusions drawn and propose recommendations for future studies, practice and policy. The chapter also outlines the challenges faced during the research and the implications of the results. This study investigated the effect of role-play in teaching the human circulatory system to grade 10 learners.

5.2 Summary of the findings in response to the research questions

5.2.1 What conceptions do grade 10 learners hold about the human circulatory system before and after role-play?

In order to determine learners' prior understanding of the circulatory system, a pre-test was administered to them and the results obtained were discussed. Generally, learners experienced low performance on the pre-test.

From the analysis of the results , it appeared that learners did not perform well on questions 2.3, 2.4, 3, 4, 5.3, 5.4, and question 7.2, since they scored less than 30%. Question 2.3; 2.4 and 3, were recall questions, whereas question 4 and 5 were application questions.The worst performance was for questions 2.3 and 4, which the whole class got incorrect. Therefore, this resulted in the need for an intervention to ensure they had a better comprehension of the concept. An improved performance in the post-test was seen for question 1; all learners obtained more than 50%.

One of the main findings obtained from the study was that there was a low performance in the pre-test, which indicated the existence of some misconceptions. Learners' marks showed some increase from the pre-test to the post-test. There were variations in the learners' performance on the post-test, with some questions showing a considerable improvement. Generally a significant improvement was seen in five out of the seven questions. In the other two questions asked, the learners performance on the pre-test was the same as on the post-test. This low performance was attributed to the difficulty level of the question; it was a higher-order question. Therefore, this indicated a need to prepare learners for higher-order thinking during the learning process. Most of the learners showed that they had a better understanding of the circulatory system concept, and the most challenging concepts appeared clearer and simpler after the intervention. However for some hard to change concepts, it is clear that post-roleplay

or pre-role play the teacher might need to find scaffolding or bootstrapping exercises to establish the concepts. In this way the next concepts in the sequence of learning might be better understood using role-play.

5.2.2 What were the experiences of learners during role-play about the circulatory system?

A questionnaire was used to explore learners' experiences during role-play. Forty learners indicated that they liked role-play as a teaching strategy since it helped them understand the concepts better. Only one learner showed some dislike towards role-play, which matched the low performance score. Most learners also stated that they were positively motivated by the use of role-play.

Learners liked role-play because of its practical nature. Role-play helped learners to concentrate more, conceptualise better, become motivated, and it made learning fun. Most learners were more interested and excited to take part in the role-play activities. They had a lot of fun during role-playing, and this motivated them to get more involved in the lessons. The role-playing stage encouraged more communication amongst learners since they had to discuss and plan their performance. Even some usually quiet learners participated and showed enjoyment during the role-playing. Even weeks after the role-play lessons were taught, some learners could be heard singing the circulatory songs during lunch breaks. Hence, this symbolised the level of interest and motivation. Lessons were taught from the known to the unknown, which showed an improvement in the learners' assimilation of concepts. Learners showed less interest in the theoretical part of the lessons. However, the teacher had to intervene in some role-play activities to demonstrate the connection between the practical activity and the theory of the concept.

5.2.3 How effective was role-play in developing learners' understanding of the circulatory system?

A post-test was used to investigate the effect of role-play on learners' performance on the human circulatory system. This post-test was administered immediately after learners were taught the topic through the role-play method. Some of the findings obtained from the analysis of the post-test results were that learners still experienced difficulties in answering question 3.8 and question 4, since there was less than a 10% pass rate on these questions. A significant improvement of 15% was seen on question 2.3, which required learnes to state the valve, as the structure that directs the flow of blood. The performance was maintained for questions 3.8

and 4.1, both pre-test and post-test. Though question 4.4 , which was an application question, recorded a 0% pass in the pre-test, it showed a 5% pass rate in the post-test. Hence, this reflected some consistent lack of understanding for certain concepts, which is an indication that further teaching support is needed, as a follow-up to the role play activity. Vygotsky (1978) pointed out that after ZPD, there is an increase in the amount of concepts that can be done without help, and a hence a decrease in what cannot be done even with help. In the case of question 4.4, perhaps another teaching strategy could be used to supplement role-play.

Role-play as a teaching strategy proved effective as reflected by the improvement in the learners' performances overall. The learning environment was free and relaxed during role-play, motivating learners to ask more questions for clarification. Hence, this prompted learners to ask more questions during the lessons. Questions and questioning can be ready powerful.Teachers have to prepare the questions ahead of lessons in order that learners develop the critical thinking and higher order thinking skills. Teachers must study how to use questioning in this regard (Astrid, Amrina, Desvitasari, Fitriani & Shahab, 2019).

Learners' group and peer discussions before and after role-play activities assisted them in improving their understanding. Vygotky (1978) points out that learners retain new concepts better when working in groups than as individuals. Therefore, discussions strengthened role-play lessons and make themmore meaningful to learners. Lessons were taught in line with the four stages of role-play, and this provided direction during learning strengthening learners' understanding. An increase in the learners' marks from pre-test to post-test was used as an indicator of improvement in the learners' level of understanding.

Role-play helped to boost learners' self-esteem and confidence. The majority of learners were very active and showed a lot of interest to be involved in the activities. Lavonen, Angell, Bymen, Henricksen, and Koponen (2007) pointed out that learners' interest in any subject can improve if the content delivery is engaging. This was reflected by some learners, like L23 and L35. They were very active, excited, and participative during role-playing activities, though they are usually quiet and withdrawn. There were other cases in which a few learners felt uncomfortable during role-play. The cause in some cases was stage fright experienced during the singing activity. Indiscipline of some learners due to poor classroom management during role-play activities, made other learners shy, uncomfortable, and less confident. The researcher could have identified the problem first, then have an open discussion, and laid out rules about

expected learners'behaviour, and also to remind them not to keep the noise to a minimum during role-play.

5.3 Implications of the study

Generally, results obtained from the study show that role-play improved learners' understanding, although in some cases the margin of improvement was small. Role-play lessons must be accompanied by higher-order questioning to encourage learners to think critically. Discussions and teacher interventions during role-play are a requirement. They help learners see the relevance of the role-play activities.

Accessing learners' levels of pre-conceived knowledge before the lesson is very helpful, as it will help give educators a clear direction during their lesson preparations. This will also help educators teach from the known to the unknown to promote learners' understanding. Exposing learners to higher-order questioning during lessons helps them to gain a deeper understanding of the concept.

Role-play activities must be designed so that there is a link between science content taught in class and society. Socio-cultural constructivism points out that effective learning cannot be isolated from social happenings as it occurs when children relate to objects, people, and other immediate environments (Ayano, 2018). Therefore, this current study helped learners to relate the rope used in the role-play lesson, as a representation of the movement of blood in the blood vessels. In addition, the use of red and blue cards, represented how carbon dioxide and oxygen are exchanged in the lungs and body tissues. In this way this will help learners see that what they learn in class applies to their societal lives; in this case to relate the simulations to the real human circulatory system.

Implications of the study for the:

(i) Teacher

Teachers should have good class control to be able to implement the role-play method successfully. Lack of class control during role-play may frustrate the teacher and prevent objectives from being achieved. Teachers need to plan and be time-conscious during role-play lessons, as role-play can be time-consuming. To help learners find

meaning in learning, teachers need to intervene and explain the implication for each role-play activity to help learners see the relevance of the role-play to their science concepts.

Teachers should give learners enough time to prepare for their role-play activities and allow discussion. This gives room for learners to be active participants and create space for critical thinking. Teachers need to have a deep understanding of the topic so as to design effective role-play activities. Role-play stages must be monitored when doing activities to prevent learners from losing track of the lesson. For role-play to become effective and successful, teachers need to include discussions to enhance understanding.

(ii) Heads of Science Department(HOD)

HODs should encourage curriculum development meetings in their departments to enrich teachers' knowledge based on challenging topics. Once teachers understand their subject content, it will be easier to apply the the role-play method in their teaching. This study offers science educators a comprehensive approach to applying role-play in their science lessons and how it can help learners use it in their everyday experience. Science educators need to collaborate with dramatic arts educators to gain drama skills that will enable them to implement role-play lessons effectively. Science department educators should come up with effective disciplinary measures in their classes to have firm class control to make role-play lessons successful.

(iii) Principals

The study may help school principals to schedule extra science teaching periods in their school timetables to accommodate the extra time needed for role-play. This study could be useful as a school intervention strategy to attract more learners to do science and improve the school's science results. School principals may convince the education authorities to build theatre rooms or realistic spaces in schools to make roleplays and other performing arts strategies possible. This is in line with a STEAM (Science, Technology, Engineering, Arts and Mathematics) approach to schooling and learning.

(iv) Curriculum advisors and curriculum planners.

The study will help curriculum advisors and curriculum planners include role-play as part of the teaching strategies in science subjects. They will have to conduct staff development workshops for teachers to prepare them to use role-play strategies. The time allocated for science lessons in the curriculum needs to be increased to accommodate time to do role-play activities. Curriculum advisors could use this study's

findings to make educators aware that role-play can help make complex concepts easier to understand. Textbook writers should include role-play activities in their textbooks to provide more activities for teachers to use.

5.4 Recommendations for future studies

The following recommendations emanate from the results of the study:

(i) Role-play can be implemented in other science disciplines to see if similar findings can be obtained. This will enhance the validity of the study.

(ii) The study can be implemented with other grade 10 learners on the same topic within the same school to see if the results obtained would be similar. This would help to increase the reliability of the results of the study.

(iii) The research can be extended to other schools within and outside the Western Cape Province to see if similar findings would be obtained. This will enhance the generalizability of the findings.

5.5 Limitations of the study

Since the study focused only on the human circulatory system topic in a Grade 10 Life Sciences class, it therefore means that all the results obtained are only related to that single topic. Only one class was used from a single school, which implies that the results obtained apply to that school and are not generalizable to other settings. The sample size used for this study was too small to make the results representative of other schools. However, others reading the study may take lessons from it in as far as it matches their own situation and context.

5.6 Conclusion

This study investigated the effect of role-play on learners' conception of the human circulatory system. The findings obtained indicated that role-play improved learners' understanding of the circulatory system. The improved understanding was seen in the post-test results, which reflected an increase in the learners' performance. Role-play activities can be effective and successful in learning if correctly used, and accompanied by proper explanations for the simulation. The use of various role-play activities helps to accommodate learners with various learning abilities enabling all of them to get a better understanding of the concepts taught. Learners need to be informed about role-play lessons well in advance to prepare themselves for the scheduled activities. The use of role-play helps to make learning practical, fun, and more learner-centred.

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7 Appendix A: Pre-test and Post-test

LEARNER CODE---------

Dear Learner

I am a student who is carrying out a research on *Investigating the effect of role play on Grade 10 learners' conception about the human circulatory system, at a selected township school in the Western Cape* .

I am requesting your cooperation with regards to your participation in this survey. It is important to inform you that your participation in this survey is completely voluntary and all your views will be kept confidential as well as treated with honesty and secrecy. This academic research is also guided by other ethical codes of conducts as prescribed by the university. This questionnaire will not take more than 40 minutes of your time. By completing this questionnaire, you indicate your willingness to participate. Thank you very much for your time and valuable input.

Sincerely

Edith Mlauzi

Answer all questions.Mark the applicable block with a cross (X). Complete the applicable information.

SECTION A: **DEMOGRAPHIC INFORMATION**

GENDER.	**Male**		**Female**	

AGE	**9 – 10 years**	**11 – 12 years**	**13 – 14 years**	**15 – 16 years**	**17 years and above**

HOME LANGUAGE.	IsiXhosa	Afrikaans	Zulu	Other

Whom do you live with?

Mother.	Father.	Grandfather.	Grandmother.

Parents' educational background:

Never attended school.	Primary level.	Secondary level	Diploma.	Degree.

How often do you read books?

Never.	Once a week.	Once a year.	Once a month.	Everyday.

Section B: Achievement test (pre- and post-test)

Marks: 50

Answer all questions below.

QUESTION 1

Indicate whether the description given below is TRUE (T) or FALSE (F).

1.1. All veins contain deoxygenated blood.

1.2.Capillaries are the largest blood vessels.

1.3.Deoxygenated blood is carried on the right side of the body and oxygenated blood is carried on the left side of the body.

1.4.The blood in the veins is blue.

1.5.Veins carry blood away from the heart.

1.6. Life stops when circulation stops.

1.7. Blood in the capillaries flows under high pressure.

1.8. Arteries carry blood away from the heart.

1.9. Arteries transport carbon dioxide to the cells.

1.10.The atrium are the upper chambers of the heart. (1x10)

QUESTION 2

Write the correct term for each of the following statements.

2.1. An organ that pumps blood in the human body.

2.2. The largest artery in the body.

2.3. The structure that direct the flow of blood.

2.4. Blood cells that carry oxygen.

2.5. Blood cells that fight germs. (1x5)(5)

QUESTION 3

Complete the following.

Instructions: Complete each fact about the circulatory system using terms from the Word Bank
Word Bank
alveoli ;arteries ;atria; capillaries; chambers; hypertension;
pulmonary circulation ;systemic circulation; veins; ventricles

3.1. The heart has four _____ that are enclosed by thick, muscular walls.

3.2. The upper part of the heart is made up of two chambers,

called the right and left _____, which receive the blood entering the heart.

3.3. The bottom part of the heart is divided into two chambers,

called the right and left _____, which pump blood out of the heart.

3.4. _____ is a short loop from the heart to the lungs and back again.

3.5. _____ sends blood from the heart to all the other parts of the body and back again.

3.6. Blood vessels that carry blood away from the heart are called _____.

3.7. Blood vessels that carry blood back to the heart are called _____.

3.8. A network of tiny _____ connects the arteries and veins, delivers nutrients and oxygen to the cells, and removes waste products such as carbon dioxide.

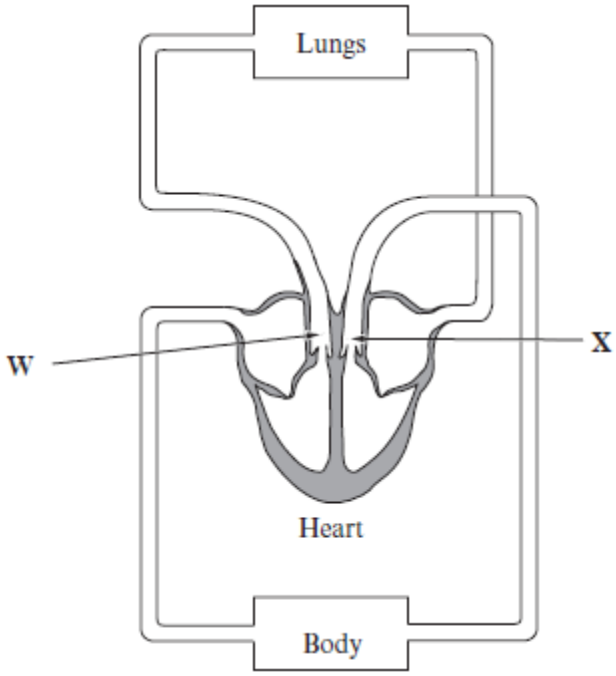
3.9. In the lungs, gases are exchanged between capillary walls

and millions of tiny air sacs called _____

3.10. High blood pressure is also called _____ (1x10)

Question 4.

The diagram below shows a section through the heart, and its valves labelled A, B, C and D.

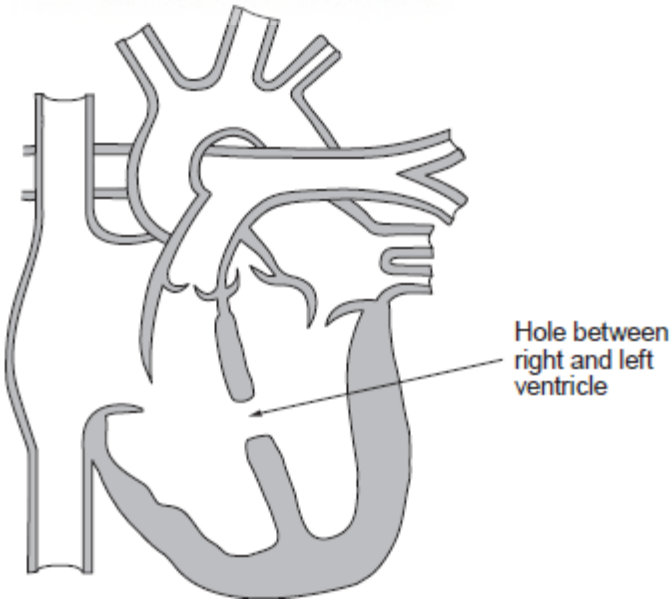


4.1.On the diagram, label the: pulmonary vein, vena cava and aorta (3)

4.2. On the diagram, draw arrows to show the direction of blood flow in the pulmonary artery and aorta. (2)

4.3. State two differences between blood vessels W and X. (4)

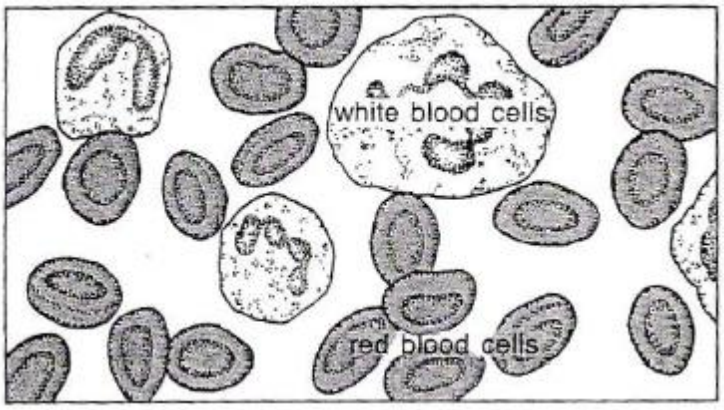
4.4. Occasionally a baby is born with a hole in the wall that separates the left and right side of the heart. In the diagram below this hole is shown in the wall separating the right and left ventricles.



Using your knowledge of blood circulation, explain the effect to a person suffering from the hole between the right and left ventricles of the heart. (3)

QUESTION 5:

Study the diagram below and answer questions that follow:



5.1.Which blood cells are the largest?----------(1)

5.2.Which type of blood cells are many?----------(1)

5.3. Give a reason for your answer in (2) above.

_____

(1)

5.4.What do you think will happen to the number of white blood cells when germs are in the body?

_____

(2)

Question 6.

6. Look at Figure B. It shows arteries and veins within the human body. Each artery and vein branches out to tiny capillaries.

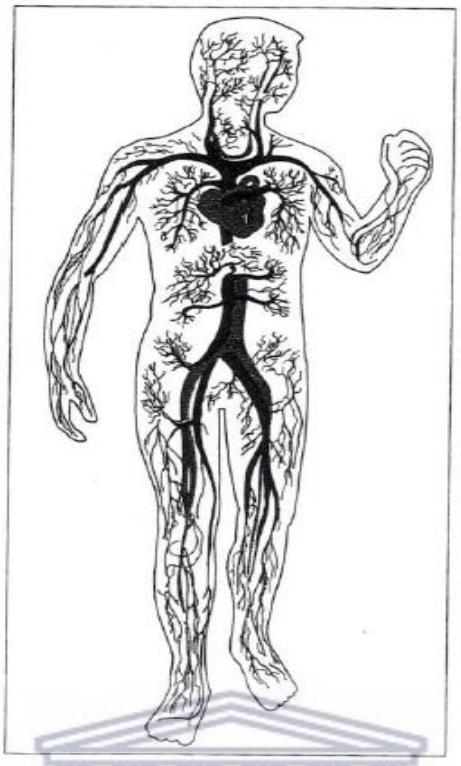


Figure B

Write the correct term in each space to answer or complete the sentence.

6.1.What pumps blood through your body?----------

6.2.Blood vessels that carry blood away from the heart are called----------

6.3.Vessels that carry blood back to the heart are called----------

6.4.Blood moves from arteries to veins through tiny blood vessels called----------

6.5.The heart, blood vessels and blood make up the ----------

system. (1x5)(5)

Question 7.

The diagram below shows a lady exercising.

7.1. Do you think exercise will decrease or increase heart rate?

---------- (1)

7.2. Give a reason for your answer in 7.1. above.

---------- (2)

8 Appendix B: Questionnaire.

LEARNER CODE---------

Dear Learner

I am a student who is carrying out a research on *Investigating the effect of role play on Grade 10 learners' conception about the human circulatory system, at a selected township school in the Western Cape.*

I am requesting your cooperation with regards to your participation in this survey. It is important to inform you that your participation in this survey is completely voluntary and all your views will be kept confidential as well as treated with honesty and secrecy. This academic research is also guided by other ethical codes of conducts as prescribed by the university. This questionnaire will not take more than 40 minutes of your time. By completing this questionnaire, you indicate your willingness to participate. Thank you very much for your time and valuable input.

Sincerely

Edith Mlauzi

Questions to be answered in full

How did you feel during role play?

Excited.	Bored.	Confused.	Angry.	Shy	frustrated	Nervous.	Other.		

1. Did you like role play?

Yes.	No.

2. What did you like about role play?

---

1. What did you not like about role play?

---

2. Would you recommend the role play to be repeated next time?

Yes.	No.

3. Give a reason for your answer in question (5) above.

---

4. Do you feel that your understanding of the circulatory system has improved after using role play?
   Yes / No

---

5. If yes, how has it improved, and if no, explain your answer.

---

6. How did role play contribute to your understanding of the circulatory system?

7. What is the importance of learning about the circulatory system?

9 Appendix C: LETTERS OF CONSENT.

73 Morgan Crescent

Brackenfell

Cape town

14 June 2018

Dear Parent

Ref : Request for permission to involve your child in a research project.

I Edith Mlauzi , a student (**3524607**) at the University of the Western Cape is requesting for the permission to undertake a research project at a selected school in Western Cape. I am studying Masters in Science Education and my research project is entitled,

"Investigating the effect of role play on Grade 10 learners' conception about the human circulatory system,at a selected township school in Western Cape."

The research will be taking place at Masimbambane High School. I request for your permission to include your child during my research project. After the conclusion of the research , if possible I wish to supply you with the final report of the research. I wish to do a similar report in future and to use the report as a secondary data for the study to be conducted soon.

If you want to give me the permission may you complete the form below.

If you wish to get further information you can conduct my research project supervisor, namely:

Professor Lorna Holtman , lholtman@uwc.ac.za

Your faithfully

Ms E, Mlauzi

I----------the parent of ---------- give permission to my child to participate in the research project undertaken by Ms E Mlauzi at Masimbambane High School.

Signature _____

Date _____

Contact number _____

73 Morgan Crescent

Brackenfell

Cape town

14 June 2018

Dear Principal

Ref : Request for permission to involve your child in a research project.

I Edith Mlauzi , a student (**3524607**) at the University of the Western Cape is requesting for the permission to undertake a research project at a selected school in Western Cape.I am studying Masters in Science Education and my research project is entitled,

"Investigating grade 9 learners' conceptions about weight and mass,at a selected township school in Western Cape."

The research will be taking place at Masibambane High School request for your permission to allow me to do research project at your school. After the conclusion of the research, if possible I wish to supply you with the final report of the research. I wish to do a similar report in future and to use the report as a secondary data for the study to be conducted soon.

If you want to give me the permission may you complete the form below.

If you wish to get further information you can conduct my research project supervisor, namely: Prof. Lorna Holtman, lholtman@uwc.ac.za

Your faithfully

Ms E, Mlauzi

I----------the Principal of ---------- give permission to the the grade 9 learners to participate in the research project undertaken by Ms E Mlauzi at Masibambane High School.

Signature _____

Date _____

Contact number _____

10 Appendix D: Learner results on pre-and post-test

Learner code	Pre-test (%)	Post-test (%)
L1	A	A
L2	32	32
L3	28	40
L4	18	22
L5	36	54
L6	46	54
L7	24	34
L8	30	30
L9	26	36
L10	A	60
L11	28	A
L13	34	36
L14	50	68
L15	A	A
L16	28	32
L17	44	42
L18	20	24
L19	A	A
L20	16	66
L21	A	A
L22	20	24
L23	38	56
L24	16	14
L25	24	32
L26	38	54
L27	24	26
L28	A	20
L29	26	38
L30	14	34
L31	20	26
L32	28	40
L33	30	A
L34	20	22
L35	48	A
L36	36	30
L37	22	A
L38	22	22
L39	58	66
L40	12	18
L41	28	44

L42	28	30
L43	26	44
L44	A	A
L45	22	40
L46	30	44
L47	26	32
L48	14	20
L49	28	22
	n= 42	**n= 40**
Aver **%**	28	36

2. Pre-test and post-test % average.

Test	**% Average**
Pre-test	28
Post-test	36

3. Question by question result analysis for correct responses:

Question	**% of Correct responses in pre-test**	**% of correct responses in post-test**
1.1	55	69
1.2	33	44
1.3	81	81
1.4	22	39
1.5	28	33
1.6	78	83
1.7	44	58
1.8	67	61
1.9	39	58
1.10	81	81
2.1	67	72
2.2	31	72
2.3	0	14
2.4	14	61
2.5	31	78

3.1	50	53
3.2	17	25
3.3	22	25
3.4	19	25
3.5	19	25
3.6	17	25
3.7	11	25
3.8	8	8
3.9	11	12
3.10	56	69
4.1	3	3
4.2	3	6
4.3	19	31
4.4	0	3
5.1	86	92
5.2	47	83
5.3	3	22
5.4	13	14
6.1	50	67
6.2	28	42
6.3	17	25
6.4	14	28
6.5	47	58
7.1	58	69
7.2	11	14

4. Question by question result analysis for incorrect answers:

Question	% of incorrect responses for pre-test	% of incorrect responses for post-test
1.1	45	31
1.2	67	56
1.3	81	19
1.4	78	61
1.5	72	67
1.6	22	17
1.7	56	42
1.8	39	33
1.9	61	42
1.10	19	19
2.1	33	28
2.2	69	28
2.3	100	86
2.4	86	39
2.5	69	22
3.1	50	47
3.2	83	75
3.3	78	75
3.4	81	72
3.5	81	75
3.6	83	75
3.7	89	75
3.8	92	92
3.9	89	67
3.10	44	31
4.1	97	97
4.2	97	94

4.3	81	69
4.4	100	97
5.1	14	8
5.2	53	17
5.3	97	78
5.4	86	64
6.1	50	33
6.2	72	58
6.3	83	75
6.4	86	72
6.5	53	42
7.1	42	31
7.2	89	86

B. Analysis of qualitative data:

Questionnaire responses (n=40)

Question	**Category response**	**% of learners**
1.How did you feel during role play	Excited Confused	97 3
2.Did you like role play?	Yes No	97 3

3. What did you like about role play?

Category response	**No. of learners**	**% of learners**
Understand better **(U)**	14	35
Focus **(F)**	3	8
Practical **(P)**	19	48
Other **(O)**	4	10

4. **What did you not like about role play?**

Category response	No. of learners	% of learners
Intolerance **(l)**	17	40
Nothing **(T)**	10	22
Indiscipline of learners **(D)**	8	19
Other **(O)**	8	19

5. Would you recommend that role play be repeated next time	Yes: 97% No 3%

6. Give a reason on why you would recommend that role play be repeated next time

Category response	No. of learners	% of learners
Understand better **(U)**	27	68
Motivation **(M)**	8	20
Other **(O)**	5	13

7. Do you feel that your understanding of the circulatory system concept has improved?

Yes	No
95%	5%

8. **How did role play contribute to your understanding of the circulatory system**

Category response	No. of learners	% of learners
Easy memory **(M)**	8	20
Increased understanding **(U)**	25	60
Other **(O)**	8	20