



RESEARCH REPORT

An investigation of how a lecturer uses discussion to promote meaning making during the teaching of the topic of Excretion to 3rd year preservice Life Sciences teachers

A research report submitted to the faculty of Education (Science Division), University of the Witwatersrand, Johannesburg, in fulfilment for the degree of Masters in Science Education

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Declaration

I, Malebo Nyaloku (1462164) declare that this report is my own unaided work except where otherwise acknowledged. It is submitted for the degree Med in Science Education to the University of the Witwatersrand, Johannesburg, South Africa. It has not been submitted before for any degree or examination at any other University.

Date 15/03/2023

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List of Abbreviations

CAPS- Curriculum and Assessment Policy statement

FET- Further Education and Training

HOTS- Higher Order Thinking Skills

LS- Life Sciences

NS- Natural Sciences

PS- Physical Sciences

SCT- Sociocultural theory

SSI- Semi-structured interviews

ZPD- Zone of Proximal Development

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Abstract

This study seeks to investigate how a lecturer uses discussion to promote meaning making during the teaching of the topic of Excretion to 3rd year preservice Life Sciences teacher. The process of meaning making includes how people understand and make sense of the content. Qualitative research was conducted to investigate how a lecturer uses discussion to promote meaning making. In this study, I used an interview and observations of video-recorded lectures on Excretion. The participant in this study is a Life Sciences lecturer at the university of the Witwatersrand. Data analysis involved watching the video-recorded lectures, transcribing them and coding transcripts to identify how discussion was used to promote meaning making and having a semi-structured interview with the lecturer responsible for teaching Excretion to 3rd year preservice teachers. The findings from this study shows that discussion promotes meaning making when students engage with the lecturer, the teaching and learning materials and with other students, which allows them to share ideas and make meaning of the intended knowledge.

Chapter 1

1. Introduction

This chapter introduced the study by presenting the background, significance of the study, research problem, research objectives and research questions.

1.1 Background of the study:

This study sought to investigate how a lecturer uses discussion to promote meaning making during the teaching of the topic of Excretion to 3rd year preservice Life Sciences teachers. According to Scott (1998) meaning making is a process involved in the construction of understanding. The process of meaning making includes how people understand and make sense of the content. Meaning making occurs in the mind. Therefore, the lecturer can only facilitate and help students in making meaning of the content learned through the use of discussion. Evidence of meaning making can be discerned from what students say and do. Discussion is an engagement and sharing of ideas that happens in a conversation form and will lead students to the same objective which needs to be achieved by the classroom.

Discussion allows students to share different perspectives, although each student is socialised differently, which might aid them with different experiences, thus, different reasoning. According to Parker and Hess (2001, pg. 273) “discussion is relevant to the broad social aims of democracy and solidarity in a diverse society and to the pedagogical aim of creating vigorous communities of inquiry”. This implies that discussion allows students to share their views on the subject matter, this enables the teacher to identify students’ misconceptions based on their prior knowledge. Discussion allows individuals to share different perspectives which brings them to a common understanding and simplifies difficult content.

In this study, I investigated how discussion is used to promote meaning making. According to Parker and Hess (2001, pg.274) “teaching with discussion is to use discussion as an instructional strategy to help students more richly understand the text at hand or to make a decision about the issue at hand”. This in my view suggests that discussion enables students to understand and make meaning of the content. Parker and Hess (2001) states that discussion is an engagement between the teacher and the learners or between the learners in the classroom.

Discussion is an important teaching strategy because students engage with the content to make meaning out of it, rather than just taking in information presented by the teacher. The topic of excretion raises too many questions from students and initiates debates from many background beliefs amongst students. The structure of the content may hinder teaching and learning because there is time allocation in the CAPS document and diverse students in the classroom have different viewpoints which requires engagement, the teacher might be limited because they are in a rush to complete the curriculum in the allocated time.

The language used might also be a challenge because of the scientific words used, which might be a challenge for some students to pronounce and understand. The context in which someone grows and develops has an important impact on learning. Therefore, there is diversity and how students were socialised affect the teaching and learning process. A student's environment plays an important role in his/her learning development. All students are recognized and valued as people who gain experiences and knowledge across many contexts.

1.2 Significance of the study

This study will help lecturers to be aware of how discussion can help students improve their performance by establishing how they make meaning of the content taught. This improvement can be witnessed when students get engaged in the discussion and demonstrate understanding of the content.

In the sector of education, Africa is ranked amongst the lowest continents, therefore, this study will help teachers in using discussion effectively and value it in a Life sciences classroom. Discussion is effective if it prompts students to participate and engage with the teacher and fellow students, as well as the learning materials. I aim to determine different effective methods that teachers could use to teach Excretion, what a teacher should take into consideration when teaching Excretion, the teacher's take on the use of discussion and how to avoid conflict and confusion in the classroom during the lesson.

1.3 Problem statement:

The aim of this research is to investigate how a lecturer uses discussion to promote meaning making during the teaching of the topic of Excretion to 3rd year preservice Life Sciences teachers. According to Krauss (2005) in any social setting, meaning making is the most fundamental aspect, this is due to the idea that language makes up an individual's view of

reality. Therefore, discussion allows individuals to engage in the classroom, this allows them to share their ideas of what they already know and they are able to construct meaning out of the discussions they have.

For an individual to understand their social setting, as well as the content they are discussing, it is important that they can tap into their cognitive abilities and be able to construct understanding, thus, enabling meaning making. Krauss (2005) states that people can construct meaning based on their own experiences. This argument suggests that although there may be discussion in the classroom, individuals construct meaning based on how they are socialized, therefore, this means that meaning making is a subjective process.

Research in this study will allow lecturers to have an awareness that individuals use discussion to construct meaning differently. Therefore, this will assist them when they engage in discussion with their students. Lecturers can be able to come up with strategies that will accommodate every student regardless of how they were socialized. Thus, assisting students construct meaning that is in relation to their learning objectives. According to Krauss (2005, pg. 763) “It is the individuals’ subjectivity, or phenomenological world, that forms the very core for meaning origination and evolvement”. People have different perspectives, therefore, meaning making is a social process which allows individuals to firstly engage in discussion then internalize it to understand it, hence meaning making is a cognitive process.

This research area also aims to acknowledge and appreciate that people have diverse understanding of life. This will assist teachers to not be biased when teaching the topic of Excretion. Lecturers use different teaching strategies when teaching in the researched context. These strategies include the use of visual representations, question and answers, discussions and watching different videos. The use of these strategies are there to assist the students understand better and ensure that the content that is being taught moves from a knowledge that is abstract to a knowledge that is concrete.

The Science Teacher qualification at the University of Witwatersrand is a four-year degree course. Preservice teachers learn Natural Sciences I and II in their first and second year respectively. At 3rd and 4th year, they specialise into either the Life Sciences or Physical Sciences streams. For this study, I used ‘preservice teachers’ interchangeably with ‘student teachers’ or students. This study sought to engage 3rd year students as this is a critical year

for those who are prepared to teach the FET Phase in schools. The skills that they gain in the 3rd and fourth years are relevant for the high school classrooms that they will teach.

A gap in the research of how discussion is used to promote meaning making means that most of the Life Sciences teachers teach students using discussion but are not aware of how it assists students into processing the information provided. This study sought to assist lecturers to use discussion effectively in promoting meaning making. Lecturers use discussion in a Life Sciences classroom, but many of them may not be aware of how discussions assist students in making meaning when teaching Science topics, consequently, students may not show the intended understanding and teachers are not able to ascertain if the learning intentions have been achieved. That means that discussions may be integrated into classroom practice without adequate reasoning of their worth. This study sought to establish whether discussions are a useful strategy for facilitating meaning making in the Life Sciences classroom.

1.4 Research objectives

- To establish the nature of student engagement in discussions that the lecturer stimulates
- To demonstrate the evidence of meaning making that can be discerned from discussions when a lecturer teaches Excretion to 3rd year Life Sciences students.
- To investigate the role of the lecturer in facilitating student teachers' meaning making during discussion when teaching Excretion to 3rd year preservice teachers
- To establish why the lecturer, stimulate discussion in ways that have been observed when teaching Excretion to 3rd year preservice teachers.

1.5 This study sought to answer the following research questions:

Main question

How does a lecturer use discussion to promote meaning making during the teaching of the topic of Excretion to a class of 3rd year preservice Life Sciences teachers?

Sub questions

1. How do students engage in discussions that the lecturer stimulates?

2. What is the evidence of meaning making that can be discerned from discussions when a lecturer teaches Excretion to 3rd year Life Sciences students?
3. What is the role of the lecturer in facilitating student teachers' meaning making during discussion when teaching Excretion to 3rd year preservice teachers?
4. Why does the lecturer stimulate discussion in these ways when teaching Excretion to 3rd year preservice teachers?

1.6 Report outline

In chapter 1, I introduced the study by presenting the background which explained what discussion and meaning making are and how the lecturer uses discussion to promote meaning making in a classroom. I also outlined the significance of the study, research problem, research objectives and research questions. In chapter 2, I reviewed literature pertaining the study, which includes discussion, meaning making, Excretion, 3rd year preservice teachers and Life Sciences. In chapter 3 I outlined the research method, research approach, data collection, research participants, research process, data analysis and the ethical considerations. In chapter 4 I presented and analysed data and in chapter 5 I discussed and concluded the research looking at the recommendations and limitations.

1.7 Conclusion

In this chapter I introduced my study which sought to investigate how a lecturer uses discussion to promote meaning making during the teaching of the topic of Excretion to 3rd year preservice Life Sciences teachers. In the introduction, I argued that discussion is an engagement and sharing of ideas that happens in a conversation form and will lead students to the same objective which needs to be achieved by the classroom. This can be achieved through the interaction of the students with the teacher, other students, as well as the material that is used during the learning process. In the next chapter I reviewed literature on discussion, meaning making, Excretion, 3rd year preservice teachers and Life Sciences.

Chapter 2

2. Literature review and theoretical framework underpinning this study

The aim of this literature review chapter is to evaluate key concepts pertaining to this study. This study focuses on how a lecturer uses discussion to promote meaning making during the teaching of the topic of Excretion to 3rd year preservice Life Sciences teachers, concepts for clarifying the study were discerned and are presented below. These concepts include discussion, meaning making, Excretion, 3rd year preservice teachers and Life Sciences.

2.1 Meaning making

According to Nielson (2012) meaning making is the development of understanding and the interpretation of individual's experience in a certain context, therefore, the teacher only guides the teaching and learning process so that the students can make meaning of the content. Meaning making is an integral part of learning. It differs from individual to individual as they construct meaning based on their experiences. Ignelzi (2000) states that individuals construct meaning differently, this implies that the level at which individuals are developed influences how they view reality, therefore, the process of meaning making is viewed as a process that continues to develop through one's life.

According to Krauss (2005, pg. 762), "a person draws meaning from or gives meaning to events and experiences. That is, experiencing starts to make sense as the person performs his or her psychological functioning of translating it into how he or she thinks and feels." This implies that meaning making is a process whereby, individuals start by engaging with the environment and the people around, thereafter, use their minds to either transform the knowledge or interpret it in an understandable manner.

In this process of meaning making, individuals internalize knowledge. The process of internalization (Vygotsky 1987) is where individuals appropriate and become able to use for themselves (on the instrumental plane) conceptual tools first encountered on the social plane. The products of internalization will be different for different individuals. Following the process of internalization, language provides the tools for individual thinking. After processing information, it is externalized in some of the activities or language. Central to this view is the continuity between language and thought. Therefore, the assumption is that preservice teachers externalize what they have internalized, and that is evidence of their

meaning making. Hence, this study will focus on what the lecturer does to enable student teachers to say and do to engage with the knowledge during teaching and learning of Excretion. People interpret knowledge from what they already know, for a lecturer to figure out whether there was a promotion of meaning making, the evidence can be seen in how the students engage in the classroom.

2.2 Evidence of meaning making in the classroom

Scott (2003) states that meaning making is promoted through engagement and social interactions. This enables students to share ideas. Through facilitated classroom discussion, inquiry should be driven by student questions rather than the teachers' questions, the role of the teacher is thus to make explicit which series of alternatives are most appropriate. (Mortimer and Scott 2003, pg.3) asserts, "Meaning making can be seen to be a fundamentally dialogic process, where different ideas are being brought together and worked upon". This process allows for engagement in the classroom, whereby, individuals come with different ideas, which they will share when working towards achieving the classroom objectives. It is not easy to check whether students understood the content, but if the teacher had to look for the evidence of meaning making, it can be through an interaction with the classroom. The teacher can allow students to share their understanding with the classroom, respond to questions and write their answers on the whiteboard.

It can be evident whether meaning making is promoted or not, through the response that the students give. Meaning making occurs in the mind, therefore, to get the thought process of students, they can be allowed to share their ideas through talking, as well as by being given tests based on what they have learnt. Their grades will be a reflection of how much meaning they managed to make through their interactions with others. Individuals through interacting with intellectual resources that frame their thinking, social interaction and through participation (Vygotsky, 1978) construct meaning, the evidence of meaning making in the classroom will be seen through how they engage with the teacher and other students through the questions they ask and the answers they give, as well as how they engage with their teaching and learning materials. According to Krauss (2005), it is through nature that humans want to make meaning of a situation and analyse it, especially out of their lives and experiences. Making meaning of knowledge is important in human lives because it helps them to be able to analyse situations even in real life.

Individuals are able to develop a higher level of thinking because meaning making allows students to think through knowledge and not only take in what they are told. This will help do away with the idea of rote learning and allow for active participation of the students. Students having higher order thinking skills can be seen as evidence of meaning making. Krauss (2005, p.762), argues, “Meanings are the cognitive categories that make up one’s view of reality and with which actions are defined”. This implies that individuals construct meaning by firstly observing the world, this shows that the process of meaning making is subjective.

How individuals construct meaning is in relation to how they are socialised in the society. Through the interactions with others, individuals are then able to process their own thinking and come up with their own understanding of reality and experiences. This indicates that individuals can have different understanding of the same phenomena, hence, it can be concluded that meaning making occurs in the mind. Krauss (2005) states that learning can be seen as a social process, which allows individuals to explore different ideas, and might challenge individuals’ existing perceptions. Learning allows individuals either to extend their existing knowledge or to construct new knowledge of what they are learning; this could be because of what they observed in the world without any guidance. Therefore, meaning making allows individuals to acquire new meanings of worldviews. The evidence of meaning making will be witnessed based on how the student understand the content, as opposed to what misconceptions they might have before the lesson.

The teacher can witness the evidence of meaning making in various ways, for instance, the teacher can give students formative assessments, which will test them on the content that they are learning. Meaning making occurs in the mind, therefore, it cannot be identified easily. The teacher can also make means to identify if the students are able to make meaning out of the content by asking questions that will prompt them to think and not only give one-word answers or answers that do not allow them to apply their higher order thinking skills. Meaning making can be facilitated in socio-cultural settings.

2.2.1 Meaning making as a social process

Meaning making is socially constructed because individuals make meaning of what they have observed from their social settings, and they internalise the knowledge. According to Scott (1998) the interaction on the inter-psychological plane is between the teacher and the student, whereby the teacher gives an explanation to the students. The teacher controls the

process of teaching and learning in the classroom, the teacher shows authority and drives the lesson through engaging students by asking questions while giving those clues of information required (Scott, 1998). The teacher engages students in the lesson, to ensure that they achieve the same goal concerning the objective of the lesson. The teacher asks students questions with the aim of finding out whether they are heading to a desired understanding of the content, thus, making the process of constructing meaning easy and useful.

Students are taught in a way that enables them to reach the common understanding with the teacher, the teacher guides students to reach a common objective of the lesson regardless of how they are socialised. Scott (1998, pg.53) argues that “pupils are being inculcated into what becomes for them a shared discourse with the teacher, this form of intervention can be interpreted in terms of the teacher providing assistance and scaffolding in the ZPD, requiring pupils to actively participate in the creation of shared knowledge, rather than merely sit and listen to the teacher talking”. This can be achieved when students are actively participating in the lesson, rather than just listen to the teacher providing them with information.

According to Scott (1998) meaning making in a classroom can be accomplished if the teacher intervenes to ensure that students actively participate, and the teacher’s role is to paraphrase and emphasise important points and guide them into achieving the objective of the lesson. The teacher should encourage students to share ideas that they have on the content, this enables the teacher to assist the students based on what they know, and also give them assurance that whether they give correct or incorrect answers, that is part of the teaching and learning process. Scott (1998) states that teachers use language to have an interactive classroom, whereby, the teacher asks questions guiding the dialogue. The teacher should drive the dialogue to ensure that everyone is on the same page and working towards the same goals.

The dialogue in the classroom should be built on the contributions that are made by both the teacher and the students, therefore, this means that the students do not only learn from the teacher, but they also learn from each other, but if the students cannot reach a desired understanding, it is the role of the teacher to guide the discourse of the classroom. Scott (1998) asserts that the teacher assists to modify student answers if the classroom does not understand, to ensure that they reach a common understanding of what they are learning. This kind of teaching and learning allows for communication with each other and for engagement with the teaching and learning materials.

According to Scott (1998, pg. 57) “in promoting shared meaning the teacher might: present ideas to the whole class; share individual student ideas with the whole class; share group findings with the whole class; jointly rehearse an idea with a student in front of the whole class, provide a spoken commentary to make explicit the thinking behind a specific activity that they are engaged in”. The teacher shares students’ ideas with others to ensure that they tackle and allows for different ideas, tackling each other’s ideas enables the teacher to understand the students’ level of thinking about the content, thus, this will make the teacher’s job of guiding students an easy one. The teacher facilitates the process of teaching and learning to ensure that students are able to achieve or make meaning of what they are learning.

Students generate meanings depending on how the teacher controls the classroom discourse through the use of different teaching and learning strategies. The teacher should create a learning environment that allows students to actively participate and freely raise concerns. This kind of classroom allows for a conducive teaching and learning environment, thus, allowing students to participate in the process of meaning making without silently being excluded from the classroom discourse. The teacher provides scaffolding by asking guiding questions and by also acting as a coach (Scott, 1998). There is a use of language to ensure that the instructions are explicit and makes it easy for students to understand. Scott (1998, pg,74) assert that “the process of internalisation envisaged by Vygotsky, cannot simply involve direct transfer of ways of talking from social to personal planes; there must be a step to personal interpretation or personal sense-making”. This implies that, although the process of meaning making begins in the social plane, this leads to a process where people make sense of the information on their own. Thus, it can be stated that meaning making occurs in the mind.

2.2.2 How meaning making occurs in the mind

According to Scott (1998) individuals should make sense of what they are learning on the social plane, this includes reconstructing and reorganizing knowledge. The process of meaning making begins when students share ideas, thereafter, they have to make sense of these ideas, taking into consideration what they already know and what the lesson is trying to achieve. It should be noted that students do not make meaning of information immediately during the classroom discussions, but they have to process the information first before it can

be internalised. New concepts that are not fully compatible with prior knowledge can only be learned when the network of prior knowledge is restructured.

Leach and Scott (2003) states that there should be changes in individual's mental modes taking into consideration the learning environment. Student's thinking is rearranged based on what they have learnt. Students should be engaged in the lesson, so that their misconceptions can be identified from their prior knowledge, this makes it easier for students to internalize knowledge that is correct and desirable. This allows students to change their existing conception. Engagement in the classroom encourages higher order thinking, empowering students to transform information into knowledge by making meaningful connections between concepts or information. Changing existing ideas occurs slowly and requires focused, ongoing effort by both the teacher and the student. If students are able to make meaning of what they are learning in their minds, this means that the process of teaching and learning was successful.

2.3 What is Teaching and learning?

Teaching and learning are fundamental concepts in ensuring that students make meaning of the content learnt in the classroom. Teaching is a process, which allows the teacher to impart knowledge to students. The process of teaching allows students to gain knowledge; this is considered as the learning process. Therefore, this implies that the teacher teaches while the students learn. Teaching and learning in a classroom occurs in different ways, but what is important is that the information should be conveyed to the students, and they should be able to understand and make meaning of it.

According to Silverthorn (2006) when teaching and learning occurs, there is a message or information that is passed to a larger number of students, although the students receive the information, this does not guarantee that there is learning that takes place. Therefore, this implies that there are different teaching and learning strategies that can be adopted to ensure that the classroom is interactive and allows discussion to take place. Silverthorn (2006) argues, teaching is highly individual and dependent on the context, and what works in one class, might not work in another. This statement indicates that each and every teacher have their own style of conducting the teaching and learning process, although the learners might be learning the same content, it can be a challenge to adapt to a universal way of teaching and learning.

Most schools are underprivileged; therefore, they do not have resources that will help them in promoting meaning making in the classroom. For instance, there are schools that do not perform hands on practical because they do not have the laboratory or the models that they need to use for their teaching and learning process. Therefore, their lessons will be less interesting and not engaging, hence it is important for a teacher to find a way to work with the students focussing on the context that they find themselves in. Silverthorn (2006) states that giving students information does not mean that they understood it, therefore, it is important that we keep them engaged in the lesson by allowing them to talk and share ideas.

According to Silverthorn (2006) teaching and learning becomes easy when the objectives of the lesson are identified, as well as what they can learn on their own. Identifying the objectives before teaching and learning takes place enables the students to understand what they have to know and the purpose that the lesson is trying to achieve. Teaching and learning is a process that is guided by the teacher with the intention of having students to make meaning of what they are learning.

According to Sherin (2002) teachers needs to learn as they teach. It is not only the students that should learn but the teachers as well, which makes it easier for them to deliver the content in a manner that is understandable, which enables the students to make meaning of what they are learning. Sherin (2002) further argues that there are two types of learning that are involved when teacher is learning. These are as follows “existing content knowledge is modified during instruction” and “new content knowledge is developed during instruction”. Teachers must use their existing knowledge in a flexible way, this implies that they should adapt to the classroom environment, find ways to teach students without sticking to the traditional way of teaching, but use methods that will accommodate every student in the classroom.

According to Sherin (2002), the teacher develops new knowledge while in the process of teaching, through how they deliver knowledge, what the curriculum says and the knowledge of the students learning. Through the interaction with the students, it is easy for the teacher to recognize their knowledge, thus, the teacher is able to develop new knowledge that will also help them in restructuring how they deliver the lesson to the students. Teaching and learning can promote meaning making when the teacher uses various teaching strategies, which allows the students to have a clear understanding of the contents and process

information. One of the strategies that the teacher can use in the classroom is discussion; this enables students to have a better understanding of what they are learning.

2.4 Discussion

Discussion is very beneficial to students because they can share ideas with the teacher and their fellow students, this can assist them in terms of understanding and correcting the misunderstandings they might have. According to Omatseye (2007), discussion encourages students to participate in the classroom; this helps them in stimulating their imaginative, as well as their conceptual thinking. The discussion instructional strategy is useful in the classroom because not only does it allow students to cooperate with each other, but also it is there to assist them in developing communication skills (Omatseye, 2007).

Discussion aims to facilitate and guide learning. It can be useful using instructional teaching strategy because it allows learners to collaborate with others. For instance, they can engage in question, and answers. This means that learners are actively involved in the tasks; this helps them in gaining understanding more than they would as individuals. According to Carpenter (2006), discussion produces a high level of understanding. Discussion is a teaching strategy that allows students to share ideas on what they are learning, this helps them develop high order thinking skills, whereby, they do not only memorise the content but also make meaning of what they are learning. Therefore, this implies that meaning making can be promoted with discussion in the classroom.

Many teachers use the traditional method of teaching, whereby, the teacher delivers the lesson and provide the students with information. With this method, it is assumed that the teacher knows everything, while the students do not know a lot. The discussion instructional strategy is of paramount importance because it changes the idea that students do not know much, and it grants them the opportunity to participate and share their ideas and thinking, this can assist the teacher in identifying what the students know, what they do not know and what misunderstanding they might have. According to Omatseye (2007) for students to participate effectively, teachers should ensure that he/she knows the names of the students; this increases classroom participation and makes the students to feel free to share their views

Discussion allows students to engage with the teaching materials and other students, as well as the teacher, therefore, this instils them with good communication and listening skills. This study therefore seeks to establish if meaning making is taking place during discussions. The

discussion teaching strategy allows students to communicate their ideas with the rest of the classroom; this enables them to develop confidence and helps them with making meaning with the help of others.

2.5 Types of discussion

Brainstorming

Brainstorming is a discussion method which enables individual or a group to bring up ideas related to a certain topic, these ideas are considered later during a discussion or a written piece. According to Unin (2016) brainstorming is a type of discussion that allows students to share their ideas freely and engage with the content provided. There are various ways that the classroom can engage with brainstorming to discuss the content, for instance, the teacher can begin the lesson with a story telling, show students diagrams and pictures, as well as to ask questions based on the content, that will allow the students to share their ideas and state what they know or understand from what is being discussed. Unin (2016) states that brainstorming assists with coming up with as many ideas as possible within a given period of time. In a classroom, the teacher can grant students a few minutes to come up with different ideas or state what they know about the content being discussed before they can go further and look into the content.

According to Unin (2016) the teacher encourages students to get involved in the lesson when they brainstorm, this enables students to be part of the discussion and share ideas amongst one another. The students do not only share their ideas with each other, but with their teacher as well, the method of brainstorming allows students to also engage with the teaching and learning resources because they might go through it in search of some ideas. Teachers use brainstorming as a way to propel the idea of learning that fosters student centred classroom (Unin, 2016). A student-centred classroom ensures that students are responsible for their own learning, therefore, this means that they are actively involved and do not just rely on teachers to give them ideas, but they engage in activities that allows them to communicate and actively come up with information, rather than receiving it from the teacher.

Unin (2016) states that brainstorming allows students to engage in activities that allows them to ask questions that keeps them interested in the lesson. Human beings are curious by nature, therefore, when they ask questions and share their thought, it is the more they want to know. According to Unin (2016) brainstorming evokes an open-ended learning environment,

which allows students to generate as many ideas as possible. Brainstorming enables the classroom to be flexible and exciting, the teacher can allow the students to brainstorm individually or put them in a small group, this makes the students to have an interest in learning as they can see that their ideas are taken into account and that their opinions matter.

Dialogue

A dialogue is a conversation between two or more people who exchange their thoughts with the aim of reaching an understanding of what they are engaging on. Dialogue is an understanding that is shared between two or more people, whereby they exchange understanding through the use of a conversation. A dialogue can be evident in the classroom when a teacher asks students questions that allows them to have an interaction, whereby, the students can learn from each other and from the teacher. According to Webb (2009) an interaction between students can be deemed as positive because it allows students to share ideas, thus, resulting in cognitive restructuring whereby they change what they initially thought they knew and gain new knowledge from their peers. Therefore, dialogue in a classroom assists teachers in identifying the misconceptions of the students, as well as their prior knowledge, this makes it easy for the teacher because they will know what the students know and what they do not know, as well as how to assist them in ensuring that they understand the content without having any misconceptions.

According to Webb (2009) the students' misconceptions can be identified when they are having conversations with others, these conversations involve the students explaining what they know and also receiving information from others which allows them to reorganize and reconstruct knowledge. The students are able to recognize their misconceptions, this happens when they identify what they already know and comparing it to what they are learning, this will then enable them to either reconstruct their knowledge or extend their prior knowledge to gain more knowledge on the content being discussed.

Webb (2009) asserts that a dialogue plays a huge role in allowing a classroom to have a question-and-answer session in the classroom, whereby, the students engage with each other, as well as with the teacher. It can also assist in the identification of misconceptions and prior knowledge. Webb (2009) argues that there can be an implementation of various activities to ensure that there are adequate interactions which enables students to have deep understanding of the content, therefore, the main purpose of a dialogue in a classroom is to promote meaning making amongst students. The use of various teaching resources such as a

picture or any kind of representation can encourage students to interact with each other, the teacher, as well as the teaching and learning materials. Thereafter, they can share what they know and what they think they understand from the materials.

2.6 Use of discussions in teaching and learning

A teacher can use discussion in the classroom by allowing the students to share their ideas of a certain topic, this will allow them to have a good understanding of the topic and correct the misconceptions that they have. According to Welty (1989), it is important for the teacher to prepare for their lessons before going to class; this will enable them to ask questions that will promote discussion. The kind of questions that the teacher could ask should be questions that do not only allow the students to give one-word answers, but questions that will allow for engagement, thus, enabling a better understanding of what is being learnt. Welty (1989) states that the students should not be passive in the classroom and the teacher should plan for the whole term, not only looking at the content but how he/she is going to conduct discussions.

The teacher can ensure that discussion is used effectively in class by grouping students, the teacher can group them based on their academic performance, in this case, group students that are average with those that are doing well. This will help the students that are not performing well to ask for help from their peers, as it could be difficult to engage with the teacher. When the students are grouped, they should be given roles to ensure that everyone is participating and gaining knowledge that will help them to construct meaning. According to Welty (1989), a teacher should find ways to involve students actively in what they are learning because that is the central goal in discussion.

Welty (1989) states that every student learns individually and responds differently. The role of the teacher is to ensure that the students are able to make meaning of what they are learning, therefore, the teacher acts as a facilitator and guides the meaning making process. According to Welty (1989), the teacher should arrive to class earlier so that he/ she can organise the classroom and ensure that it is conducive for the discussion teaching method.

2.7 Engaging students in discussions

According to Orsolini and Pontecorvo (1992), classroom talk is considered a social activity whose patterns are expressions of underlying rules and structures. Classroom talk is very important as it allows individuals to share different experiences because people are

socialized differently. A teacher has to engage students in a classroom discussion taking into consideration that the students come from different families; therefore, they cannot experience the world the same way. The role of the teacher in this instance is to ensure that they share their experiences, thereafter, make sure that misconceptions are cleared considering that the classroom objective for the lesson is known and is clear to all the students.

In a socio-cultural constructivism classroom, learning is often optimized through discussion in a class. The role of the teacher is to encourage students to express and explore their thoughts, feelings, and emotions. The teacher should establish teaching strategies that enable students to interact with their peers in a form of group work and classroom discussions. The most critical way of encouraging learning is through a dialogic process (Scott, 20003). It is through social interaction that students can share and exchange knowledge and understanding with each other, thereby, making it possible for the teacher to recognize misconceptions. Scott (2003) further argues that talk allows students to make connections between previous knowledge and the new experiences and ideas.

Vygotsky (1978) argues that children learn more when they have a more knowledgeable other. Students learn easily when others are involved; an example for this would be that students work on an assignment with the assistance from a teacher, then they will be able to stand on their own without assistance (Powell and Kalina, 2009). Sociocultural theory is based on how a student's social experiences and culture influence the way a student looks at things, and it also influences the student's way of understanding in the classroom, during the lesson. Interaction of the learner occurs socially, either inside of school or outside of school.

Socio-cultural factors may influence the methods of teaching that the teacher chooses to use. For instance, in a Life Sciences classroom, if a learner is from a Christian family and does not believe that it is appropriate to discuss female and male reproductive systems, the teacher should then find a suitable method to teach this topic, even though learners do not believe in it, it is the teacher's duty to find suitable methods of teaching which may be suitable to learners of certain prior knowledge, the prior knowledge that they acquired anywhere, even in their previous grades. Therefore, the construction of knowledge from learners' prior knowledge does not take place during the lesson, regardless of where or how the prior knowledge was acquired. This sets a teacher as a mediator. The teacher moves from being the giver of knowledge to being a mediator. The teacher mediates the prior knowledge that the learners bring to the

classroom, with the actual content knowledge. Kalina and Powell (2009) argues that learners acquire knowledge that is too difficult for them to learn on their own through ZPD and scaffolding; the mediator (a teacher) facilitates this.

2.8 How teachers promote or stimulate discussions and why promote/stimulate meaning making

Lectures promote meaning making in various ways, therefore, various teaching strategies such as asking students questions prior to teaching and learning process is important for the lecturer to know and understand the students' background. This process of question-and answer shapes how the teacher delivers their lesson, thus, enabling them to promote meaning making easily. According to Baxter Magolda (2000), educators do not know the backgrounds, unique experiences, and developmental journeys of every student they come across. Thus, the teacher should ensure that they ask the students questions that will enable them to tap into their cognitive structures. Meaning making cannot just be witnessed in the classroom during discussions, but it goes deeper because the students have to process the information they are granted and make sense of it. Meanwhile partaking in the process of meaning making, there are various factors that are at play. These factors include students background knowledge.

Students are socialized differently, therefore, they have different access to information, some might have information that is misleading, therefore, before the teacher can promote meaning making, they have to start by understanding the kind of information their students have, and make sure that they correct their misunderstandings and restructure some of the knowledge they might have. According to Baxter Magolda (2000), teachers have to create inclusive and effective teaching and learning environments. It is very important that students have an environment that is conducive for them; this makes it easy for them to make meaning of the content because even the participation is not forced, and they partake in activities willingly.

Baxter Magolda (2000) states that conducive learning environments that are inclusive and effective provides opportunities for complex cognitive, intrapersonal, and interpersonal development for all students. Teachers should acknowledge that students have different experiences; this means that every experience should be valued and respected because it contributes to how a student make meaning of the content being learnt. Baxter Magolda (2000) argues that when students are provided with support when they make meaning, it

assists them to take risks into developing more complex ways of making meaning. The students feel acknowledged and feel that they are capable of achieving a clear understanding of the content, thus enabling them to participate willingly and make sense of what is being learnt. Thus, helping them develop confidence.

Teachers should stimulate discussions by challenging students' thinking, for instance, give them a scenario and allow them to share their views. According to Baxter Magolda (2000) students should be guided into developing their own thinking. This study focuses on how meaning making is promoted when teaching the topic of excretion, this topic is taught in a Life Sciences classroom.

2.9 Life Sciences

Life Sciences is the most fundamental subject because it provides people with the most important knowledge. The specific aims of the Life Sciences document are as follows; “Knowing the subject, doing science or practical work and investigations and 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”. According to Magner (2002) Life Sciences is a Science of living things. In this subject, living things are studied, from their interactions with one another as well as the environment. According to the CAPS document, this is an accepted Science because it includes certain methods, which allows for investigations and experiments to be carried out, as well as for hypothesis to be formulated.

When teaching Life Sciences, it is pivotal that students are able to make meaning of the content and understand it properly because it relates to what is happening in their daily lives, this includes the environments they live in and in their bodies. CAPS states that in science, knowledge does not remain constant, but it can change as new knowledge is discovered. This indicates that scientists continue to explore and look into different information to figure out what is not known. CAPS asserts that learning Life Sciences will help students gain scientific skills and think like scientists, it can also assist them understand ways in which living things interact with living and non-living things. It is therefore fundamentally important that student teachers understand biology topics because they are applicable in their lives and that understanding is key for preparing teachers to teach in schools.

2.10 Teaching of excretion and meaning making

A student centered approach is recommended to achieve the learning objectives of Excretion (Djamahar, Ristanto, Sartono and Darmawan (2020). A student centered approach enable the students to make mistakes and be able to correct them. According to Djamahar et al (2020) the learning of excretion is much easier when there is a use of constructive learning, which allows students to get involved in the teaching and learning process. Teaching and learning of excretion is not easy, therefore, it is important for the teacher to engage students and ensure that they are actively involved. It enables the students to unpack the concepts and make meaning of them, it makes learning not to be abstract. According to Djamahar et al (2020) giving students activities in groups or as a whole class increases the understanding of the biological concepts of excretion. Cooperative learning has an impact on learning and understanding of excretion concepts (Djamahar et al, 2020).

The teacher should begin the lesson by making students aware of the most important concepts of excretion, thereafter, explain each of these concepts to them. Giving explanations of these concepts before the lesson will allow students to have an idea of what the topic of excretion is about. The learner-centred approach allows students to have control over their studies. They will be able to relate these concepts to their realities; this will be done with guidance from the teacher. When learning about excretion, the teacher should engage students in the lesson, this is because excretion is a Life Sciences topic that talks about what happens in an individual's body, thus, allowing students to share ideas might be very interesting to them because it is what they relate to and see every day. Djamahar et al (2020) argues that to achieve what the lesson is intended to do; the teacher should include students and engage with them in the lesson. When students are included in the lesson, they feel acknowledged and know that their opinions matters, this will help them with the process of meaning making. In this paper, the students who I refer to are preservice teachers who are learning about the topic of excretion.

2.11 Preservice teachers

According to Baeten and Simons (2014) traditionally, teachers gained experience in the teaching field by observing lessons prior to being given full responsibility to teach individually. It is very important for student teachers to observe other teachers teach so that they can learn from them and to check which teaching methods can be useful in assisting

students to make meaning of the content. According to Baeten and Simons (2014), collaborative teaching inspires the modern methods used for student teachers; this is known as team teaching. This team teaching is based on socio-constructivist view on learning. Baeten and Simons (2014) states that in this view, knowledge is constructed through the students' interactions with each other and their teacher. Moreover, in this perspective, learning occurs when there is participation and engagement with the activity at hand (Baeten and Simons, 2014). Students share ideas with each other, this helps with the construction of knowledge as they also help each other understand better. According to Baeten and Simons, (2014) "by sharing ideas, providing alternative perspective, and receiving advice, they negotiate meaning and learn from each other's knowledge and skills". This implies that students need each other so that they can achieve more than they could individually.

According to Baeten and Simons (2014), team teaching focusses on two or more student teachers collaborating with each other. Teachers are not limited to which strategies to use in teaching the student teachers. Baeten and Simons (2014) outlined that there are different team-teaching models that can be used in student teachers. I will look into the observation model, coaching model, lastly, the assistant teaching model. According to Baeten and Simons (2014), the observation model is when the student teacher is given an opportunity to observe another teacher teach, this is a passive process because the student is not actively engaging. This only enables the student to collect information from just observations. In contrast, the coaching model, the teacher with the expertise, which might be the content knowledge can mentor or coach the student teacher (Baeten and Simons, 2014). This can be a collaborative method because they can assist and consult with each other. In contrast to the observation and the coaching model, the assistant teaching model is when the responsibility is not only given to one teacher, but the student teacher also assists by providing support to the learners (Baeten and Simons, 2014). This model allows for shared responsibility amongst the teacher and the assistant teacher.

According to Beauchamp and Thomas (2010, pg 631) "during their field placement, student teachers are encouraged to reflect on their observations of practicing teachers and on their own development as professionals". The student teachers need to find their actual identity as they enter into the field of teaching as professionals; they can do this through the observations of other teachers and being in the classroom carrying out teaching practical. This can be done through self-introspection and reflections after every lesson. Beauchamp and Thomas (2010) states that the identity of the students may change due to various factor,

such as the context in which they do their teaching practice, as well as their interactions with others. Preservice teachers are developing teachers who are trying to gain experience in the field of education, thus finding out who they really are and the kind of teachers they want to become. Beauchamp and Thomas (2010) asserts that if the student teacher have selfawareness and the growing sense of self that may be useful in practice.

Summary of Key features of Meaning making and meaning making processes

In this chapter, I reviewed literature on discussion, meaning making, Excretion, 3rd year preservice teachers and Life Sciences. Students constructs meaning differently, this is dependent on how they are socialized in the context they are in and from their background. Therefore, the teacher's role is to ensure that the students are constructing meaning out of what they are learning, that can be done through discussion. Discussion allows students to share their beliefs and understanding on the topic of Excretion, therefore, the teacher will be able to identify what they know, what they do not know and the misconceptions that they may have. This will help the lecturer to be able to guide the process of meaning making in students. In the next chapter, I will outline the research method, research approach, data collection, population sampling, research process, data analysis and the ethical considerations.

2.12 Theoretical Framework

This study follows Vygotsky's (1978) socio-cultural perspective. The perspective on learning which was drawn on aspects of sociocultural theory was presented as follows; firstly, was "the fundamental assumption of Vygotsky's view of development and learning, that higher mental functioning in the individual derives from social life" (Vygotsky 1978, p. 128). In this instance, language and other semiotic mechanisms give the means for people on social (or intermetal) plane to communicate. In this theory, there is the process of internalization (Vygotsky 1987) whereby, individuals appropriate and learn to use conceptual tools that they initially encountered on the social plane for themselves (on the instrumental).

The products of internalization will be different for different individuals. Following the process of internalization, language provides the tools for individual thinking. Socio-cultural perspective is a process whereby knowledge is socially meditated (Vygotsky, 1987, as cited in Msimanga and Lelliot, 2013). This perspective explains that students learn through social interactions, thereafter they internalize the knowledge into their cognitive structure.

According to Shabani (2016) Vygotsky's sociocultural theory argues that the process of meaning making does not begin in the mind, but from the social interactions that occur between individuals that are more knowledgeable and those that are less knowledgeable.

The selected framework guides this study because for students to construct meaning, they primarily interact on a social level, this process triggers the thinking process, thus, there is internalisation of knowledge and making sense of it cognitively. According to Shabani (2016) language is a driving force which allows for learning and development to occur. Meaning making is subjective because individuals understand from their own point of views based on how they are socialized. Shabani (2016) argues that learning is influenced by social mediation, whereby, there is a use of semiotic tools such as language to aid higher levels of thinking. The sociocultural theory guides this study, as it is clearly indicated that there is a use of discussion to make meaning of the concept of Excretion to 3rd year preservice teachers. Therefore, this theoretical framework helped with structuring the study, particularly, the importance of language in communicating thinking and meaning.

Conclusion

In this chapter I evaluated key concepts pertaining to this study. These concepts include discussion, meaning making, Excretion, 3rd year preservice teachers and Life Sciences. This study focuses on how a lecturer uses discussion to promote meaning making during the teaching of the topic of Excretion to 3rd year preservice Life Sciences teachers, concepts for clarifying the study were discerned and are presented above. In a socio-cultural constructivism classroom, learning is often optimized through discussion in a class. The role of the teacher is to encourage students to express and explore their thoughts, feelings, and emotions. The teacher should establish teaching strategies that enable students to interact with their peers in a form of group work and classroom discussions.

Chapter 3: Research methodology

3. Introduction

The previous chapter outlined the literature on which the study was built. The aim of this section was to outline the research method, research approach, data collection, population sampling, research process, data analysis and the ethical considerations. This chapter used qualitative research method, which includes interviews and an observation of a video recorded lecture for teaching Life Sciences 3rd year preservice students.

3.1 Research design: Qualitative

This study used the qualitative research design. This study is qualitative because it analysed data that is non-numeric. This is appropriate for this study because it allowed the researcher to understand and analyse data from the perspective of the participant that is being investigated. According to Srivastava and Thomson (2009) qualitative research undergoes different processes during data collection, this includes participant observation whereby, a participant is being studied and analysed. Qualitative research answers the objectives and the questions relating to the subject being studied. Qualitative data comes in a form of written interview transcriptions which may also include non-written data such as tables, pictures, audios, and video recording (Patton, 2002; Straus and Corbin, 1998). Therefore, qualitative research is focused on an in-depth description of perspectives surrounding the participant. This study is a qualitative research because it deals with an in-depth interview and an observation of a video recorded interview.

Qualitative research often uses triangulation whereby research data is integrated from various sources to avoid bias (Maxwell, 2008). As argued by Nassaji (2015) qualitative research involves various data collection tools such as classroom observation, interviews, questionnaires, and focus groups. Triangulation helps in reducing a bias that may arise from the researcher; that means the researcher may have prior ideas on what is being investigated which he/ she takes into the study and data generation process to influence the research findings. The researcher can influence what the interviewee says, this is based on how the questions are asked. Therefore, triangulation will lessen the chances of the data being biased. The tools used in this study is an interview and an observation of a video-recorded lecture.

According to Nassaji (2015) qualitative research is dedicated to understanding the phenomenon from the individual's perspective, whereby we look deeply at the participant's

opinions, perspectives, and attitudes. This implies that qualitative research is subjective and allows individuals to have differing perspectives on experiences of the phenomena being investigated.

Nassaji (2015) further argues that in qualitative research, interviews are organized with interviewees to check, confirm, and clarify the emerging themes in data. This implies that the participant simplifies and make understandable the themes that arises during the data analysis process. Srivastava and Thomson (2009) state that qualitative research provides a solid foundation for research analysis and interpretation. Qualitative research describes the data gathered by the researcher, from viewpoint of the people who have experienced the phenomenon being investigated using the chosen research method.

3.2 Research paradigm

The research paradigm that was followed in this research is interpretive. According to Scott (2013) in an interpretive paradigm there is no single way of looking at the world, but individuals can construct meaning based on their own subjective experiences. This approach was appropriate for this study because there is no universal knowledge on the phenomenon being investigated, therefore, this allowed for different perspectives from the lecturer on Excretion and from what the researcher have gathered from the video recorded lecturers.

According to VanWynsberghe and Khan (2007) an interpretive paradigm asserts that there are various ways of looking into reality, it also focuses on giving an in depth understanding of how individuals create meaning in their everyday lives. The interpretive paradigm allowed for individuals to construct the views of reality in a way that makes sense to them, it gave a space for individuals to use their own experiences to interpret knowledge. The interpretive approach focuses on a local context rather a global context because knowledge is constructed based on how individuals are socialised, instead of looking at the society at large we focus on how individuals understand knowledge in their given context.

According to VanWynsberghe and Khan (2007) the interpretive paradigm assumes that there is no single way of constructing knowledge because individuals interact and experiences the world differently. Interpretivism studies the human behaviour whereby the views of reality are socially constructed or made meaningful through actors' understanding of events.

According to VanWynsberghe and Khan (2007) the interpretive approach is compatible with a case study as it believes that the views of reality are social and depends on the individuals

that are interacting with the world. The interactors derive different perspectives from their experience of how they were socialised in the world. The researcher interpreted how meaning making is constructed when teaching the topic of Excretion to 3rd year preservice students.

3.3 Research Method: Case study

According to Hafiz (2008) a case study is a research method that a researcher uses in his/ her study to answer the questions of “how” and “why” and deal with situations based on the contexts in which they occur. A case study helps organise and simplify the data gathered by the researcher. Hafiz (2008) states that the behaviour of the participants involved in the study cannot be manipulated and the context which the phenomenon being investigated occurred. It is very difficult to report data, therefore, using a case study can assist the researcher to simplify complex data (Hafiz, 2008). This study was a case study because the researcher provided a description of behaviour that comes from interviews and other data sources such as observations. Case studies are less costly and less time consuming, this enabled the researcher to gather as much data as possible. It provided insight for further research.

According to Gerring (2004) a case study does not analyse cases, but rather, it defines them in a way that complex information is simplified. A case study method requires the researcher to gather information on what is being investigated and then try to simplify it so that it becomes easy for the next person who is going to read it or interested in the researched phenomenon. Gerring (2004) argues that a case study is a form of qualitative research methodology whereby a researcher focusses on a single phenomenon to be investigated. If a researcher chooses to focus on a lot of phenomena on a single case study, it might cause a lot of confusion, as the information is wide and does generalises a lot of information presented. According to Gerring (2004) a case study studies a single unit so that a larger unit of information can be understood. A case study is understood in broader terms when it focuses on a specified subject that is studied.

In this study, the case study method focussed on how the lecturer used discussion to promote meaning making when teaching Excretion to 3rd year students training to be Life Sciences teachers. Using a case study in this research helped in simplifying the data because information was gathered from the observation of video-recorded lectures and interviews

and it was simplified for everyone to understand. This case study interpreted how meaning making was constructed when teaching Excretion to 3rd year preservice students.

It can be very difficult to work on a case study and not understand the context, the context helped the researcher in making sense of the information that is provided and helped to avoid bias whereby the information could be manipulated based on what the researcher feels about the researched phenomena. According to Hays (2003) observation and interviews are very important when using a case study method, because it becomes easy to understand the interactions when you are able to see them and also get opinions from individuals who are directly involved.

Hafiz (2008) states that it is difficult to have a real reflection of what the phenomena is if the context is not taken into consideration. The context provides clarity of the portrayed message, it is not easy to make assumptions when the intended message is made clear and easily understood by people. It is very difficult for researchers to focus on one problem when using a case study, therefore, to avoid that they have to always refer back to the research questions (Hays, 2003).

Hafiz (2008) suggests that it is important to figure out the type of case study to focus on, this stems from the purpose of what the case study tries to achieve. There are different kinds of case studies and can be chosen depending on what is being investigated and how the information should be provided. Hafiz (2008) further argues that the researcher should choose a case study that fits into what they want to achieve, for instance, if a researcher chooses to focus on an explanatory case study, it means that it would explain situations of what happens in real life that are too complex. It is of vital importance that a researcher understands what the research is trying to accomplish, this makes it easy in facilitating an understanding of the investigated phenomena. Hays (2003) states that the researcher is responsible for sorting and organising data to make it more comprehensible.

According to Hafiz (2008) it is important for a researcher to know whether it is viable to conduct a single case study or multiple case studies of a single phenomenon. A single case study focuses on a single research issue, whereas multiple case studies focus on more than a single case (Hafiz, 2008). A single case study explores the researched phenomena and its context in-depth, whereas Multiple case studies can be built on each other, or they can be conducted simultaneously. According to Brown (2009) a case study research includes

categorising data into different themes, which makes it more understandable. The type of case study in this research is explanatory because it explains how meaning making is promoted when teaching Excretion to 3rd year preservice students training to be teachers.

According to Hafiz (2008) a case study allows a researcher to gather information from various sources and make sense of them. Case study research allows for a researched phenomenon to be viewed in multiple perspectives without the data being manipulated or bias to fit the researcher's point of view, but rather, the context is there to assist with accurate analysis of the data. It is important to understand what a case study is not, before you can uncover what it is; in this instance, it is important to understand that a case study is not a research technique or a method (VanWynsberghe and Khan, 2007).

According to VanWynsberghe and Khan (2007) a case study cannot be regarded as a technique that is used by a researcher to gather information on a given phenomenon. The phenomena studied in this research is how discussion promotes meaning making. A case study simplified information that is gathered using different research techniques such as interviews and observations. According to Gerring (2004) a case study generalizes across a wide range of information investigated. This is a case of how a lecturer promotes meaning making during the teaching of Excretion. A case study was chosen because this research aimed to gain concrete and in-depth knowledge about how a lecturer used discussion to promotes meaning making during the teaching of the topic of Excretion to 3rd year preservice teachers.

3.4 Data collection

3.4.1 Research techniques

The data collection techniques that this research used are video-recorded lectures and video-stimulated semi-structured interviews.

3.4.1.1 Observation of video-recorded lecture

The main purpose of observation in this study was to gather data from the video-recorded lectures and analyse it in relation to the objectives of this study. According to Nassaji (2015) observation is a data collection process whereby the researcher observes the participant while studying them. In this study, I observed video-recorded lectures on the topic of Excretion taught to the University of the Witwatersrand 3rd year students. Observing lectures helped me to understand how the lecturer uses discussion and how it promotes

meaning making. According to Cowie (2009) it is very important to write down what you observe so that you can refer and that will make it easy to remember everything.

3.4.1.2 Video- stimulated Semi- structured interviews

According to Langos (2014) semi-structured interviews are used to guide the researcher. Some specific questions were created for the researcher to steer the interview towards the satisfaction of research goals, but additional questions were made encountered for during the interviews. This implies that some of the questions that were asked was a follow up on the responses given by the participant, and the questionnaires prepared prior the interview served the purpose of guiding the research looking at what it aims to achieve. Semi-structured interview allows the participant to give a response that cannot be obtained in an unstructured interview (Mcintosh and Morse, 2015). It allowed the researcher to come up with follow up questions.

According to Nassaji (2015) semi structured interviews are the data collection method whereby, the questions are open ended and do not limit the participant with the choice of answers. The main purpose of doing the video-stimulated semi-structured interviews in this study was to get the perspectives of the lecturer and be able to give follow up questions based on the videos I have observed. This help me understand the opinions and beliefs of the lecturer. According to Bariball and While (1994) semi-structured interview allows for different perceptions from the participants, therefore, it does not become biased. The video stimulated interviews are appropriate in this study because there are pre-recorded lectures which guided me with the formulation of the research questions. According to DiCiccoBloom and Crabtree (2006) a semi structured interview comprises of open-ended questions which are constructed from the answers that are given by the participant.

According to McIntosh and Morse (2015) a semi-structured interview aims to get a response that is subjective. This implies that the researcher does not expect any specific response from the participant, but allows the participant to share knowledge based on their experiences. The interviewer should always be prepared to come up with questions that stems from the answers that are given by the participants. According to DiCicco-Bloom and Crabtree (2006) the objectivity of the interview should not be compromised. Therefore, the researcher should not pick sides, but should share information according to how the interviewee has described it.

3.4.2 Research tools

The data needed for this research was gathered using qualitative data collection techniques; namely, observation of video recorded lectures and video-stimulated semi structured interviews.

3.4.2.1 Observation guide:

Observation is appropriate for this study because it assisted me when formulating questions, as some of them were based on how the lecturer conducts his lessons using discussion. According to Cowie (2009) there are researchers who are participant observers, whereas, others are non-participant observers, in qualitative research many researchers do not participate but only observe the participant. The researcher should organise and interpret the observed data in a manner that is easy to understand.

3.4.2.2 Semi-structured Interview guide: The semi structured interview follows the following guide:

According to DiCicco-Bloom and Crabtree (2006) the semi structured interview can either focus on an individual or a focus group, when one person is interviewed, the researcher digs deep into their knowledge, whereas a focus group give a general account across the researched phenomena. Individual semi structured interviews allow the interview to dwell more on what they need to know; they may ask follow up questions just to ensure that the interviewee gives detailed information on the phenomena. Whereas a focus group gives an opportunity to a group of people to share their experiences. The semi-structured interviews usually take about 30 minutes or more.

According to DiCicco-Bloom and Crabtree (2006) individual in-depth interviews are very useful because they allow the researcher for a wide range of research questions to be asked. The interviewer should always be prepared to ask or formulate more questions based on the responses that are given by the interviewee. Often, the question in an in-depth individual interviews lies on what response was given by the participant. According to DiCicco-Bloom and Crabtree (2006) during semi structured interviews, the interviewer can decide to change questions that he initially had to get hold of knowledge that supports the research. The interviewer can follow the participant's train of thought to be able to formulate questions that elicit the interviewee's interests.

3.5. Population, sampling, and Sample size

According to Tuckett (2004) sampling in research focuses on a small amount of data, so that the researcher can be able to study in-depth details of the study. This study relied on purposeful sampling, because the participant was chosen on the basis that they can provide details in-depth and has more information on what the research focusses on. According to Glenn (1992) there are various ways of selecting the population size, this may include referring to similar studies. Referring to similar studies may assist in the identification of the kind of population size which may work best.

3.5.1 Population

The population of the study is one individual who has experience and expertise in teaching the topic of Excretion to 3rd year students. The individual selected is a lecturer who was responsible for teaching Excretion to 3rd year students training to be Life Sciences teachers.

3.5.2 Sample size and Sampling procedure

The participant in this study was a Life Sciences lecturer at the University of the Witwatersrand. The lecturer was chosen because he taught the topic of Excretion to 3rd year Life Sciences preservice teachers. There is only one participant for this study.

The Sampling procedure was a purposeful sampling. The participant was selected based on knowledge and expertise regarding the research subject. The participant is knowledgeable in the phenomenon under investigation, have sufficient and relevant understanding, and work experience in the field of Life Sciences.

The sample size of this research was driven by the urge to have an in-depth information about the experience of the lecturer. According to Tuckett (2004) the researcher determines the sample size based on the amount of data that is presented. This study focussed on the in-depth data that was gained from the interview, therefore, only one participant was observed and interviewed on how discussion is promoted during the teaching of excretion to 3rd year students, the observation was based on the recorded videos of the lecturer. According to Tuckett (2004) the research should try to remain reliable and valid even when using a certain sample size

3.6 Data analysis

According to LeCompte and Schensul, 1999, as cited in Kawulich (2014) data analysis is the process whereby the researcher reduces data to a story and interpretation. Data analysis is the most important part of the study because it summarises the data gathered to make it less complicated and more understandable. As a result, it assists us in making conclusions and gain logical information from the study. Marshall and Rossman (1999:150) describes data analysis as “the process of bringing order, structure and meaning of the mass of data collected”. This implies that the process of data analysis organises the data gathered and clarify it. According to Lacey and Luff (2009) interviews or observational data generates a large amount of data that needs to be described and summarised. Lacey and Luff (2009) further argues that the researcher has to look for connections between numerous themes being identified or relate to the respondent’s behaviour or beliefs.

Data analysis enables data to be reduced and avoids a lot of incorrect interpretation of data. Moreover, Kawulich (2014) states that “A qualitative content analysis approach to data analysis involves reading and re-reading transcripts, looking for similarities and differences that enable the researcher to develop themes and categories”. Data analysis makes it easy for the researcher to make sense of the data, this also enables other people to comprehend the data as they are reading through. According to LeCompte and Schensul, 1999, as cited in Kawulich (2014) data analysis undergoes the process of coding, whereby we look for certain patterns and themes. Coding helps us to group our data and break it down so that it is more understandable.

According to Kawulich (2004) inductive data analysis can be witnessed in qualitative research, whereby there is transcription of all the data gathered. I have drawn my conclusions from interpretation of lecturer’s actions in the video-recorded lectures. In this study, the data gathered was analysed from the video recorded lectures and semi structured interviews with the lecturer. In doing that, I watched the recorded lectures to identify how the lecturer used discussion to promote meaning making during the teaching of Excretion to 3rd year preservice teachers. I firstly transcribed the video recordings, as well as the semi-structured interview. Thereafter, coded the aspects that helped me to identify how discussion is used to promote meaning making. The data collected was reduced and simplified so that it is easy to understand.

According to Maxwell (2008) coding is one of the strategies that can be used in qualitative research. Coding ensures that the researcher finds it easy to summarise and analyse data. According to Maxwell (2008) coding categorises data in different themes that will be easy to understand. Coding in qualitative research ensures that the data gathered from research is organised and easy to understand.

3.7 Ethical considerations

A researcher needs to consider ethics to avoid harming the research participant. The participant's identity was respected, this was done by allowing the lecturer to sign a consent form and was allowed to withdraw anytime, this assured the participant that his/her participation is voluntary. The responses are treated as confidential and are used for the purpose of the research and not for personal gain. The participation letter and consent form reassured the participant that their answers are confidential and that helped in making them feel comfortable engaging in the research project. There were no personal costs for this project.

The participant did not receive any personal benefits from participation but there were no disadvantages or penalties if he/she decided to withdraw from this study. The participant may decide to not answer some questions if they did not feel comfortable. This research was completely anonymous. I did not disclose any names or identity, the information is held securely and not disclosed to anyone else. If the participant experienced any distress or discomfort at any point in this process, we would have stopped the interview or resumed another time. According to Arifin (2018) when doing qualitative research, it is important to protect the human rights of the individuals that are participating in the study.

This, as Arifin (2008) further argues is important because the participants may not be at ease when expressing their feelings and experiences. Therefore, the ethical consideration enables them to be able to participate with ease and with the knowledge that they are protected, that is, they are participating voluntarily and has every right to decide to stop participating when they no longer feel comfortable or are made to feel uncomfortable during the interview sessions. Arifin (2018) states that participants should have informed consent and voluntary participation. When there is informed consent, participants have the power to decide whether the study is good for them or not, thus, they have a sense of agency to decide for themselves and not feel pressured to partake in the study.

According to Arifin (2018) participants deserves to be given enough information before they can partake in a research study, this allows the participant to accept or decline an offer of being part of the study looking at whether there are risks involved or whether it would not affect them in any way. The participants are granted freedom to decide on what they think is good for them. According to Arifin (2018) individuals are given all the details they need to know pertaining the study and whether they will be affected by the study in any way, they are also given the freedom to ask questions they would like to know and seek clarity on things they might have misunderstood.

It is the researcher's duty to ensure that the participant is provided with an information sheet and a consent form that allows them to read through and sign to indicate that they agree with the terms that are provided on paper that involves the study as a whole. According to Arifin (2018) the participant ought to be presented with information sheet that gives them written information that relates to the research, as well as a consent form that has to be signed. The participant was given assurance that their opinion matters, this is because the research was designed in a manner that allows individuals to have control over their contribution, if they decided that they do not want to be part of the research anymore, they will not face any consequences.

According to Arifin (2018) individual's anonymity and confidentiality is kept safe because their real identities were not revealed in the research. The participant's identity are preserved and kept a secret; this is to protect the participant from being known by others. It becomes easy when the participant is not known because other people who do not agree with their point of view with regards to the phenomena being investigated will not have the power to attack them, or even judge them because of their views. Therefore, anonymity and confidentiality helps in avoiding tension that could arise. Arifin (2018) states that if the interviewer cannot get hold of the participant, then they should not share the information of the research with others, even if they are related or are very close, rather inform them to alert the participant that you are trying to reach out to them, and they should get back to you when they get a chance.

The interview done with the participant can be physical or telephonically, therefore, when the researcher does the interview, he/she should ensure that there are no other people who might listen to the interview or even know who the participant in the study is. According to Arifin (2018) the transcribed data of the interview should not have names of the participants,

therefore, to protect the identity of those partaking in the research study, they should use pseudonyms. After the data is transcribed into written form, it should be protected so that only the researcher can have access to it. According to Arifin (2018) data gathered from the research should be protected in a device that requires a password and is encrypted. It is the researcher's duty to ensure that the participant feels comfortable sharing information knowing that it will be safe and protected.

3.8 Reliability and Validity

Reliability is the quality of the results to be consistent if the research can be repeated under the same conditions. (Joppe, 2000, as cited in Golfshani, 2003) if the results can be reproduced under the same conditions and are consistent and accurate then they are considered to be reliable. Reliability helps with proving that the data gathered is consistent, even if the research is performed at different times it produces the same result. To improve the reliability of the result of research, the investigations that took place should be repeated under the same conditions and should produce consistent results or observation. According to Golfshani, 2003, pg. 599 "a high degree of stability indicates a high degree of reliability, which means that the results are repeatable". If there is reliability, it means that the results will not change, but remain consistent even when they are obtained at different times. To produce an effective study, the result must be reliable and valid.

According to Thanasegaran (2009) reliability produces results that are consistent and has no errors. Reliability is the degree to which the results are error free and are consistent and producible. According to Fitzner (2007, p776) Inconsistent results undermine the strength of research findings and may lead to earnest practices. The research findings must be consistent with no errors to show or prove reliability. The research must be standardized to avoid fluctuations of the results. Fluctuations of the results would mean that they are not reliable since there is no consistency and reproducibility.

Validity of the results checks whether the results measures what it is intended to. According to Golfshani (2003) validity measures and focuses on the purpose that the research tries to achieve. If research has validity, then it will measure what it is intended to measure. We should measure what it is intended to measure without including other outside factors.

3.9 Conclusion

In this chapter I discussed the research method, research approach, data collection, population sampling, research process, data analysis and the ethical considerations. In this research, a qualitative approach was used, and it analysed the data that comes from the participant's perspective.

Chapter 4: Data analysis, interpretation and presentation of findings

4.1 Introduction

This chapter presents data analysis, interpretation and the results of this study. The findings are presented under the following headings: How students engage in discussions, evidence of meaning making that can be discerned from discussion, the role of the lecturer in facilitating student teachers' meaning making and why the lecturer stimulate discussion in ways mentioned.

The research questions that guided the study were:

Main question

How does a lecturer use discussion to promote meaning making during the teaching of the topic of Excretion to a class of 3rd year preservice Life Sciences teachers?

Sub questions

1. How do students engage in discussions that the lecturer stimulates?
2. What is the evidence of meaning making that can be discerned from discussions when a lecturer teaches Excretion to 3rd year Life Sciences students?
3. What is the role of the lecturer in facilitating student teachers' meaning making during discussion when teaching Excretion to 3rd year preservice teachers?
4. Why does the lecturer stimulate discussion in these ways when teaching Excretion to 3rd year preservice teachers?

I analysed transcriptions from video recorded lectures and the interview with the lecturer who taught excretion to 3rd year preservice teachers. The data collected were in the form of video recorded lectures and an interview with the lecturer. I transcribed five videos which helped me with the analysis and presentation of the results found from the study. I watched the recorded lectures to identify how the lecturer uses discussion to promote meaning making during the teaching of excretion to 3rd year preservice students. I firstly transcribed the video recordings as well as the semi structured interview. Thereafter, I coded the aspects that helped me to identify how discussion is used to promote meaning making. I derived the codes from the transcripts of the videos by identifying patterns and categorising them into different codes. The coded transcripts will be included in the Appendix.

4.2.1 Illustration of Analysis of the video-recorded lectures

To analyse the videos, I firstly watched each video at least three times. I transcribed the audio of each video verbatim and took screenshots of sections of the video to capture some supporting evidence of how the lecturer used discussion in the lesson. After transcribing all the five lectures, I read through the transcripts identifying and coding the lecturer's utterances. The five videos I transcribed are conducted by the same lecturer. Below is an excerpt of Transcript 1 of 5 videos showing the coding, the codes are highlighted in red. The rest of the coded transcripts are in Appendix 1.

The lecturer probes for discussion in students by asking questions that requires them to give responses. The lecturer uses open ended questions to allow students to exchange ideas and further their thinking and learning.

Below are the codes that I generated:

- Explaining and probing
- Question and answers
- Conceptual understanding
- Explaining and asking questions
- Lecturer uses teaching aids

Below is an example of analysis of a transcript from video 1 of 5

Lecturer: Someone is saying we have things like poriferas (Lecturer elaborates on student's answer), what are those? (followed the student's answer with another question?) Poriferas? The lesson is not about poriferas; we are just mentioning them as one of the organisms that will excrete some of the materials to maintain the internal environment, okay? (Affirmation question? Those are the sponges; do you know what sponges are? Question (Lecturer leaves question unanswered) Then we have here the Annelida, then you have your Arthropoda. So the the list is... So if we look at the school curriculum, where is the focus? Question Where is the focus when we talk about excretion? Lecturer repeats question Do we say anything about Protista? Question Do we say anything about porifera? Question Do we say anything about Arthropoda? Question

Students: No

Below is another example of analysis of a transcript from video 1 of 5

Lecturer: No, no. You can't give that answer; you have to be certain. So those... I am trying to show you that if I have got ions there, things like iron, which is an ion, your magnesium, your calcium, your potassium, your chlorides, all of those, okay... Which is why sometimes we talk about the mineral salts like your table salt, what is it called again? (Explanation and question)

Student: Sodium chloride

Lecturer: Sodium chloride... (affirms answer) It is sodium, so we got sodium and chloride, okay? Because the other thing we learnt from our Natural Sciences matter and materials, it is matter and materials, not so? Natural Sciences matter and materials is that some of these salts, is it some or all of them? You have to go and tell me. When they are dissolved in water they break into the ions, that is why we are talking about the ions because it is not like you are literally eating the ions, okay? It is not like you are literally eating the ions. So, let us talk about the nutrients (discussion)

After generating the transcripts from the five videos, I generated codes based on how the lecturer used discussion to teach the topic of excretion to 3rd year students training to be Life Sciences teachers.

4.3 Presentation of results

4.3.1 How students engage in discussions

Students engage in discussions with the lecturer, as well as with other students. This is done when the lecturer asks students questions that allows them to share their opinions. The lecturer poses questions that are related to the content of excretion, then the students share what they know from their everyday knowledge, as well as what they may have learned in previous classes before they can be given correct explanations of what the content is about.

Below is an extract from Lecture 2 of how the students engaged in the lesson:

Student: It is the repression of the amount of water and solids because the amount of water can only be regulated... (Student answering the question)

Lecturer: So, we are talking about water and solids, Okay? The regulation of water and solids in the internal environments, that is what we talk about osmoregulation. (Lecturer provides clarity). Remember we said that the internal environment could mean in the cell especially ... or inside the blood vessels, in other words the amount of water within the blood, the amount of salt within the blood, so here we normally talk about the ions, we talk about them in form of ions, of course there will always be some terms that we use when we describe what is happening inside or in the internal environment compared to what is happening outside. We have got the internal environment and we got the external environment, so when we compare the state or the conditions inside in terms of the solids, the amount of water compared to the outside is different, okay? Now, in a case where we have this tool (water solutes) more inside we normally use a term hyper, okay? Hyper? Hyper? We are talking about osmoregulation; we can't say hyper regulation. It is going to be hyper? (Explanation followed by a question)

Student: Osmotic

Lecturer: Yes, hyperosmotic, but if we got less inside, that is hypo osmotic (Lecturer gives an explanation and explains further). So, these are some of the terms that we will be using, so it is just a comparison of...if we compare the concentration of water which is inside or in the internal environment or external environment, what we say about it... there will be cases where it will be less and then we use hypo and there will be cases where it will be more and then we use hyper, of course there will be cases where it will be the same and which term do we use? We use? (Question)

Student: Iso (student answers question)

Interpretation

In this lesson there is a whole class discussion as the students were giving explanations and giving a chorus answer. The type of discussion that the lecturer and the students were having in their conversation is a dialogue because they were exchanging thoughts with the aim of reaching a common understanding. Discussion is stimulated when students are responding to

the questions posed by the lecturer, the students are responding based on their prior knowledge which enables them to identify what they know and whether it is correct or not, thus enabling meaning making to be promoted. The questions that the students answered were guiding questions, whereby the lecturer started by giving them explanations first which helps in guiding their thought processes. According to Wilkinson (2009) discussion is a collaborative way of exchanging ideas, either between teacher and student or between students themselves. Therefore, in this discussion the exchange of ideas was between the teacher and the students, the students are dominant in this discussion as they are given an opportunity to give explanations of what they know. The lecturer managed to evoke prior knowledge using different strategies. At the beginning of the lesson, the lecturer managed to invite students to engage with the questions which were on the slides before the presentation of the actual lesson. The questions were said to be questions that are aimed at guiding the lesson of excretion and find out if they still remember what was discussed on the previous lesson.

Key finding

There is a whole class discussion whereby, the lecturer and students are sharing ideas.

4.3.2 Evidence of meaning making that can be discerned from discussion

The lecturer ensures that the students understand the meaning of concepts as they are learning. The evidence that the students understand the concepts is shown as they are asked to respond to questions that are posed by the lecturer. The evidence is in how they respond and whether their responses show an understanding.

Student: Yes

Lecturer: And what did we say, so we have external and internal environment, so we had something like that, not so?

Student: No

Lecturer: It is slightly different?

Student: Yes, it is a bit different

Lecturer: So, we are saying, let us say that this is our internal environment, okay? And this is our external environment then we are comparing their concentration inside which is the

internal environment, and outside which is the external environment. The example that we gave was that let us say inside we have got salt solution

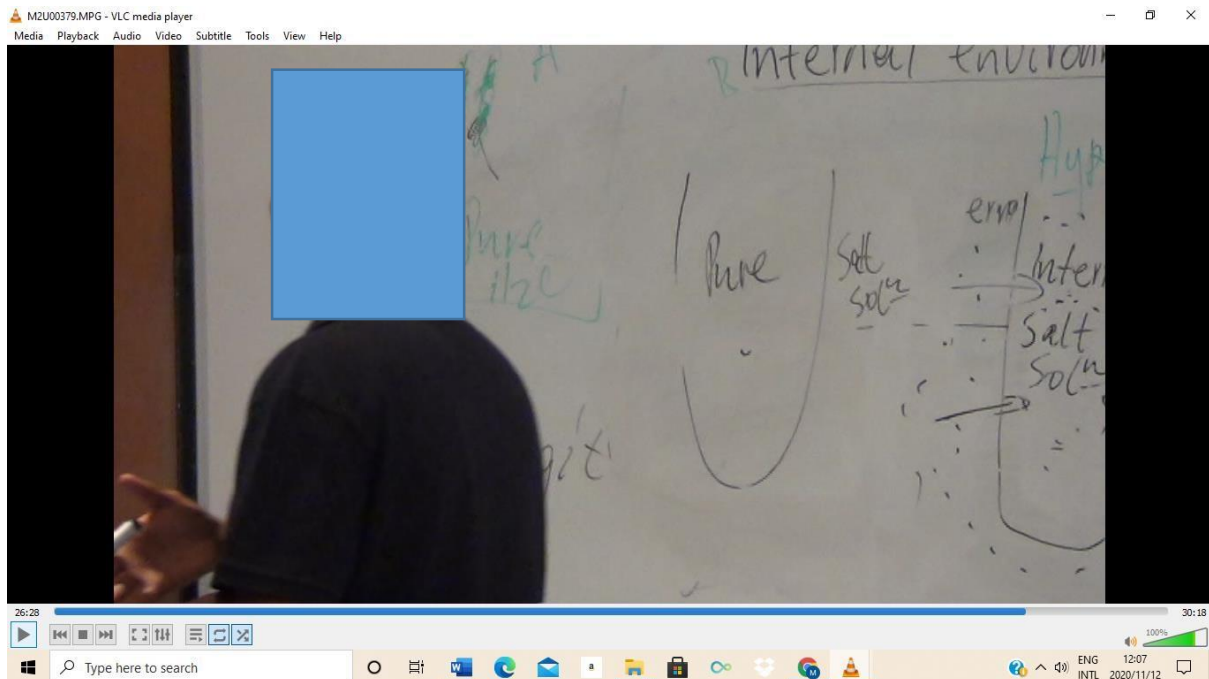


Figure 4.1: Evidence of meaning making from discussion with the lecturer

(lecturer explains using the whiteboard)

Student: Yes

Lecturer: Yes, high concentration of salt solution. Was it about that? (Question)

Student: Yes, and we used calcium ions (answers question)

Interpretation

Individuals are able to bring up ideas on Excretion, these ideas are then written on the board for an effective discussion to take place. The lecturer and the students came up with different ideas which were used in the lesson. The discussion above enables a conversation to occur between the lecturer and the student, students are actively involved in constructing their own knowledge and understanding. The discussion was mainly based on question and answers, this aided for a discussion to occur. Although there was a discussion, it cannot be concluded that meaning making was promoted. The lecturer writes down students' contribution on the board, this helps everyone in the classroom to remember what is written when they use the ideas they brainstormed for explanation of the content. What is written on the board is very important because even students who missed what is being discussed can be able to see on the board.

The discussion taking place is between the lecturer and the students, therefore, this is a whole class discussion.

Key finding

The classroom discussion is mainly based on question and answers.

4.3.3 The role of the lecturer in facilitating student teachers' meaning making

The lecturer's role is to ensure that each and every student is engaged with the content. The lecturer should explain concepts to the students and also ask questions to ensure that the students have a deep understanding of the content. Below is an example of how the lecturer facilitates student teachers' meaning making:

The lecturer writes on the board when engaging the students in discussion. The writing on the boards helps the students to be on the same pace as the lecturer. Thus, enabling that no student is left behind. Writing on the board also ensures that every student can keep up, because if they missed any point from what the lecturer discussed, they can be able to see it on the board. The image shown below represents a lecturer writing on the board during a discussion.

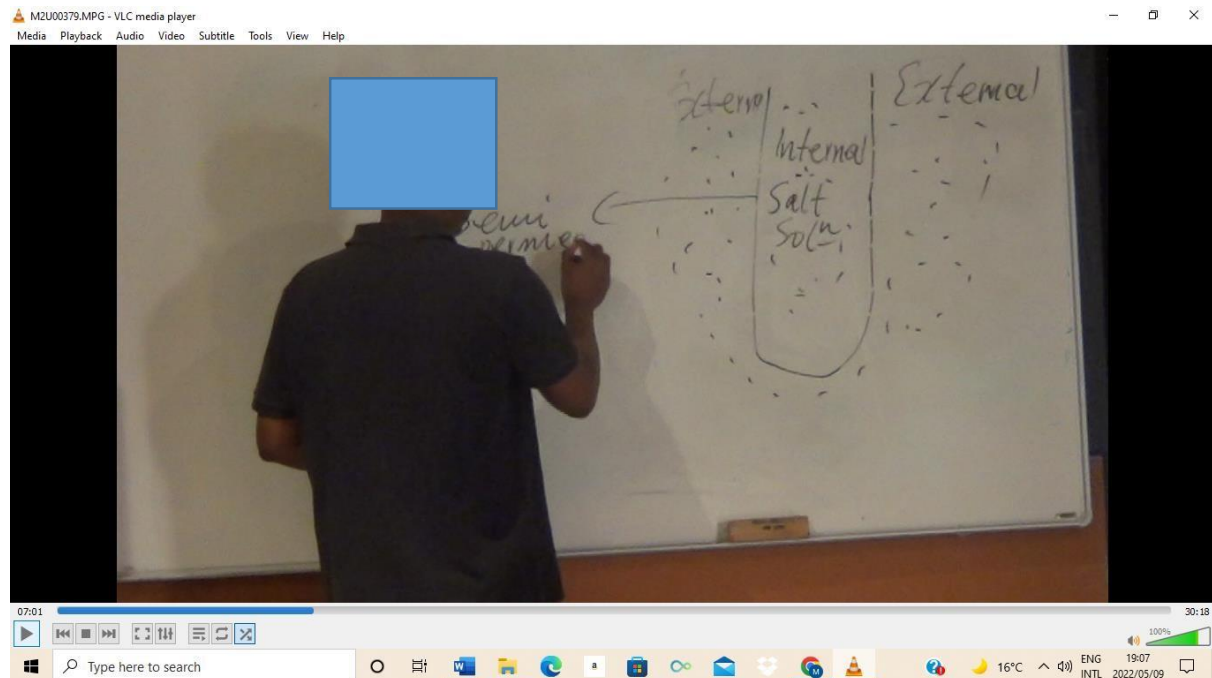


Figure 4.2 Explanation using whiteboard

It can be seen from the extract below that the lecturer repeats the question, this is because it was left unanswered. Repeating the questions ensures that even the students that did not get it

the first time can be able to grasp it and those who hear it can get more time to think of the response to give.

*Lecturer: Someone is saying we have things like poriferas **Lecturer elaborates on student's**, what are those **and followed the student's answer with another question?** Poriferas? The lesson is not about poriferas, we are just mentioning them as one of the organisms that will excrete some of the materials to maintain the internal environment, okay **Affirmation question?** Those are the sponges; do you know what sponges are **Question?** **Lecturer leaves question unanswered***

Then we have here the Annelida, then you have your Arthropoda. So the the list is...

*So if we look at the school curriculum, where is the focus? **Question** Where is the focus when we talk about excretion? **Lecturer repeats question** Do we say anything about Protista? **Question** Do we say anything about porifera? **Question** Do we say anything about Arthropoda? **Question***

Interpretation of the results of the analysis

The type of discussion that took place in this lesson is a dialogue, it allowed the lecturer and the students to exchange ideas and share knowledge. The discussion is between the lecturer and the whole classroom. The lecturer facilitated the discussion in the classroom in order to promote meaning making, this is done through the use of a white board. Writing on the board guides students into going through the lecture on the same pace with the lecturer, it also helps them to identify important concepts and it provided the students with the opportunity of asking more questions and that helps the lecture to identify what they understood, as well as their misconceptions. The teacher is able to facilitate the process of meaning making because the use of a white board allows for drawings and annotations to be used for more explanation, thus, providing clarity to students who are struggling to grasp the content. It also allowed students to write down what the lecturer is indicating to them and helps them to avoid having to remember a lot of information during a short period of time, instead they referred on the notes they wrote to make learning easy and enjoyable.

Key finding

There is a dialogue between the lecturer and the students, there is a use of a whiteboard to facilitate meaning making.

4.3.4 Why the lecturer stimulate discussion in ways mentioned

The lecturer stimulate discussion through the use of question and answers, this enables the lecturer to acknowledge and use prior knowledge. The aspects which I consider to be successful in engaging students from the observed videos was the ability of the lecturer to identify prior knowledge. The lecturer managed to evoke prior knowledge using different strategies. Discussion is stimulated in this way so that prior knowledge from the students can be identified and if there are any misconceptions, they are corrected. At the beginning of the lesson, the lecturer managed to invite students to engage with the questions that were on the slides before the presentation of the actual lesson. The lecturer begins the lesson on lecture 2 by saying:

Lecturer: Was this the last slide that we discussed?

Learners: No

Teacher: So, we didn't say anything about this? This slide? And what did we say about it? Was this the last slide that we discussed?

Learners: Yes

Teacher: What did we say about this slide? What did we say about it? Can you remember what we said regarding the information on that slide? You have got the information here and you are agreeing that you are not seeing this slide for the first time, and we discussed the slides, that is what you are telling me. What did you say about the slide? (Recap)

Learners: I am confused; I don't have any notes to this slide

Teacher: So, the determining factor is that you do not have notes on the slide, therefore we did not discuss this slide. What did you say?

The transcript above indicates that the lecturer recaps his lessons, therefore, prior knowledge is catered for in his lessons, thus, using engagement successfully. The lecturer is able to probe

students into engaging into the lesson. When the lecturer asked “So, the determining factor is that you do not have notes on the slide, therefore we did not discuss this slide. What did you say?”, this indicates that he wants to check if the students remember what was taught prior this lesson. This draws from the cognitive constructivism as the teacher is able to identify prior knowledge, this is done through recapping and asking students what they know about the content before the lesson could begin.

In one instance, the lecturer gives an explanation to students that states “... Because the solute movement results in the movement of water by osmosis, the net effect is to regulate both solutes and water. So, we have tried to explain”.

As the lecture progressed, there were instances when the lecturer used question and answers to check for students’ understanding. As I went through the transcripts, I noticed that the lecturer often provided explanations that were followed by questions to check if the students were understanding what was being presented.

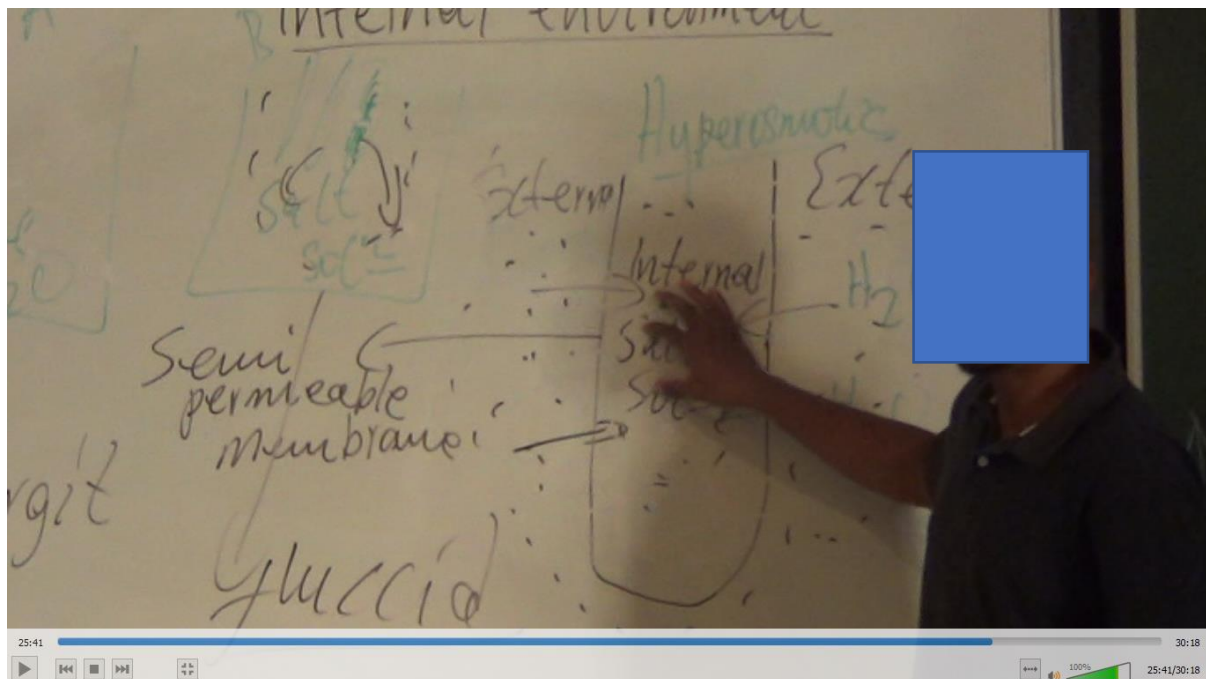


Figure 4.3 How discussion is stimulated

As can be seen in the excerpt above, students could answer the questions based on the illustrated content, which shows that they were engaging with the content, hence there is active engagement. Through the use of this strategy, it is clear that the students would get engaged in the lesson. The teaching strategy motivated students to ask questions as well.

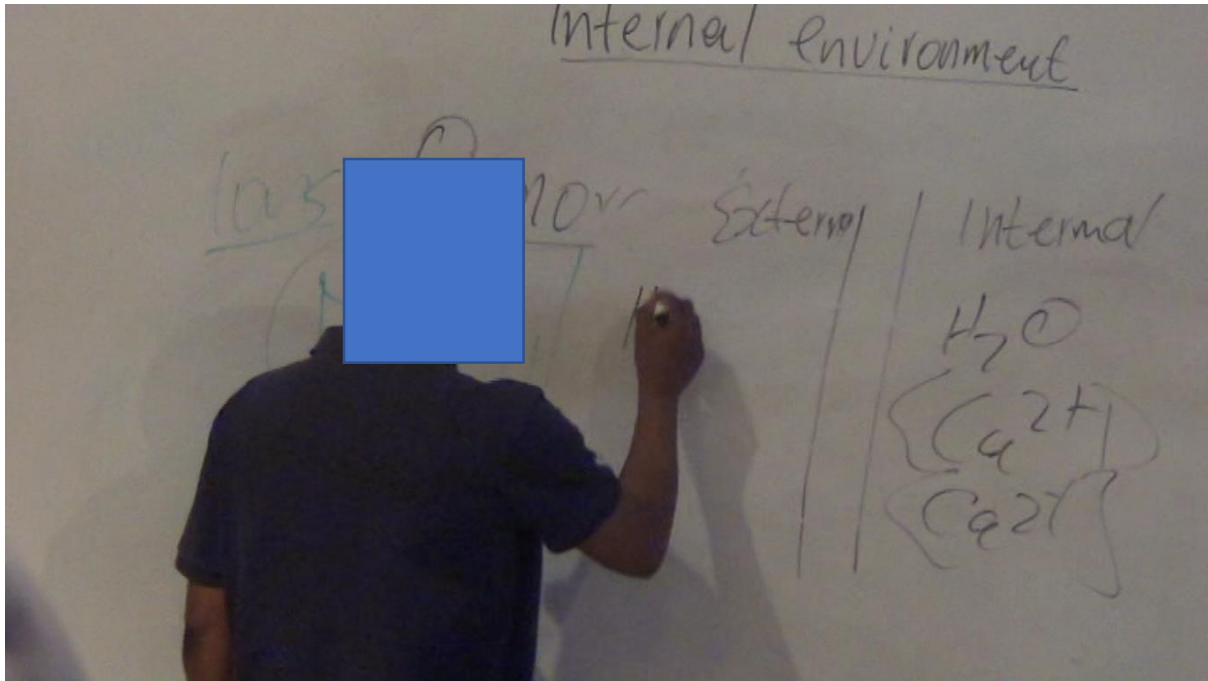


Figure 4.4 Lecturer provide guidance and explanation by writing on the board

However, just with the recapping episode presented above, although there was active participation, most of the time there was no adequate response because students were giving one-word answers and often did not answer the lecturer's questions during which he ended up answering by himself. The quality of questions used did not allow students to engage fully with the content which then hindered engagement and hence meaning making. This is indicated below:

Lecturer: And what did we say, so we have external and internal environment, so we had something like that, not so?

Student: No

Lecturer: It is slightly different?

Student: Yes, it is a bit different

The lecturer provided guidance by using question and answers. With this strategy, students were asked questions which they had to respond to. Thereafter, the lecturer provided guidance by further explaining and giving affirmations to some of the answers they gave. The affirmations were to just to show them that they are correct and further explanations were provided.

Below is another example of a discussion between the lecturer and the students:

The lecturer engages students in discussion by providing explanations and also asking questions to the students. This can help promote meaning making when teaching the topic of excretion because the lecturer ensures that the students unpacks what they know and understand. This assists the lecturer to identify the misconception of the students, that enables them to be able to have a correct way of looking at the content. Thus, promoting meaning making. The purpose of asking questions is to ensure that the students are engaged in the task at hand and to check understanding of the content. The extracts below indicate how the lecturer engages the students in discussion by providing explanations and asking questions:

Lecturer: Yes, so we also have ammonia. So, if we compare ammonia from these two, it is more toxic. So, we say, some of the organisms are able to store this ammonia, but for others because this is toxic, the nitrogenous wastes are stored in a different form, either in urea or uric acid. So, what we said goes on in human beings, so what about other organisms produce uric acid apart from human beings? Which organisms produce uric acid? We produce some of uric acid, not so? But you find that in our case, urea is the most dominant form, but there are certain organisms that mostly produce uric acid, which ones are those? (*Lecturer provides an explanation followed by a question*). So, in this case we mostly have the bats. Okay? Yes, well the problem is how we pronounce that Ales and other people call it allles, but we are talking about the bats and the most reason why they produce uric acid instead of urea. One of the reasons is because of the amount of water that is there. Urea is a soluble form, whereas uric acid is insoluble so there is a difference between those two. One is soluble, the other one is insoluble, so for the organism to remove ammonia and urea there is a need of a lot of water, so for such organisms, for such organisms where uhm, there is a limited amount of water, like in the case of bats that comes out as uric acid. So, generally these are the things that we will cover, but apart from that we have got another term that is called osmoregulation, so when we talk about the maintenance of internal environment we talk about excretion, we talk about osmoregulation. We know what excretion is, because we said that it is the removal of excess and the waste, what about osmoregulation. What is it? What is osmoregulation? Yes? (*Lecturer provides guidance which ended with a question*)

Student: It is the repression of the amount of water and solids because the amount of water can only be ... (*Student answering the question*)

The excerpt above shows that the lecturer probes students by providing explanations when they cannot answer the questions. The explanation provided by the student helps others to further understand the concept of excretion and provides clarity for whatever confusion they might have. The questions are followed by guiding statements which allowed them to have a clear understanding of the content that is being discussed before they can give their responses. The lecturer provides guidance to the students followed by a question which allows them to answer properly.

Below is another example of an excerpt from the transcript:

Lecturer: So, we are talking about water and solids, Okay? The regulation of water and solids in the internal environments, that is what we talk about osmoregulation. (*Lecturer provides clarity*). Remember we said that the internal environment could mean in the cell especially ... or inside the blood vessels, in other words the amount of water within the blood, the amount of salt within the blood, so here we normally talk about the ions, we talk about them in form of ions, of course there will always be some terms that we use when we describe what is happening inside or in the internal environment compared to what is happening outside. We have got the internal environment and we got the external environment, so when we compare the state or the conditions inside in terms of the solids, the amount of water compared to the outside is different, okay? Now, in a case where we have this tool (water solutes) more inside we normally use a term hyper, okay? Hyper? Hyper? We are talking about osmoregulation; we can't say hyper regulation. It is going to be hyper? (*Explanation followed by a question*)

Student: Osmotic

Lecturer: Yes, hyperosmotic, but if we got less inside, that is hypoosmotic (*Lecturer gives an explanation and explains further*). So, these are some of the terms that we will be using, so it is just a comparison of...if we compare the concentration of water which is inside or in the internal environment or external environment, what we say about it... there will be cases where it will be more and then we use hypo and there will be cases where it will be more and then we use hyper, of course there will be cases where it will be the same and which term do we use? We use? (*Question*)

Interpretation

The lecturer uses the question-and-answer teaching strategy to draw from the students' prior knowledge, in order to know what knowledge they carry to the classroom and whether the

knowledge need to be restructured and corrected. The question and answer strategy is also important because the lecturer becomes aware of what representations to bring to class and that guides him as to how to teach the students depending on how much guidance they need, therefore, the teacher acts as guidance in order for meaning making to be promoted. To identify any difficulties, this is done through question and answers, whereby students' prior knowledge is identified, and they have discussions.

It is clear that the reason why the lecturer uses this strategy is to check for students' prior knowledge and to check if they understand the content, therefore, this strategy could assist in promoting meaning making as it allows students to be actively engaged in the lesson. The lecturer showed that he uses question and answer teaching strategy in trying to check the students' prior knowledge, this is important because when checking their prior knowledge, it becomes easy to identify what they know and what they do not know. This makes it easy for the lecturer to know whether to continue delivering the lesson the same way or to continue using the same representations or not. I believe this strategy is useful in a sense that the lecturer will know which representations to use, thus, assisting students to move from an understanding that is abstract to an understanding that is concrete. Although this strategy may be useful, one hindering factor that this identified was the quality of the questions asked to check for students' prior knowledge and understanding. The questions that the lecturer asked required one-word factual recall answers which do not result to adequate engagement. For instance,

Student: I just changed like one word, I will say that salt molecules will move, and I think this is the low concentration from the external to the internal environments

Lecturer: There is a high concentration of solutes outside and there is nothing outside, the salt should move to where it is not there or to lower concentration, okay? But now that we have got that semi permeable membrane what effect does it have? (Question) If this was just a free border where there is a free movement for all particles, movement from the higher concentration to a less concentration or where there is no concentration at all, but now that we have that partially permeable membrane what does it mean? (Question)

Student: Uhm, the partially permeable membrane what it does is that it... the amount of salts ...

4.4 Data Analysis

How the excerpt develops meaning making:

As stated in socio-cultural theory, successful engagement can be promoted through social interactions and active engagement, and the construction of understanding occurs in the mind. As Vygotsky (1978) stated, it moves from a social plane to an intrapersonal plane, whereby learners internalize knowledge. As it can be seen from the videos, the lecturer uses question and answers to check for prior knowledge and students understanding, therefore, there is active engagement and interactions, this assists learners in making sense of the content and being able to relate it to their everyday experiences. The lecturer mediates learning and helps students by providing guidance and facilitation of the lesson, this is done through classroom discussion.

Although, this can assist students in making sense of the content, when they do not give answers desired by the teacher it becomes difficult for meaning making to be promoted, it is not always guaranteed that the engagement will be adequate because some students may only give short responses while others are not even participating.

The analysis of the lectures indicates that there was limited engagement based on how questions were asked, they allowed students to give one-word answers, therefore, that hindered the promotion of meaning making because there is no adequate engagement and often students gave chorus answers.

To check whether meaning making was promoted, it can be indicated from the responses they give when they are asked questions, that becomes difficult to figure out because it is not always all the students that participates, others just keeps quiet while only a few give responses to questions provided. To get all the students' responses that can be done by giving them a test based on what they learned, the answers they provide and their scores could give an idea of whether meaning making was promoted or not, although that is a good way of discovering if meaning making was promoted or hindered, it does not always assist because some students are able to study on their own and do not rely on lectures to make meaning of the content.

Key finding

The kind of responses given by students indicates whether meaning making was promoted or not.

4.5 Analysis of the semi structured interview

I had an interview with the lecturer responsible for teaching Excretion to 3rd year Life Sciences students. Below is the response from the lecturer, the interview questions are attached in the appendix. I transcribed the audio from the lecturer and then coded the aspects that helped me identify how meaning making is promoted during discussion.

Lecturer: *Okay, uhm your first question here is what do you understand by the term meaning making, well I don't know how this is explained in research but uhm I think it is a research construct but I think when you talk about meaning making, my understanding is that you are talking about the process of how as individuals, we interpret the information, how we understand uhm the information, generally how we make sense of the information that we are exposed to, so for me that will be the meaning making.*

Interpretation

The lecturer believes that discussion can promote meaning making in students, hence there is always discussions that occurs in the classroom. The lecturer stated that there are various teaching and learning strategies that are used which allows students to share their knowledge of the content, this includes; question and answers, whole class discussions and the explanation of content where the students are facing a challenge. The teaching strategies mentioned by the lecturer are evident in the video recorded lectures that I transcribed.

According to Scott and Palincsar (2013) the higher order functioning of individuals can be traced back from their social interactions with others, therefore, it can be stated that language plays a major role in the process of meaning making in different individuals. The lecturer stated that it is very difficult to check whether students understood the lesson or not, but when the class is interactive and questions are asked, then the students will be able to give their views on the content and that is when the lecturer will be able to check if meaning making is promoted, other than just giving them information.

The lecturer allows students to share different opinions based on their prior knowledge. Scott and Palincsar (2013) argues that learning in the sociocultural theory allows students to adapt to certain values shared by a group of individuals, hence, it can be stated that learning is a way of enculturation. Although students are given an opportunity to share their opinions, it is very difficult for the lecturer to ensure that the entire class shares their opinions, this is because the classroom is big and there are many students, therefore, there is limited time to

allow everyone to participate. The lack of participation from some students can be deemed as a disadvantage because there are high chances that some students are silently excluded, in a sense that they do not follow through the lesson and are afraid to raise it in class.

Therefore, this implies that they may be left behind, which makes it difficult for meaning making to be promoted. Below is an extract from the interview with the lecturer:

Lecturer: *One of the problems of facilitating discussions is the fact that some of the students normally do not contribute at all and it is difficult to make everyone contribute because we have a large class, so it is difficult in that way in the fact that only few individuals are able to contribute, even if uhm you would make sure that everyone contributes or everyone was willing, there is limitation of time if you have got a class of 100 students. There is no way that for every concept everyone can have a say, otherwise it will take forever, uhm there is a limitation of the numbers that we are having uhm people not being able to or willing to contribute and also restriction that is brought by the time, so those are some of the problems that we normally come across during the discussions.*

Interpretation

It is not easy to promote meaning making when there are lot of students in the classroom, this is because not all students participate, therefore, the lecturer engages only with students that share their ideas during the class. Whereas, others might be left behind due to having a larger class and limited time.

Key finding

It is not easy to identify if meaning making was promoted, therefore, there are activities that the teacher can provide to check if meaning making was promoted to students. For instance, giving students a test.

4.6 Findings from the video recorded lectures

The video recorded lectures show a sociocultural theory of teaching and learning, whereby, individuals are able to develop and make meaning of what they are learning when they engage with other people. The internal development of individuals is encouraged by how they socialise with others. Meaning making in this instance occur in the mind of individuals, they first have to make sense of what they encounter in their interactions with others.

Therefore, there is internalisation of knowledge from the social setting that they have to make sense of individually by processing their thoughts (Scott and Palincsar,2013).

According to Scott and Palincsar (2013) there is an internal development that occurs when students engage with their peers. Learning starts from the social environment before it can be internalized, the students have to make sense of the discussions taking place in a social plane. Vygotsky (1978) introduced the idea of the Zone of Proximal Development (ZPD) which suggested that learning should be in synch with the level of students' development, development in students varies whereby the actual development is when they are able to attain knowledge alone and work on their own, whereas, the potential development refers to the knowledge that the students cannot attain on their own, but requires assistance from people who know more than they do.

From the extracts provided above, it can be noted that the lecturer gives the students a chance to respond to questions. This enable the classroom to have a discuss, thus, allowing the students to engage with the content of excretion.

While providing explanations of specific concepts, the lecturer asked probing questions that facilitated students to understand and make meaning of the concepts in small steps as part of the discussions. Questions were answered in plenary by the whole class.

The lecturer engages students in the lesson by asking questions that are related to the topic of excretion. Although, there is engagement, the students are giving one word answers most of the time, which does not make it clear whether there is meaning making during the lesson. For meaning making to be deduced from an interaction, students should demonstrate their understanding of the content by interpreting situations and further elaborating on their knowledge to show deep understanding of the content.

4.7 Conclusion

This chapter presented data analysis, interpretation and the results of this study. Students engage in meaning making through the use of discussion which is facilitated by the lecturer. Meaning making occurs in the mind, therefore, it is not easy to see whether it was promoted or not. The teacher can identify meaning making from the students based on how they answer questions and also asks questions related to Excretion.

Chapter 5: Findings, conclusion and recommendations

5.1 Introduction

In chapter 4, I discussed the results and analysed the study. This chapter presents the findings of the study which emerged from the results and analysis in chapter 4. Therefore, I formulated a conclusion based on the results, and presented the recommendations for the study. The aim of this study is to investigate how a lecturer use discussion to promote meaning making during the teaching of the topic of Excretion to 3rd year preservice Life Sciences teachers. Meaning making can be promoted when students engage in meaningful discussions with the lecturer, as well as with other students. This study demonstrates the evidence of meaning making that can be discerned from discussion and the role of the lecturer in facilitating student teachers' meaning making during the teaching of Excretion to 3rd year preservice teachers.

5.2 Findings

The findings that emanated from the data analysis in chapter 4 are presented below. The research questions of this study are answered in this section. The findings of this study will be presented as follows: the findings on; 5.2.1 how students engage in discussions, 5.2.2 the evidence of meaning making that can be discerned from discussion, 5.2.3 the role of the lecturer in facilitating student teachers' meaning making and 5.2.4 why the lecturer stimulate discussion in in ways mentioned.

5.2.1 Findings on how students engage in discussions

Key finding 1:

There is an engagement between the lecturer and the students

According to Senthamarai (2018) students usually engage in interactive brainstorming, which allows them to work in groups. Students engage in discussions in various ways. There is a use of different teaching and learning strategies that are involved to ensure that the students are participating in the discussion in the classroom. There is a use of question-and-answer teaching and learning strategy, this allows students to be involved in the discussion as they will answer questions that arise from the lecturer, not only are they involved in a discussion with the lecturer, but with other students as well. Reba (2017) states that

effective teaching strategies results in students achieving fruitful results. When one student answers or asks a question, it allows other students to also think about the responses and more questions they could ask. This allows the students to engage with their teaching and learning materials as well. Those who have read the materials prior to the lesson are able to make sense of what is being discussed and what they have read. Whereas those who did not read their materials before the lesson are able to refer to their content in order to make meaning of what was discussed and to also get involved in the discussion itself.

The question-and-answer method that was used in the lesson allows students to tap into their prior knowledge as the lecturer asks them questions based on what they learnt the previous day, as well as what they know from previous classes or their everyday knowledge. This helps the lecturer to identify misconceptions of the students during discussion, therefore, this information may help students to engage in successful discussion as they will be able to reconstruct their knowledge or extend it, which will help them in meaning making, thus, enabling them to produce good results. Students engage in discussions in a classroom by having the ability to listen to other people's ideas and being able to reconsider ideas. The use of brainstorming is useful in promoting successful engagements because students are able to come up with different ideas and are able to choose ideas which may aid a good discussion. To promote successful engagements students are allowed to make mistakes, which are later corrected, this allows them to have confidence to share their ideas without any fear of feeling judged. According to Reba (2017) the teacher should tell students what he/she expects from them before the end of the lesson, and also give them activities that are challenging to facilitate meaning making.

5.2.2 Findings on the Evidence of meaning making that can be discerned from discussion

Key finding 2:

There is a use of a whiteboard to write down what the class is discussing.

According to Senthamarai (2018) in interactive engagements, students are given a few minutes before the start of a lesson, so that they can come up with ideas on the topic discussed. It is very difficult to recognise whether meaning making is promoted or not. In this lecture, there is a use of a white board in aiding for meaning making. The evidence of meaning making is not easily seen, because meaning making occurs in the mind, therefore, the lecturer used the whiteboard as a way of facilitating meaning making, this can also be

evident through the kind of questions students ask and how they answer the questions. The lecturer ensured that meaning making is promoted through the kind of questions he asked, these questions requires students to apply a higher order thinking skill. The use of a whiteboard uses brainstorming as a type of discussion method, therefore, what students say to the lecturer is noted down and that can be used as an evidence of whether meaning making is promoted or not. Senthamarai (2018) argues that brainstorming allows students to engage in ideas and also share their thoughts on a given topic. An example of how the lecturer used a whiteboard is indicated below:

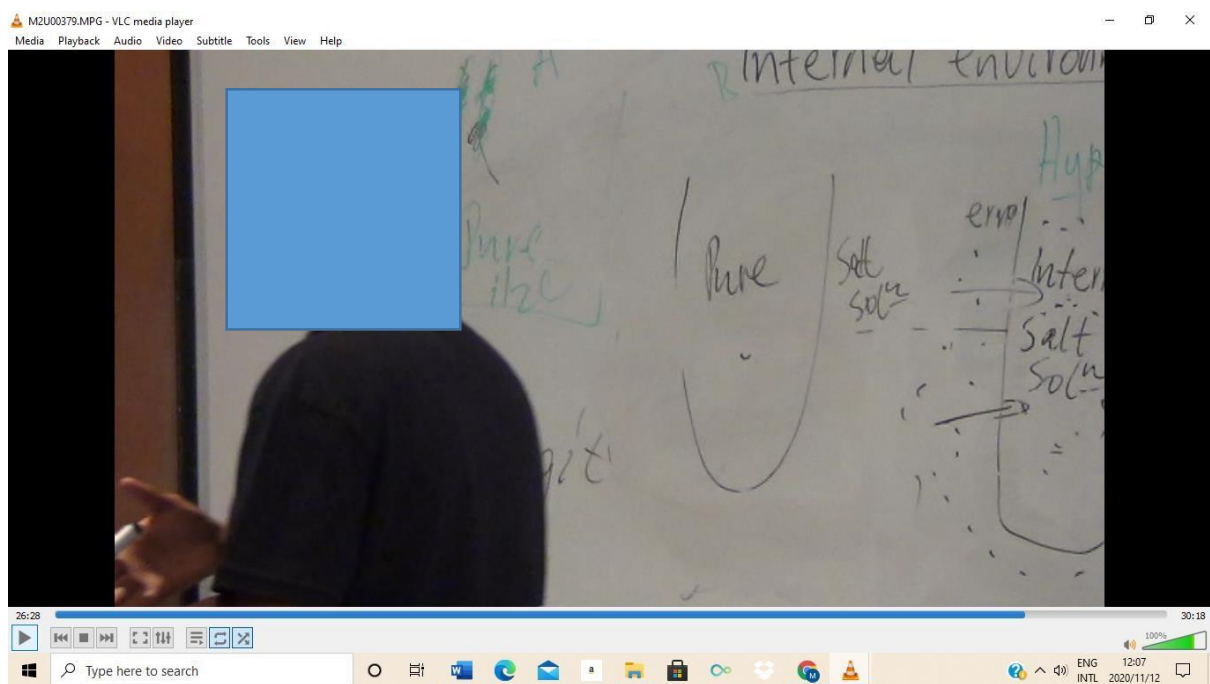


Figure 5. The lecturer uses a whiteboard of what the students are Brainstorming

It is difficult to immediately recognise whether meaning making is promoted or not, therefore, the lecturer can give students a test which covers the content they have discussed in class to check their level of understanding and how much he has to put an effort in assisting the student to make meaning of the content.

5.2.3 Findings on the role of the lecturer in facilitating student teachers' meaning making

Key finding 3:

The role of the lecturer is to ensure that the process of meaning making is facilitated, hence, the use of different teaching and learning strategies, such as a dialogue and brainstorming to ensure that the process of teaching and learning occurs successfully.

According to Burgin (2020) it is of paramount importance that teachers find ways to ensure that they make Science to be personally meaningful, especially for students that are underrepresented and marginalised. Teachers should design instructional tasks that are grounded in authentic real-world settings and that students should work in groups. It is important for students to work in groups because it enables them to look at the activity from different perspectives and can have a variety of skills to tackle complex tasks. In addition, authentic tasks allow learners to use their own personal experiences to solve tasks.

According to Reba (2017) the teacher should encourage cooperative learning amongst the students. Authenticity can be witnessed when a student is able to engage in a scientific activity and be able to play a role in making meaning of the given activity, instead of relying on the teacher to feed them with information. The students need to engage with the materials they are given and be able to ask questions, analyse and share ideas. Authenticity determines the meaningfulness and the importance of performing a certain task and whether it benefits people who are undertaking the task at hand. Burgin (2020) points out that authentic task is contextually meaningful to those who are engaging in it and, its meaningfulness and significances influences its authenticity. In a Life Sciences laboratory, the practical is meaningful to both the learners and the teacher, this is mainly because they have the same objective in the task, the teacher devised the task with the aim that the learners should work towards the same goal of discovering the unknown, whereas the learners strive to achieve this goal through the use of engagements and working with other learners.

In this study the teacher is able to guide the classroom discussion. Students are actively involved in constructing their own knowledge and understanding of what is being discussed, this shows that students internalize what is being taught, thus bringing about authenticity. This perspective indicates that successful engagement enables students to reach new understanding in a formal learning situation. The lecturer offers the learners new ways of thinking about the world, but if these ways are different from their everyday knowledge, the lecturer have to persuade them of the reasons and usefulness of the new scientific point of view. The lecturer engages the students in discussion, by allowing them to share knowledge from previous classes they had on Excretion, they are also allowed to brainstorm and engage in cooperative learning with other students.

According to Engle and Conant (2002) productive disciplinary engagement can be understood by designing learning environments that support problematizing subject matter,

giving students authority to address the problems, holding students accountable to others and shared disciplinary norms, and providing students with resources. Different principles may foster disciplinary engagement, firstly, problematizing content. This principle suggests that teachers should encourage the students to come up with questions, proposals and other intellectual contributions and not rely on assimilation (Engle and Conant, 2002). The teacher's role is to identify the learners' prior knowledge, and if the need arises, they can also rectify their misconceptions, this leads to an engagement that is successful, this allows students to internalize what is being discussed and make sense of it in their cognitive structures. Successful engagement can be viewed as the ability of the students to develop critical thinking. Problematizing can be used as tool that analyses different subjects. When students share their responses in the classroom, it is easy to tell whether they are using argumentation effectively by how they reason and justify their responses. Group discussions can provide participants with learning opportunities by turning their implicit supporting argument into explicit.

5.2.4 Findings on why the lecturer stimulates discussion in ways mentioned

Key finding 4:

The teacher can use different teaching and learning strategies to foster and promote meaning making, thus including strategies such as question and answers in order to check the students' misconceptions, as well as their prior knowledge.

The lecturer stimulates discussion by using different teaching and learning strategies, these includes; question and answer, the use of a white board and explanations of the content. According to Larson (2006) discussion helps students to build knowledge and be able to make connections between their everyday knowledge and the scientific knowledge. The lecturer explains the content to students so that they can create meaning of what they are learning about. The lecturer does not only explain but asks questions before explaining, this is done so that the students can have an understanding and engage in discussions. According to Larson (2001) for meaning making to be promoted in the classroom, the students should be able to share their opinions and support it with evidence, they should also be able to respectfully criticise other people's opinions. The use of discussion encourages students to share ideas with each other. Sharing of ideas allows students to be able to correct each other and some will be able to gain more knowledge than they would if there were no discussions.

Senthamarai (2018) suggests that interactive learning grants students an opportunity to share their ideas and also learn from each other's inputs and experience. The lecturer uses question and answer in his lesson to promote engagement, students were able to respond, which then helped the lecturer to be able to continue with the lesson having the knowledge of what they know and do not know, which then helps him carry out the lesson and allow students to feel comfortable, thus, promoting a conducive environment for teaching and learning. The conducive environment will enable students to engage in discussions without any fear of judgement. The teacher should make it clear to the students what the objectives of the lesson are, this helps them to know what they need to learn and understand at the end of the lesson (Silverthorn, 2006).

Meaning making can be promoted when students are given a chance to be active in the lesson, this also promotes a higher order thinking skill in the students because they are granted an opportunity to think deeper and analyse what the discussion is about. According to Silverthorn (2006) to identify that students are learning and understand the content, they should be granted an opportunity to talk. Allowing students to talk enables them to share their opinions, which enables the teacher to identify whether they understand or not. Silverthorn (2006) having a lesson with the students does not mean that they learnt and understood. Therefore, involving them in a classroom talk or giving them questions before or after the lesson might help in identifying the gaps that they might have.

5.3 Recommendations

After completing the study and in view of its limitations, the following recommendations can be made for future research:

- A similar study can be conducted which focusses on the topic of Excretion, but it should also include the students in the sample size
- A study on meaning making in Excretion can be done under different circumstances, such as contact interviews instead of online
- The research should also focus on how the evidence of meaning making can be spotted in a classroom situation

5.4 Limitations of the study

The study has the following limitations; limited access to data, time constraint and lack of previous studies. This study has a limited access to data because I only interviewed one

lecturer, this is due to the Covid-19 pandemic that existed in our country, the pandemic made it difficult for me to have a lot of participants in the study. Therefore, instead of interviewing a lot of people I resorted to watching video- recorded lectures which focussed on the topic of Excretion to 3rd year students training to be Life Sciences teachers. A further limitation due to the lack of access to data is that the information is only from the lecturer, therefore, there is no contribution of knowledge from the students, this can result in the data being biased because we only have access to information that is in one perspective.

There was also a time constraint in the study because there is a certain period of time that is granted, whereby, the research should be completed, therefore, it becomes a challenge to complete everything in a given period, which might jeopardise the quality of the results. There is lot of research that needs to be done, this includes, finding articles that are related to the study and ensuring that relevant articles are selected and read to support the research and its quality, but due to time constraint, it is not possible to do everything, hence, this may be a limitation to this study.

The other limitation is lack of previous studies on the topic. There are articles that are about meaning making, but they do not focus on the topic of Excretion to 3rd year students training to be Life Sciences teachers, hence it becomes a challenge to have access to a lot of information on the study.

To overcome the limitation of having less access to data, the research could have included the students who are doing Life Sciences in their 3rd year of study, although that could have been a great idea, the quality of the results could have been jeopardised because the students in the video are no longer in their 3rd year of study, which means that what I observed on the videos may not be a reflection of what the other students experience, this is because different students have different experiences each year.

5.5 Conclusion

In conclusion, there are various ways in which discussion is stimulated. The use of discussion ensures that meaning making is promoted. Discussion enables students to think deeply about the content that is being discussed, thus enabling higher order thinking, which leads to the promotion of meaning making. Students' meaning making is facilitated through the use of teaching and learning strategies such as question and answer, as well as the use of a whiteboard. The evidence of meaning making can be witnessed through the kind of

questions that students ask and how they respond to questions posed by the lecturer or by other students. This study investigated how a lecturer uses discussion to promote meaning making during the teaching of the topic of Excretion to 3rd year preservice Life Sciences teachers. The study had one participant and five video-recorded lectures were observed to ensure that there is enough information on the study. Discussion is used to promote meaning making, this includes brainstorming, and allowing students to have a dialogue that enables them to share different thoughts and assist each other in constructing meaning out of the content.

Reference list

- Baeten, M., & Simons, M. (2014). Student teachers' team teaching: Models, effects, and conditions for implementation. *Teaching and Teacher Education*, 41, 92-110.
- Barriball, K. L., & While, A. (1994). Collecting data using a semi-structured interview: a discussion paper. *Journal of Advanced Nursing-Institutional Subscription*, 19 (2), 328-335.
- Baxter Magolda, M. B. (2000). Teaching to promote holistic learning and development. *New directions for teaching and learning*, (82), 88-98.
- Beauchamp, C., & Thomas, L. (2010). Reflecting on an ideal: Student teachers envision a future identity. *Reflective practice*, 11 (5), 631-643.
- Cowie, N. (2009). Observation. *Qualitative research in applied linguistics: A practical introduction*, 165-181.
- DiCicco-Bloom, B., & Crabtree, B. F. (2006). The qualitative research interview. *Medical Education*, 40 (4), 314-321.
- Djamahar, R., Ristanto, R. H., Sartono, N., & Darmawan, E. (2020). Approaches to respiratory and excretion systems teaching: an innovative learning through cirsa. *Universal Journal of Educational Research*, 8(6), 2204-2210.
- Gerring, J. (2004). What is a case study and what is it good for?. *American political science review*, 98 (2), 341-354.
- Glenn, D. I. (1992). Determining sample size. *A series of the Program Evaluation and Organizational Development*. University of Florida, Publication date: November,...
- Golafshani, N. (2003). Understanding reliability and validity in qualitative research. *The qualitative report*, 8(4), 597-607.
- Kalina, C., & Powell, K. C. (2009). Cognitive and social constructivism: Developing tools for an effective classroom. *Education*, 130(2), 241-250.
- Kawulich, B. B., & D'Alba, A. (2019). Teaching qualitative research methods with Second Life, a 3-dimensional online virtual environment. *Virtual Reality*, 23(4), 375-384.

- Krauss, S. E. (2005). Research paradigms and meaning making: A primer. *The qualitative report*, 10(4), 758-770.
- Leach, J., & Scott, P. (2003). Individual and sociocultural views of learning in science education. *Science & education*, 12, 91-113.
- Magner, L. N. (2002). *A history of the life sciences, revised and expanded*. CRC Press.
- Maxwell, J. A. (2008). Designing a qualitative study. *The SAGE handbook of applied social research methods*. (Vol. 2, pp. 214-253)
- McIntosh, M. J., & Morse, J. M. (2015). Situating and constructing diversity in semistructured interviews. *Global qualitative nursing research*, 2, 2333393615597674.
- Mortimer, E., & Scott, P. (2003). *Meaning Making In Secondary Science Classrooms*. McGraw-Hill Education (UK).
- Msimanga, A., & Lelliott, A. (2014). Talking science in multilingual contexts in South Africa: Possibilities and challenges for engagement in learners home languages in high school classrooms. *International Journal of Science Education*, 36(7), 1159-1183.
- Nassaji, H. (2015). Qualitative and descriptive research: Data type versus data analysis. *Language teaching research*, 19(2), 129-132.
- Omatseye, B. O. (2007). The discussion teaching method: An interactive strategy in tertiary learning. *Education*, 128(1)
- Orsolini, M., & Pontecorvo, C. (1992). Children's talk in classroom discussions. *Cognition and instruction*, 9(2), 113-136.
- Parker, W. C., & Hess, D. (2001). Teaching with and for discussion. *Teaching and teacher education*, 17(3), 273-289.
- Scott, P. (1998). Teacher talk and meaning making in science classrooms: A Vygotskian analysis and review.
- Scott, W. R. (2013). *Institutions and organizations: Ideas, interests, and identities*. Sage publications.
- Scott, S., & Palincsar, A. (2013). Sociocultural theory.

- Senthamarai, S. (2018). Interactive teaching strategies. *Journal of Applied and Advanced Research*, 3(1), S36-S38.
- Sherin, M. G. (2002). When teaching becomes learning. *Cognition and instruction*, 20(2), 119-150.
- Silverthorn, D. U. (2006). Teaching and learning in the interactive classroom. *Advances in Physiology Education*, 30(4), 135-140.
- Srivastava, A., & Thomson, S. B. (2009). *Framework analysis: a qualitative methodology for applied policy research*.
- Tuckett, A. G. (2004). Qualitative research sampling: the very real complexities. *Nurse researcher*, 12(1), 47-61.
- Thanasegaran, G. (2009). Reliability and Validity Issues in Research. *Integration & Dissemination*, 4.
- Unin, N. (2016). Brainstorming as a Way to Approach Student-centered Learning in the ESL Classroom. *Procedia-Social and Behavioral Sciences*, 224, 605-612.
- VanWynsberghe, R., & Khan, S. (2007). Redefining case study. *International journal of qualitative methods*, 6(2), 80-94.
- Vygotsky, L. S. (1978). *The role of play in development*.
- Webb, N. M. (2009). The teacher's role in promoting collaborative dialogue in the classroom. *British Journal of Educational Psychology*, 79(1), 1-28.

Appendix 1 (CODE BOOK)

Video 1

M2U000376

Lecturer: ... Internal environments. Can we discuss different reasons why the internal environment of uhm, organisms be maintained at a certain stage, not so? We talked of water that is inside the cells, the amount of water that is inside of the tissue fluid, okay? And the influence of the environment around , that is like the influence of what is happening inside, so what we say is that, if we look at different organisms maybe we start with protista

Lecturer: Someone is saying we have things like poriferas **Lecturer elaborates on student's**, what are those **and followed the student's answer with another question?** Poriferas? The lesson is not about poriferas, we are just mentioning them as one of the organisms that will excrete some of the materials to maintain the internal environment, okay **Affirmation question?** Those are the sponges; do you know what sponges are **Question?** **Lecturer leaves question unanswered**

Then we have here the Annelida, then you have your Arthropoda. So the the list is...

So if we look at the school curriculum, where is the focus? **Question** Where is the focus when we talk about excretion? **Lecturer repeats question** Do we say anything about Protista? **Question** Do we say anything about porifera? **Question** Do we say anything about Arthropoda? **Question**

Students: No

Lecturer: The focus is on us, mostly mammals, that is where the focus is. We start with what is happening at a singular celled organism, okay? Like ...now, what does this tell us? Because of the difference in structure, because of the difference in complexity, it means the internal environment is being changed will be different for different organisms, not so. In other words, if you compare paramecium and human beings, the way they maintain their internal environment is not the same because one is just a single cell and the other one is an organism made of systems, complex systems. So it is not going to be the same. The reason why the internal environment is being maintained is the same because the reactions that are taking place either inside the cell or inside the multicells...will only happen at certain conditions, so those conditions have to be... So we also talked about the fact that some of the materials are

toxic, okay? So they need to be removed, some of them are toxic. It is not only about the balance, but it also removes toxic materials. What do they include? Especially looking into the mammals

...what do we say... Which are those materials? **Lecturer provides an explanation which ended with a question**

Student: Uhm urea, uric

Lecturer: Urea, uric and we normally use those umbrella name of what? What's the umbrella term for those? (**Lecturer is asking questions**)

Students: Nitrogenous wastes

Lecturer: And why are they called Nitrogenous wastes? We are saying we got Urea, we got uric acid. What is the other one? Is it only those two? Are those the only Nitrogenous wastes that ...that are produced by metabolic processes? **Question**

Student: Carbon dioxide

Lecturer: We are focussing more on Nitrogenous wastes (**Lecturer providing guidance**)

Student: Oh

Lecturer: Yes, we are focussing more on Nitrogenous wastes. Which are there? The most, remember we say that these are toxic, okay? The level of toxicity is not the same, okay? We have got the one that is more toxic compared to the ones that we have mentioned. When we talk about human beings, which is what they have done... we are ... Grade 11?

Student: Grade 11

Lecturer: **In Grade 11, we focus on those two because they are the forms that we get from human beings. Which is the other one? Which is more toxic than those? Yes?**

Student: Ammonia

Lecturer: **Yes, so we also have ammonia. So, if we compare ammonia from these two, it is more toxic. So, we say, some of the organisms are able to store this ammonia, but for others because this is toxic, the nitrogenous wastes are stored in a different form, either in urea or uric acid. So, what we said goes on in human beings, so what about other organisms produce uric acid apart from human beings? Which organisms produce uric acid? We produce some of**

uric acid, not so? But you find that in our case, urea is the most dominant form, but there are certain organisms that mostly produce uric acid, which ones are those? (Lecturer provides an explanation followed by a question). So, in this case we mostly have the bats. Okay? Yes, well the problem is how we pronounce that Ales and other people call it allles, but we are talking about the bats and the most reason why they produce uric acid instead of urea. One of the reasons is because of the amount of water that is there. Urea is a soluble form, whereas uric acid is insoluble so there is a difference between those two. One is soluble, the other one is insoluble , so for the organism to remove ammonia and urea there is a need of a lot of water, so for such organisms, for such organisms where uhm, there is a limited amount of water, like in the case of bats that comes out as uric acid . So, generally these are the things that we will cover, but apart from that we have got another term that is called osmoregulation, so when we talk about the maintenance of internal environment we talk about excretion, we talk about osmoregulation. We know what excretion is, because we said that it is the removal of excess and the waste, what about osmoregulation. What is it? What is osmoregulation? Yes? (Lecturer provides guidance which ended with a question)

Student: It is the repression of the amount of water and solids because the amount of water can only be ... (Student answering the question)

Lecturer: So, we are talking about water and solids, Okay? The regulation of water and solids in the internal environments, that is what we talk about osmoregulation. (Lecturer provides clarity). Remember we said that the internal environment could mean in the cell especially ... or inside the blood vessels, in other words the amount of water within the blood, the amount of salt within the blood, so here we normally talk about the ions, we talk about them in form of ions, of course there will always be some terms that we use when we describe what is happening inside or in the internal environment compared to what is happening outside. We have got the internal environment and we got the external environment, so when we compare the state or the conditions inside in terms of the solids, the amount of water compared to the outside is different, okay? Now, in a case where we have this tool (water solutes) more inside we normally use a term hyper, okay? Hyper? Hyper? We are talking about osmoregulation; we can't say hyper regulation. It is going to be hyper? (Explanation followed by a question)

Student: Osmotic

Lecturer: Yes, hyperosmotic, but if we got less inside, that is hypoosmotic (Lecturer gives an explanation and explains further). So, these are some of the terms that we will be using , so it

is just a comparison of...if we compare the concentration of water which is inside or in the internal environment or external environment , what we say about it... there will be cases where it will be more and then we use hypo and there will be cases where it will be more and then we use hyper, of course there will be cases where it will be the same and which term do we use? We use? (Question)

Student: Iso (student answers question)

Lecturer: Yes (affirms student answer), in this instance we use iso osmotic, those are the terms that we use when we describe the internal and the external environment. So, this is just an overall of what we look at, chances are I have gone through all the slides that we need. How many are they? 16? How many are they? (Question) So, with the amount of content that we have just covered here, you should be able to go through those slides alone, okay?

Student: No'

Lecturer: You can't say No, you haven't looked at the slides, so you are not at a point where you can make a decision to say that some of them you cannot understand (encouraging students to go through their slides). Okay, uhmmm, the one that we have here, we discussed yesterday, not so? We talked about interstitial fluid where we said the fluid that falls between the cells and the ... and we also discussed the blood plasma to say it also forms part of the internal environment. So what we have there is what we call internal environment, okay? We also have intracellular fluid which tells us what is happening inside the fluid inside the cell, okay? So those two are the description of the internal environment, those two are the description of the internal environment and we know that some of those materials we removed from the cells, like which ones? Which nitrogenous wastes did we already mention? The ones that are being removed from the internal environment because we are saying that they are toxic, what else? We can see that there is a double arrow for water, it means that if there is too much water within the internal environment, some of them will be removed, okay? Anything else? (Explanation that ended with a question)

Student: Carbon dioxide (answers the question)

Lecturer: Carbon dioxide, so all this time you were saying Carbon dioxide. So, Carbon dioxide also needs to be removed from the body, okay? It also needs to be removed from the body. Of course, we have those that are being absorbed into the internal environment like Oxygen, like your ions, also with the ions, if the concentration is too much inside the body,

some of those ions have got to be removed, okay? But there are cases where there is a need for such solutes, so it means they have to be absorbing too much in the internal environment and then you also have the nutrients, it looks like the nutrients is one there, there is never other nutrients being taken out of the internal environment and what nutrients are we talking about there? We are talking about the nutrients, what are we talking about? What are there? Nutrients will be a term that we use but at this level we want to be more specific, what is it that is under nutrients? So we have 90 percent of the class not knowing what are nutrients, we are talking about the nutrients that are being taken into the internal environment and we want to list because you don't understand, because if we use examples it is gonna be easier, by listing the examples of

... what do we do there? I know this is the point which you don't like most, where I am asking you questions and you are supposed to be responding according to what you told me yesterday, but you are not responding. So, what I have said, yes... (Explanation followed by a question)

Student: The minerals (Student answers the question)

Lecturer: Let's talk about the minerals, what are the examples of minerals? (Follow up question)

Student: Ions (Student answers the question, there is interaction)

Lecturer: Ions, then it means it will fall under the ions that we have, okay? Yes...?

Student: Can't we say a different Iron?

Lecturer: Oh okay, so you mean this Iron (Fe)

Student: Yes

Lecturer: So, you are saying this is not an ion? What are you saying? Isn't it that we are saying...shhhh... we are listing, and we say that when we talk about the nutrients, some of the things we say that they would include minerals, okay? And now I am going to say... under minerals what do we have? And she said irons, I thought she was talking about ions and you said no you are not talking about ions but you are taking about irons, okay? So, I am writing it in this form (Fe) to show that even if it is ion, it is still iron

Student: Can we talk about magnesium? (Question)

Lecturer: We can talk about magnesium, Is it one of the minerals? (Lecturer answers and ask a question)

Student: No, I am just asking a question

Lecturer: You are also asking? Okay, I will respond to you. Is magnesium one of the minerals?

Student: It could be (not giving a definite answer)

Lecturer: No, no. You can't give that answer, you have to be certain. So those... I am trying to show you that if I have got ions there, things like iron, which is an ion, your magnesium, your calcium, your potassium, your chlorides, all of those, okay... Which is why sometimes we talk about the mineral salts like your table salt, what is it called again? (explanation and question)

Student: Sodium chloride

Lecturer: Sodium chloride... (affirms answer) It is sodium, so we got sodium and chloride, okay? Because the other thing we learnt from our Natural Sciences matter and materials, it is matter and materials, not so? Natural Sciences matter and materials is that some of these salts, is it some or all of them? You have to go and tell me. When they are dissolve in water they break into the ions, that is why we are talking about the ions because it is not like you are literally eating the ions, okay? It is not like you are literally eating the ions. So, let us talk about the nutrients (discussion)

Student: ...

Lecturer: Well I am not ... explicitly like that of course we have those that are being absorbed into the internal environment like your oxygen, like your ions, also with your ions if the concentration is too much inside in the body or in the internal environment... Well I know I have not entirely or explicitly answering but I am still happy with the way I have answered. So, what about the nutrients? (answers question, then ask another question)

Student: Proteins

Lecturer: Proteins and they are the ones which are going to give us what? We have proteins, so we say proteins and in what ways are waste materials are involved in that? The nitrogenous waste that we mentioned like your uric acid, like your uhm ammonia or urea and what would

be the waste that I likely to come from that? Your Krebs cycle, is it a crab cycle? What are the products of crab cycle? Do you know anything about the crab cycle? What are the products of the crab cycle? We say...it is gonna be? The waste products, the waste products of cellular respiration, name doesn't come straight from the crab cycle. We are talking about cellular respiration, to say if carbohydrates are involved in cellular respiration, what is one of the waste products of that process? (Ask questions and provide guidance).

Student: Carbon dioxide

Lecturer: Is it Carbon dioxide? (Question) We are talking about cellular respiration, we say we have carbohydrates as one of the nutrients, okay? Uhm in this case we have, say nitrogenous wastes, the nitrogenous waste are from a process we were talking about ...and one of the waste products is coming from that protein, now the question is we have carbohydrates but what do we get from there?...Your glucose, your glucose is involved in cellular respiration, not so? And what is the name of the waste product of cellular respiration? It is? It is Carbon dioxide, the one that we mentioned there, so...

Video 2:

M2U00377

L: So there is... between the interstitial fluid and the internal environment of the cell and the internal environment of the blood, we know that ... until that blood ... which is why we have got... some of them ... in the blood, one that needs to be excreted and some of them are taken into the tissue and They are important. Well we have covered the answer to those questions, not so? To say when we are talking about osmoregulation and excretion, what are we talking about. Explaining the meaning of osmoregulation and excretion, how do you explain the meaning? Does this make sense to you? The better phrase there would be what is the meaning of osmoregulation and excretion? Question Or explain osmoregulation and excretion, so those are some of... remember generally we said excretion is the process that occurs in terms of the internal environment, but under homeostasis the focus is on the two that I have mentioned osmoregulation and excretion, and of course in one case we talk about the movement of water and the solids, in another case we still look at the movement of water and solids but we also talk about toxic materials that are being removed which is why we are mixing both of them, otherwise in some cases osmoregulation falls under excretion, but not all the time which is

why we need to remove them **Explanation**, I will explain to you what I have just said, I can see you are confused . If we look at what is happening with excretion, we say it is the removal of excess materials, okay? but not only excess materials but also those that are toxic in the internal environment, but when we look at osmoregulation, what are we talking about?(**Question**). The movement can either be towards the internal environment or towards the external environment and when it is towards the external environment it means that there is an exit outside the body, so the body is trying to remove that excess, this is why it falls under excretion, but we can see that it does not only fall under excretion because the movement is inside (**Explanation**)

S: It makes sense (**Shows understanding, but never answer the questions**)

L: It does make sense? (**Checks understanding**)

S: Yes

L: Now let's see what is going on that side. One of the things that people complain about is that they come to class and they are not learning about anything is because learning is not a passive process, it is not, so you cannot just sit there and listen to me . You need to actively engage with the content that we are discussing, okay? Try to make sense of it, now look at the slides that we have, look at the information that we have and see if we have covered everything. I can see that people are not listening to me because others are busy looking at me and I said look at the slides. The first two we have already covered, not so? (**Encourages active participation**)

S: Yes

L: and the last one, but what do you understand by that, we say because solute movement results in the movement of water by osmosis, the net effect is to regulate both solutes and water. What is meant by that? Does it make sense? (**Explanation followed by a question**)

S: Yes (**Students only answered the last question**)

L: Does it make sense to you? (**Checking students 'understanding**) Well you can't even answer yes or no

S: Yes

L: What does it mean for those who are saying yes? (Question) It looks like you are still... what does it mean? We are talking about the movement of solutes and water. Yes...

S: Okay, uhm so ... so if it says that solids are moving... what happens is that solids move from an area of less concentration to an area of more concentration (answering question)

L: Well I know you are smart enough to understand that, well you see I am going to try and simplify it for myself because I am a slow learner, okay there are no issues, you can understand. Okay? One way of putting it is to say because we have got three environments, the internal and the external and both are separated by, what do we call it? I can't remember but it is a barrier between the internal and external environment, and we say we have got these solutes on both sides, in some cases we only have the solutes and water in one side and nothing on the other side, no so? Like in our case, well we are actually surrounded by water molecules so it will be a misconception to say there is no water it is just found in a different phase than the one that we know, not so? So we say if we have water molecules and your ions inside and we have a high concentration of those inside, then maybe we have got water molecules with lower concentration then probably you have got some ions but the concentration is lower, what is happening inside, okay? Let's have one... to say the amount of water inside and outside is the same in terms of the concentration, the only difference is the concentration of ions. What is happening in that case?... especially of water, what could happen is that if we say that we are comparing the concentration of the ions inside and outside, they are more inside than outside but the amount of water... water molecules is the same. What is likely to happen? Maybe I am not asking you this question the way I would want to ask it. What is likely to happen in that case? Do you want to try? Take your time. What do you think will happen? Well maybe you are confused by calcium ions and all that, well let's talk about your salt, the table salt, okay? You have got high amount of salt this side, your sodium chloride, okay? Your table salt, but in this case, there is just a small amount of salt, but when we look at the water there is no difference, so what is likely to happen? And the membranes have holes there to indicate that it is partially permeable, so the barrier that we have in between is partially permeable. What is likely to happen? (Provide explanation with questions)

S: If the salt is excess, they will penetrate through the membrane to the internal environment ... (Answered only one question)

L: She is saying, if the holes that we have here ...

S: (Mumbling)

L: Shhh...

Video 3

M2U00379

L: Was this the last slide that we discussed

S: No

L: So, we didn't say anything about this? This slide? And what did we say about it? Was this the last slide that we discussed?

S: Yes

L: What did we say about this slide? What did we say about it? Can you remember what we said regarding the information on that slide? You have got the information here and you are agreeing that you are not seeing this slide for the first time and we discussed the slides, that is what you are telling me. What did you say about the slide? (Recap)

S: I am confused, I don't have any notes to this slide

L: So, the determining factor is that you do not have notes on the slide, therefore we did not discuss this slide. What did you say?

S: ...

L: But I was explaining, what is it that I was explaining?

S: You were trying to make an example

L: An example of...? (Question)

S: The internal and external factor, if the internal environment is balanced then the external is not balanced (Answering question)

L: If the internal is balanced then the external is not balanced, is it the discussing that we had?

S: Yes

L: Was the discussion around the balance

S: You remember you asked us what the meaning of the last one is

L: Because the solute movement results in the movement of water by osmosis, the net effect is to regulate both solutes and water. So, we have tried to explain

S: Yes

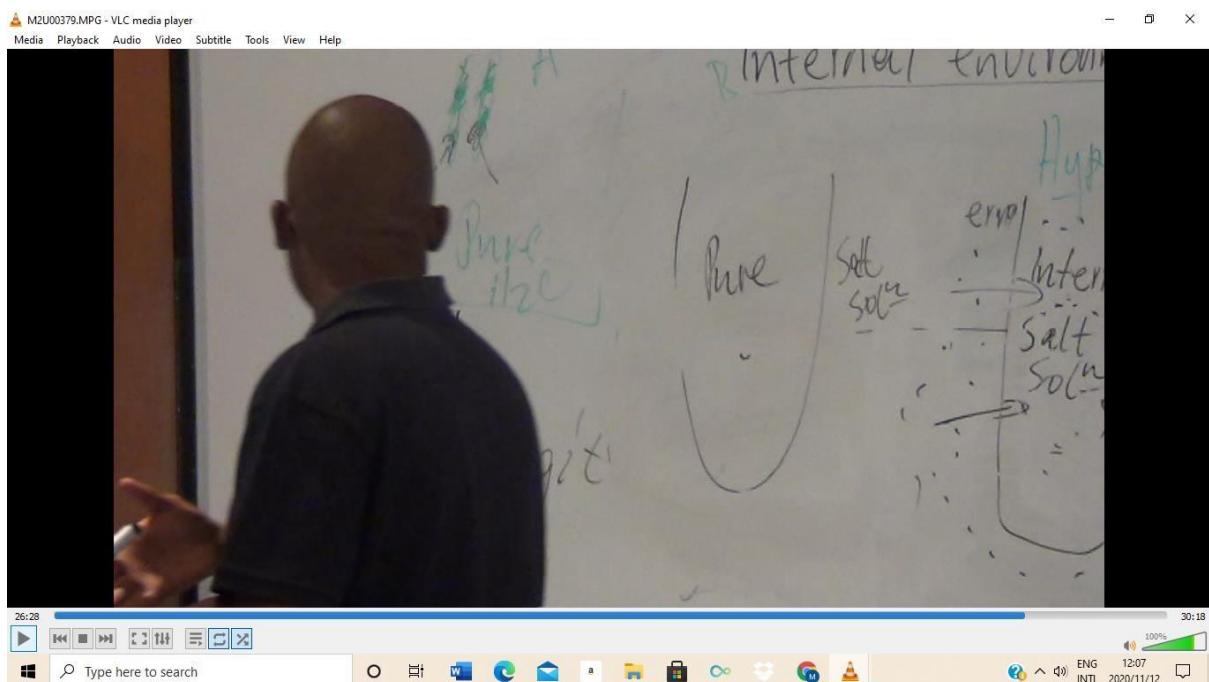
L: And what did we say, so we have external and internal environment, so we had something like that, not so?

S: No

L: It is slightly different?

S: Yes, it is a bit different

L: So, we are saying, let us say that this is our internal environment, okay? And this is our external environment then we are comparing their concentration inside which is the internal environment, and outside which is the external environment. The example that we gave was that let us say inside we have got salt solution



(explanation using whiteboard)

S: Yes

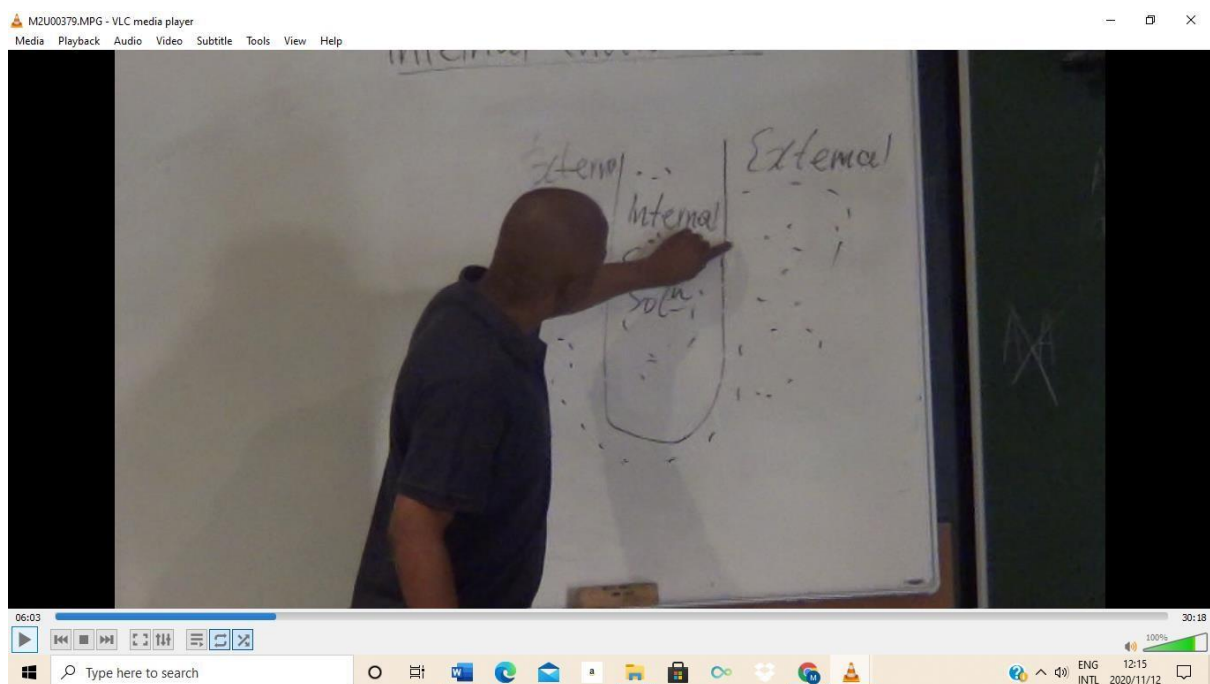
L: Yes, high concentration of salt solution. Was it about that? (Question)

S: Yes, and we used calcium ions (answers question)

L: We used calcium ions. Its fine, we are now using sodium ions and chloride ions, okay so we have got salt solution inside so this means that we got water molecules inside and outside, okay? So, let us assume that the dots that I am drawing there represents water. Last time I had something like this (H₂O). If we look at this, it looks like there is no way it will pass through the walls of the membrane, not so?

S: Yes

L: It will cause a little bit of confusion, but instead of using this symbol we can work around this



(Dots) (Uses Whiteboard to demonstrate). Let's say we have water around, this is a salt solution which means that even inside there is still some water molecule, not so? There is still some water molecules, now if we got this and we say we have some sort of a semi permeable membrane, meaning it is able to allow some materials to go through but not everything, it is those materials that are small enough. Those that are small enough are able to pass through, but those that are big are not able to go through. If we have a situation like that, what is likely to happen there? (Explanation followed by question) We have this bag of salt solution and then we put it inside pure water, what is likely to happen? And we have got a semi permeable membrane between or dividing the internal environment. So, this is semi permeable membrane, sometimes we call that a partially permeable membrane, what is likely to happen? Well we do not know the answer, which is why I am asking you what is likely to happen, so I am looking for a prediction, but unfortunately, we cannot see, we can only explain. What do

you think will happen if we got such a situation? Internal environment which is the inside where we got the bag of salt and the external environment where we only have water molecules. Yes...

S: So, I think some of the salts will escape into the water molecule (**Answers question**)

L: So, she is saying that some of the salts will escape to the water molecule, anybody else? Yes...

S: I just changed like one word, I will say that salt molecules will move, and I think this is the low concentration from the external to the internal environments

L: There is a high concentration of solutes outside and there is nothing outside, the salt should move to where it is not there or to lower concentration, okay? But now that we have got that semi permeable membrane what effect does it have? (**Question**) If this was just a free border where there is a free movement for all particles, movement from the higher concentration to a less concentration or where there is no concentration at all, but now that we have that partially permeable membrane what does it mean? (**Question**)

S: Uhm, the partially permeable membrane what it does is that it... the amount of salts ...

L: Err...let's not say they close, let's not say they close, they are always there, they regulate in that not everything is able to go through, okay? Not everything is able to go through, but I think the confusion is that we are not sure whether the salt particles are able to pass through this membrane or not, not so? Because if they are whatever explanation you have given me will hold, but in this case the tendency is that the salt particles inside are not allowed to move outside, okay? Which means that the only movement that we can have is of the water molecules towards inside, so instead of having the salt particles moving towards inside because they are more inside because of the pressure and the permeability of the membrane they are not able to go to the outside, so they are retained within the back, okay? Rather we have the movement of the water molecules towards the inside. So, the water molecules are the ones that are moving towards the inside, which means the pores that we have at the back, they are able to allow free movement of water. Okay? (**Explanation**)

S: Yes

L: But not that of salt particles, so the sodium and chloride particles are not able to go through, therefore, only water is able to go inside, so that is likely to happen (**Explanation**). Isn't it that

when we show osmosis using the potato cups or potato chips, that is what we say, not so? Have you come across that before? You say you have the chips, one you put them in pure water and the other ones you put them in salt solution., So you put the chips there , your normal chips, your normal chips , your normal potato chips, what happens in that case? Is there any difference between the ones that are put in water compared to the ones that are put in salt solution? We are talking about the chips, about the fish and chips that you eat, not the crispy ones, okay? Fish and the chips, so instead of putting them inside the oil some of them are put inside the water and some of them are put inside the salt solution. Well with -

S: Are they fried? (Question)

L: No, they are not fried, they are not fried. So, we say, let us say a day later we come back and compare the two sets of chips, does that make sense? Two sets of chips. What do you think will be the difference? What will be the difference? Will there be any difference? (Question)

S: Yes

L: What will be the difference? Some of them are put inside the water and some of them are put in a solution of sodium ions, what will be the difference? (Question)

S: The other one will be salty (answers question)

L: The one that is put in salt will be? (Question)

S: Salty

L: Salty...

S: (Laughs)

L: Well they will be salty, the reason is that they will be surrounded by salt, but in this case remember we are talking about the raw chips , we take potatoes into few strips and we put some of them in pure water and some of them we pour salt, we are comparing in terms of appearance not taste, let us not say anything about the taste. What do you think will happen? (Question) Apply what we have said here. What do you think will happen if some of them are put in pure water and some of them are put in salt solution? The ones that are put in pure water will be turgid, what do we mean by that? And the ones that are in a salt solution will be? What is the term? Flaccid, they will be flaccid, and the other ones are hard, they are turgid, whereas the others are soft. Its flaccid, how do you write that? (Question) You are English speaking, so help us on how to write, if it is not turgid it is what? (Question)

S: Flaccid **answers question**

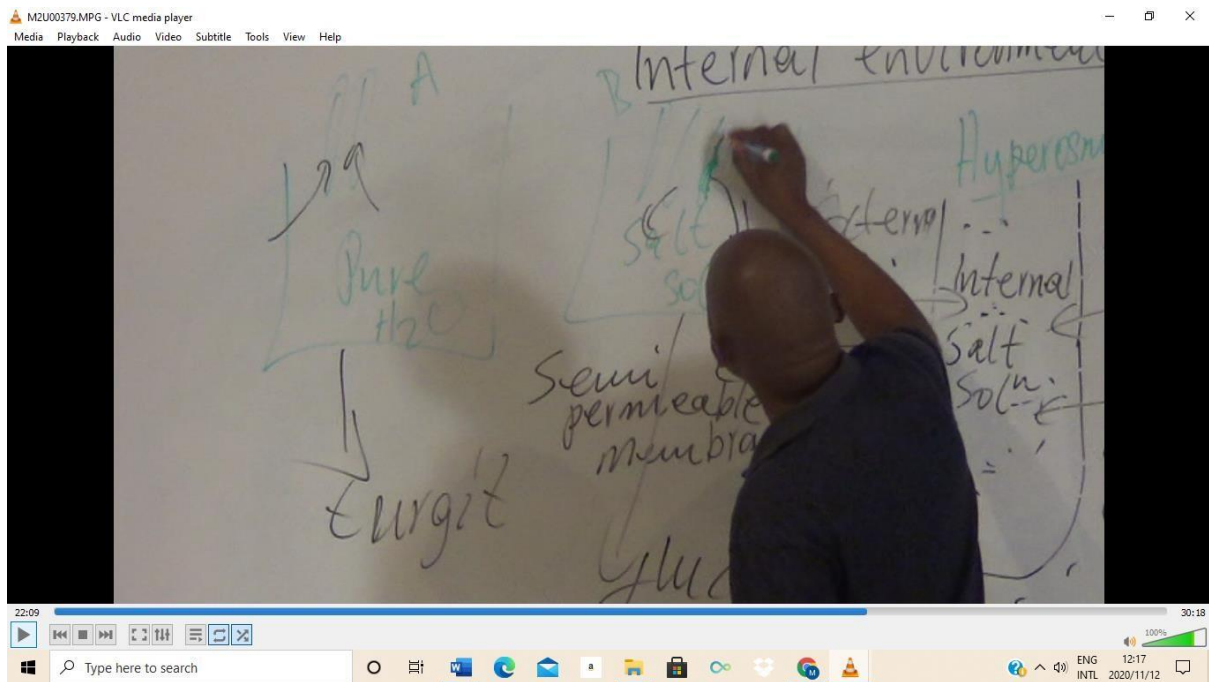
L: Yes, flaccid. Like that you will double check the spelling, chances are it is not correct, but they will be softer and why are they softer? We are talking about the semi permeability of the membranes, okay? It means in this case, some of the water that is contained in the chips is gonna move out into the salt solution, okay? But in this case (of pure water) the water is moving inside. So, the difference is that in one case the chips are taking more water from the surrounding, okay? In another case the chips are losing water into the surrounding, but the salt is not able to pass through the membrane of the chips, so they are salty because the salt is only found on the surface, not inside, okay? Not inside. So, that is likely to happen, and we talked about the terms that we use there to say if there is a difference between the inside and the outside, what term do we use? Now the focus is the internal environment, okay? So, it is hyper or hypo in the first case, in this case (pure water)? Is it hypertonic or hypotonic? What do you say, for the first one? maybe we should start with this, in this case we are describing the internal environment, okay? So, if we say that it is hypo, we are referring to the internal environment compared to the external environment. Is it hyper or hypo? What do you say? Hyper or hypo? Remember we said that the internal environment has got a high amount of salt particles compared to the surroundings, so what term do we use? What term do we use to describe the internal environment? Look, we need to understand what we described last time, for us to understand what is gonna come after this. What did we say about the solution that is referred to as hypertonic? Or hyper osmotic. There is more salt, because in this hyper there is more salt, now I want to make a comparison between the internal environment and the external environment in this case and describe that as hyper or hypo (**Lecturer explaining and asking questions**)

S: Hyper

L: It is gonna be?

S: Hyper

L: It is gonna be hyper, in this case our internal environment is hyper osmotic. it is hyper osmotic, okay? It is the same as which one if we say that this is A (Pure water) and this is B (salt solution). A or B? Look at that, what are we describing here?



(whiteboard) We are saying the internal environment in this case is hypo osmotic, it is the same as which one in this case? A or B? Well you can't even say A or B

S: B

L: Is it B? yes...?

S: B

L: Okay, so everyone is saying B, but why are you saying B? Why do we say B? Which one is our internal environment? (Pose thought provoking question)

S: Inside of the potato (answers question)

L: Inside of the potato, not so?

S: Yes

L: So, if we say that the inside of the potato is our internal environment, we are comparing the internal environment and the external environment. are we saying in this case the internal environment is hypo osmotic? Are we still saying that? So, we say that the inside of the potato is our internal environment, okay? Which means that whatever we have inside this beaker is the external environment, so we are comparing the concentration of the solutes inside the chips which is our internal environment compared to what is in the beaker. So, are we still saying in that case the internal environment is hypo osmotic? Do you think it is hypo osmotic or hyper?

(Lecturer is asking questions and working with students to solved problems) S: Hyper

L: Hyper, which means what we have here will be the same as what we have here (pure water).

The question is how? She wants to explain that. Isn't it that you are the one who is saying it is the same as what is happening? Let us look at that, we are comparing the internal environment of the chips, okay? The internal environment of the chips compared to the external environment. The external environment is the pure water and we are saying if we compare the two, where do we have the higher concentration of the solutes? Is it inside the chips or where we have the pure water?

S: Inside the chips

L: What are you saying?

S: Isn't it that the potato has salt in it?

L: That is what we are saying, we are comparing that because there are salts inside. If you compare what is happening outside there are no salts which is why we are talking about pure water and remember when we say hypo osmotic, we are talking about the concentration of solutes, the solutes that we are talking about there will be the salts that is when we have higher salts that, is it inside the potato or in the water ?

S: In the potato

L: Is it inside the potato or in the water? Think about it. I want you to say that

S: It is inside the potato

L: It is inside the potato, okay? Now we want to describe the inside, the internal environment of the potato compared to what is happening outside, do we say that it is hyper or hypo?

S: Hyper

L: It is gonna be hyper because there will be more salts solution in the potato compared to the outside (**Explanation**). Do you get it now?(**Question**) Now if we look at that normally if we were able to move the salts particle, because let us look at this, we are saying that the fact that there is high concentration of salt inside, there is a tendency of water to move inside. Do you get that? Then we say if we got a reverse, we still have the internal environment and the external environment, but this time around inside we have pure water, okay? Outside there is a salt solution, in other words this is then inside the ... what is gonna happen? In this case what will happen?(**Explanation followed by question**) There is a tendency of water to move outside

, can you see , there is a tendency of water to move outside, now from those two scenarios you can see that there is a tendency of water to always follow the high concentration of the solutes , can you see that?(Confirming question) If we have a high concentration of the solutes inside the water will flow, it will flow inside, but if we have got a high concentration of the solutes outside the water will move outside, so if we control where we have a high concentration of the solutes at the same time there is a tendency of water to flow, what do we mean by that? (Explanation followed by a question) What this means is that if some of the salts can be moved outside until we get to a point where there concentration is high that is done by the passive movement of water, so if we control the solutes , at the same time we are able to control the amount of water of the direction that the water is flowing in, that statement is about that, it comes from the explanations, if we put more solutes outside the water will move outside, if we move more solutes inside the water will move inside , the water is always following the high concentration of the solutes because it is always towards where we have hyper osmotic conditions. (Lecturer answers own question) So, the functions of osmo regulation and excretion we have looked at some of those, isn't it so? To rid the body of potential toxic wastes such as excess nitrogenous products (through excretion), okay? Uhm, through osmoregulation animals control solute concentration and balance water gain and loss, at levels appropriate for metabolic activities, just like that.

Semi- structured interview

Interviewer: What teaching and learning strategies are used during the teaching of the topic Excretion to 3rd year pre-service teachers?

Lecturer: “Normally, the first thing I do is to go through the curriculum and here the focus is excretion, so I go through excretion and then I identify the key concepts within excretion, now normally when I teach these concepts I will start with, this is meant to give an overview regarding the whole topic (Go through concepts), because when we go on the chances are students will forget what we go through but if from the onset you identify what we call the key concepts now they will probably know that they are the key concepts they need to know and with that when we go into the details when we go through the key concepts I try to identify what is difficult about that concept, so I take that into consideration when I am teaching, so for each concept I make sure I use multiple representations because these are meant to make whatever I am teaching or whatever concepts I am teaching easier or to for students to understand and another is that I take into consideration prior knowledge, I do this by asking

them questions, so, if we have the first key concept, we discuss that and then I ask them questions, so that when we go into detail, I already know what they know about that key concept we're dealing with at that particular moment and of course these are not done independently, as we move along going from one concept to the next, I ask students questions (Question and answer) every time and the purpose of that is to find out what is it that they know (**check prior knowledge**) and even at the end I ask them questions so I can confirm if they understood whatever it is that we were dealing with at that particular moment or that particular day."

Interviewer: Why are these strategies used?

Lecturer: "As I have indicated in the first question, I believe that when you have a broad topic, students cannot remember everything that you are teaching but if you highlight what is important or what is key within whatever you are teaching them (**Overview of the content**), chances are they will understand that but I also believe that for them to understand whatever you are teaching them then you have to link whatever you are teaching them with their prior knowledge, which is why I talked about their prior knowledge, to say what is it that they bring to the class in relation to what we will be dealing with, so if you understand that it will be easier for you to come up with appropriate representations and of course the trick is that when you come to class you already have those representations, but if when try to deduce their prior knowledge you find out that chances are some of the representations that you chose are not appropriate then you come up with the new ones that are not on the slides at that particular moment (**prior knowledge**), so, knowing what they bring to class influence the way you teach, it influences the way you teach the concepts and probably the strategy that you will be using to teach that lesson, concept or the topic as a whole".

Interviewer: How do the strategies identified above promote or hinder meaning-making?

Lecturer: "I believe that when we talk about meaning making it is more about active engagement and interactions with the objects and trying to identify the relationship or drawing on the experience of similar situations, which is why I indicated that I ask students questions (**Question and answer**) all the time and it is one way of trying to keep them actively involved and then also when I choose representations, I indicated, I normally try to choose the ones that they can relate to because in teaching, rather in learning it is easier for you to learn if you are able to link what you see in front of you with what you have encountered before, so I take this

into consideration when I am teaching and I believe these strategies are likely to promote meaning making”.

Interviewer: How can you tell that they promote or hinder meaning making?

Lecturer: “Well, it is unfortunate that at this level it is only a few students who will be responding to your questions (Question and answer), so it is difficult to see whether they understand what you are teaching them or if they are working or not, you will only be able to see mainly when we give them a test when they are passing or when they are failing, the problem is that if someone is passing sometimes it is not about whether your strategies are working, it could be that they are able to learn on their own, so it is a little bit tricky, but with a few that are interactive, at the end you can see the way they respond to your questions, and you can see that they were able to learn something based on the strategies that you used as a lecturer”.

Semi-structured Video-stimulated recall tentative interview questions

Questions

1. What do you understand by the term ‘meaning making’?
2. What is your understanding of the term ‘discussion’ during teaching and learning processes?
3. What types/ forms of discussion do you use in your Excretion lessons?
4. How do you use discussion to promote meaning making during the teaching of the topic of Excretion to 3rd year preservice Life Sciences teachers?
5. How do you engage students in discussions?
6. Why do you use discussion in the ways mentioned above when teaching Excretion to 3rd year preservice Life Sciences teachers?
7. How appropriate are discussions for promoting meaning making?
8. what have been your problems in facilitating discussions (check stimulating them, monitoring them, using them to consolidate meaning/ understanding)?

Lecturer’s responses

Lecturer: *Okay, uhm your first question here is what do you understand by the term meaning making, well I don’ t know how this is explained in research but uhm I think it is a research construct but I think when you talk about meaning making, my understanding is that you are talking about the process of how as individuals, we interpret the information , how we understand uhm the information, generally how we make sense of the information that we are exposed to, so for me that will be the meaning making*

Lecturer: *...and then your second research question is what is your understanding of the term discussion, uhm and this needs to be explained in terms of teaching and learning, so discussion for me is the sharing of information with individuals and in the teaching setting then this information will be shared with students, so it is not just one way movement of*

information, so the students would share their opinions about whatever concept and also report back where we have a broader discussion as a class, those are some of the type of discussions that we normally have in class,

Lecturer: You also want to know how we use discussion to promote meaning making during the teaching of the topic of excretion, umh to 3rd year preservice Life Sciences teachers, umh regardless of whether I am teaching excretion or any other topic to any other group for that matter, umh my understanding is that as we discuss people are able to reflect on their understanding and if that understanding is not aligned to the accepted understanding

through the discussions, through the questions that we ask, the contribution that is coming from other people, they are able to make their own meaning because they need to interpret whatever information that we are discussing, umh on their own, so in that way during the discussions, people are able to make their own meaning

Lecturer: Then your other question is how do you engage students in discussions, like I have indicated, it is difficult to accommodate everyone but at least what I do is to make sure that different people from different settings of the class are given a chance, I do not only talk to few individuals, so I normally go around and point even those that do not raise their voices so that they contribute, you find that some of them are even shy, they can't say their opinion to the class. So, normally I go closer to them and listen to what they are saying and then I can interpret that or give that information to the whole class so it is one way of engaging the students, if the explanation they come up with is not aligned to the acceptable concepts or definitions, I normally probe them until we get to a point where we agree that this is the correct or accepted umh understanding that everyone needs to have

Lecturer: So you also want to know why I use discussions in a way that I do, because I believe that you need to understand students' opinions, their understanding because if you just give them information, it is difficult to determine whether they understand or not but as we ask questions, as we hear their views, their understanding of the concepts it is then that you determine whether they understand or not, otherwise you will just be giving them information and you do not know whether they understand anything, so these questions help in that they can determine and drive the lesson in the right direction because students will know certain concepts, as you discuss and they do not understand the concepts you assumed they did then you can go into detail, so that is how discussions are likely to help. They are very appropriate, they are very appropriate because you get different views and from those views people are able to make their own interpretation, they can deduce the understanding and the more we discuss, the more people have a chance of understanding whatever is being discussed, therefore, I think uhm discussions are very much appropriate for promoting the meaning making

Lecturer: One of the problems of facilitating discussions is the fact that some of the students normally do not contribute at all and it is difficult to make everyone contribute because we have a large class, so it is difficult in that way in the fact that only few individuals are able to contribute, even if uhm you would make sure that everyone contributes or everyone was willing, there is limitation of time if you have got a class of 100 students. There is no way that for every concept everyone can have a say, otherwise it will take forever, uhm there is a limitation of the numbers that we are having uhm people not being able to or willing to contribute and also restriction that is brought by the time, so those are some of the problems that we normally come across during the discussion

