
A Bernsteinian Analysis of the Recontextualization of Knowledge in the Plant Biotechnology Lessons

Mafunase Mwale^{1*}, Overson Shumba²

^{1,2}The Copperbelt University, Zimbabwe

Department of Mathematics and Science Education

*Corresponding Author: mafunasemwale@yahoo.com

ABSTRACT

The goal of this study was to explore the contextualisation of knowledge in the plant biotechnology lessons at the Copperbelt university in Zambia. The study was aimed at understanding the pedagogic discourse which the biology education students experience during their training. The study used a qualitative approach to collect and analyse the data. Observation method was used to collect the data by video recording three lessons. Bernstein's framing and classification concepts were the analytic tools in this study. Atlas ti 8 software was used to analyse the data. The study found that the framing was strong in the hierarchical rules, selection, sequencing, pacing and that the evaluation criteria and that the framing was weak in the evaluation criteria. The classification was weak (C-) in the inter-disciplinary relations, inter-discursive relations and in the intra-disciplinary relations. These findings indicate that biology education students were not adequately prepared to teach biology in secondary schools.

Keywords: classification, framing, plant biotechnology lessons, pedagogic discourse, recontextualization

INTRODUCTION

The aim of this study was to understand how knowledge is recontextualised in the biotechnology lessons at the Copperbelt University. The plant biotechnology course is one of the courses taken by the biology education students who are training to be teachers of biology in secondary schools in Zambia. The plant biotechnology course is one of the courses developed in the Department of Biological Sciences (DoBS). The plant biotechnology course is developed for the students enrolled in the DoBS. While the biology education students are enrolled in the Department of Mathematics and Science education (DMSE).

The biology education students take a number of the courses developed in the DoBS. The plant biotechnology course is one of the courses included in the biology education curriculum. The development of the plant biotechnology course was guided by the objectives of training the students enrolled in the Department of Biological Sciences. The objectives in the training of the biology education students were not considered when developing the plant biotechnology. The plant biotechnology course is taught by the

lecturers in the Department of Biological Sciences. Therefore there is a need to understand how this course would help to effectively prepare the prospective teachers of biology for their future profession as teachers of biology. Teacher training is concerned with the pedagogic discourse. The pedagogic discourse which teachers experience during their training influence the practices of the teachers in schools (Ensor, 2001, 2004).

Therefore, there is a need to understand how the plant biotechnology course relates with the 5090 biology syllabus for which the biology education students are being prepared to teach. The 5090 biology syllabus was developed by the Curriculum Development Centre. This study was focused on understanding how the plant biotechnology course was taught to the biology education students at the CBU to prepare the students to teach biology to all the learners. Table 1 show the courses in the biology education curriculum. The plant biotechnology course is taken in the fourth year of the training of the biology education students.

The research question which guided the study was: How is knowledge recontextualised in the plant biotechnology lessons. Bernstein's Pedagogic device was used to frame this study. The pedagogic device is a device with three hierarchically related rules which systematically guides the production of the pedagogic discourse. The three rules of the pedagogic device are the distributive rules, recontextualization rules and the evaluation rules (Bernstien, 1996). The distributive rules regulate the production and the distribution of the pedagogic discourse. They establish who gets access to what knowledge. The distributive rules regulate the power relations between social groups by distributing different forms of knowledge to different social groups (Diehl, Lindgren, & Leffler, 2015).

The recontextualization rules provide the rules for selecting, dislocating, relocating and refocusing a discourse with other discourses to produce a pedagogic discourse/pedagogic communication. Recontextualization leads to the translation of the specialist knowledge into a pedagogic discourse as the discourse produced does not resemble any of the discourses which have been relocated and refocused (Bernstein, 1996; 1999; 2000). Therefore, a pedagogic discourse is different from the extracted texts. In the context of this research where the focus is on biotechnology, the biotechnology taught in class is different from the knowledge which is produced in the disciplines from where the knowledge was selected. This is because the selected knowledge is transformed through the recontextualization process to become school knowledge.

Table 1. Curriculum for the undergraduate biology education

Year of study	Course name	Course code
Year one	Physics 1	PH 120
	Chemistry 1	CH 120
	Biology 1	BI 120
	Mathematics 1	MA 120
	Introduction to Education	PE 110
	Communication Skills	PE 121
Year two	Plant and Animal Physiology	BI 260

Year of study	Course name	Course code
	Biochemistry	BI 240
	Systems of Plants, Animals and Fungi	BI 250
	Molecular Genetics	BI 265
	Education Media	PE 231
	Educational Psychology and Sociology of Education	PE 210
Year three	Introductory Entomology	BE 330
	General Ecology	BI 370
	Biology Teaching Methods	BM 330
	Research Methods	PE 330
	Teaching Practice	PTP 330
Year four	Plant Biotechnology	BT 440
	Entomology	BI 420
	Conservation Biology	BI 410
	Education Administration and Management	MG 420
	Biology Education Project	BI 400
	Science Education	SCE 410

The third set of rules of the pedagogic device are the evaluation rules. The evaluation rules are concerned with the transmission and acquisition of knowledge which take place in the classroom. The rules regulate and shape the pedagogic practices at the classroom level. They define what must be taught to the learners and how the content is to be taught (Player-koro, 2012). It is the evaluation rules which guide the selection of what is to be taught and how it will be taught to the learners. The evaluation rules are either explicit or implicit (Reeves, 2006). Explicit evaluation indicate that the criteria is known to the learner, while implicit indicate the criteria is not known to the learner. The evaluation is also determined by the sequencing and pacing of the learning. Bibila (2016) point out that the pedagogic discourse is about evaluation since evaluation condenses the meaning of the whole device. This is similar to Bernstein (2000) who has also said that evaluation condenses the whole meaning of the pedagogic discourse. It is the evaluation rules which have an effect on the performance of the learners. Evaluations can be used to check if the method being used is helping the teacher to transmit the knowledge. Depending on the findings, the teacher can decide to change the pedagogies being used or maintain them (Zintle, 2012). Studies have shown that explicating the evaluation criteria would help the

disadvantaged learners to acquire the recognition and the realisation rules required in the development of the vertical discourse (Morais, et al., 1992; Morais & Neves, 2001; Bournr, 2004; Rose, 2004, Morais et al., 2004).

It is in the reproduction field which is the focus in this study since the study attempts to understand how knowledge is recontextualised in the plant biotechnology lessons in preparation for their future profession, that is teaching biology in secondary schools. The reproduction field is concerned with the reproduction of knowledge. Reproduction of knowledge mainly takes place in workshops, schools, and classrooms. The reproduction field is concerned with the transmission and acquisition of knowledge. Its main focus is on the pedagogic practices and evaluations. The reproduction field is a secondary field in knowledge production. In this field, agents such as the trainers and teachers are involved in recontextualising the knowledge as they prepare the lessons from the different sources. Lesson preparations require that a number of resources such as textbooks, journals, powerpoint slides are used. Teachers describe this process as a process of authorship (Deng, 2009, 2011). In the case of this study, it was the training of the teachers of biology teachers in secondary schools which was the focus.

In addition to this process of authorship, teachers /trainers engage in pedagogic practices and assessment practices. The discussion has shown that the production of a pedagogic discourse is a struggle between the agents involved at each level of the pedagogic device. The struggle is over the control of the discourse. Those with control determine the content, how it will be evaluated (Nsubuga, 2008; Player-koro, 2012). The agents influence the pedagogic discourse which get into schools and also influence pedagogic practices in class, this process influence the pedagogic discourse taught in class.

The pedagogic discourse embeds two discourses which are the Regulative Discourse (RD) and Instructional Discourse (ID). The regulative discourse is a discourse of social order, its focus is on the control in the communication, that is the hierarchical rules. Bernstein used framing to determine the control relations in the communication. The instructional discourse is concerned with what is to be transmitted, that is the selection, sequencing, pacing and the evaluation criteria of the knowledge and the relations between the discourses. The rules of the pedagogic discourse are characterised using the classification and the framing concepts. The discursive rules and the hierarchical rules inform the rules of the pedagogic device (Bibila, 2016; Hewlett, 2013; Bourne, 2003).

Bernstein used the framing concept to determine the strength of control in the selection, sequencing, pacing, and in the evaluation criteria and he used the classification to determine the strength of the relations between the discourses. According to Bernstein, framing is said to be very strong (F++) if the control is entirely in the hands of the teacher, the framing is strong (F+) if the control is shared between the teacher and the learner, but mostly in the hands of the teacher, framing is weak (F-) if the control is shared between the teacher and the learner but it is mostly in the hands of the learner, framing is said to be very weak (F--) if the control is entirely in the hands of the learner. To be able to read the data, classification and framing strength was used to develop the indicators used to guide the analysis (Ensor & Hoadley, 2004). The strength of the classification and framing are

important in determining the strength of the recognition and realisation rules required in the acquisition of the text or content being transmitted.

METHOD

This study used a qualitative approach to collect and analyse the data. Observation method and interview method were used to collect the data. Three lessons were video recorded (Creswell, 2015). Video recording of the lessons helped to collect the data that was needed to answer the research question. Before starting to video record any of the lessons, consent to video record the lessons was got from the students taking the Plant biotechnology course at the time of the study and from the lecturer who was lecturing the course at the time of data collection. The students and the lecturer were assured that the data collected through the recordings was purely for the study which was being carried out (Creswell, 2007, Merriam & Tisdell, 2017). We collected the classroom data by video recording 3 Biotechnology lessons. This approach is similar to the approach used by Bertram (2012) and that of Luckett (2009) who also recorded three lessons in each class in their recontextualization studies.

Video recording helped us to have a permanent record of the data collected. Classroom data was collected by video recording 3 consecutive biotechnology lessons in the year 2020. The video recordings of the lessons were saved and numbered as lesson 1, lesson 2, and lesson 3. The dates on which the recording was done was also indicated on the file (Bertram, 2012). Video recording of the lessons was done by the research assistant. This is because the research assistant had the experience in video recording which was necessary for this research. Video recording of the lessons enabled the researchers to repeatedly listen and watch the recordings which allowed the researcher to get the details of the classroom activities. Recording of the lessons also allowed the researcher to scrutinise the lessons in detail. Video recording of the lessons also helped the researcher to collect the most comprehensive recording of lessons and that video recording produced a permanent record on what was said, including a language, facial expression and the interactions which were there. The recordings also saved as evidence of the data collected which could be provided on request (Bertram, 2012).

In this study, the video recording was done during the plant biotechnology lessons. The recording was focused on capturing the activities in the lesson. However, video recording can be challenging and may most likely not be successful if the person recording is not experienced in video recording (Dawson, 2008). To overcome this challenge, we worked with the person who was experienced in video recording who was of help in taking the videos of the biotechnology lessons. The recording of the lessons helped to keep the data collected in the way it was collected. Recording the lessons.

enabled the researchers to listen and watch the lessons at their own quiet time. This enabled the researchers to have a rich and in-depth data collection on the lessons.

Video recording observations helped the researcher to record the information as it occurs in the context. Recording the observations also helped the researcher to have detailed observations on what was recorded during the Plant biotechnology lessons. What is to be

observed in the field was guided by the research purpose that is the research questions for the study (Merriam & Tisdell, 2017). Video recording of the lessons helped in capturing a highly descriptive data in which much details of the classroom was captured (Merriam & Tisdell, 2017).

Interviews were conducted with the lecturers who were teaching the three lecturers who were teaching the course. An appointment to meet with each of the participant to be interviewed was done. The appointment to meet each individual was done through the audio telephone call. On the appointed day as decided by the participant, a meeting was done with each individual. During the first meeting, introductions were done and the aim of conducting the interviews was explained to each of the participant (Hancock, 2007; Starman, 2013). The participants were that the data to be collected in the interview was purely for the purpose of the study. Each individual to be interviewed decided on the date, time and the venue for the interview. This arrangement was done with all the individuals who were to be interviewed in this study.

All the interviews were carried out on the date, time and venue as suggested by the interviewee. This was done in line with the interview protocol to increase the comfort of the interviewee to speak (Hancock, 2007). We also requested to audio record the interview (Hancock, 2007; Alshenqeeti, 2014). All the interviews were guided by an interview guide (Hancock, 2007; Alshenqeeti, 2014; Merriam & Tisdell, 2016).

The recordings were first transcribed into texts. Using the different strength of classification and framing discussed earlier, indicators were developed to read the data. A sentence or a complete statement was a unit of the analysis. The transcripts were coded using Atlas TI 8. The codes, categories and theme emerged from the analysis.

RESULT AND DISCUSSION

The codes included in this category are: lecturer explains, lecturer questions and answer, lecturer questions and learner answers, and lecturer questions and learner answers. Table 2 show the codes, categories and the theme which emerged from the analysis of the data. The classroom activities were characterised by the lecturer asking questions, lecturer explaining a point to the learners and lecturer writing on the board. Most of the time the lecturer was explaining to the learners and the learners were listening to the explanations. In this approach the lecturer was at the centre of the learning. In some cases, the lecturer was writing the notes on the board while the learners were copying the notes from the board.

All the questions were asked by the lecturer. Some of the questions asked were answered by the learners while some of the questions were answered by the lecturer while some questions were answered by the learners. In some cases, the questions asked were not answered at all by either the lecturer or the students as shown in the data extracts below. When a learner answers the question, in most cases, the lecturer acknowledged that the answer was either correct or wrong. The lecturer did not explain why the answer was correct or why the answer was wrong. No elaboration was made on the answers given by the learners.

Table 2. Codes, categories and theme from the observation data

Codes	Categories	Theme
<ul style="list-style-type: none"> ○ DNA bases ○ DNA replication ○ DNA strands ○ Identification of organisms ○ Importance of PCR ○ Marker genes ○ Marker genes ○ Primers ● Lecturer explains ● Lecturer questions and answer ● Lecturer questions and learner answers ● Lecturer questions and no learner answers ● Writing of notes 	<div style="background-color: #c8e6c9; padding: 5px; text-align: center;"> <p>CONTENT IN BT 440 LESSONS</p> </div> <div style="background-color: #ff9800; padding: 5px; text-align: center;"> <p>TEACHING APPROACHES</p> </div> <div style="background-color: #00bcd4; padding: 5px; text-align: center;"> <p>CRITERIA</p> </div>	<p>INSTRUCTIONAL DISCOURSE</p>

In most cases, the learners gave no answer to the question asked by the lecturer, instead the lecturer gave the answer to the questions asked as seen in the data extracts, “What is meant by replication? What is meant by replication? What is meant by replication? Replication means, making the exact copy.” (Lecturer in lesson 2) “What do we mean by reporter genes? In the previous lecture I taught you about the report genes. What do we mean by the reporter genes?” ...Yes please! I taught you about the reporter genes. Is it correct or not. No! Yah, I have given a lecture on them. Some of the slides are there. What do we mean by the reporter genes? What do we mean by the reporter genes? What do we mean by the reporter genes? It is a gene that is attached to other genes for it to bind to the other genes for the development of the marker genes.”(Lecturer in lesson 3)

In some instances, the questions asked by the lecturer were answered by the learners. Student activity in on going learning discussion activities shows that students are able to answer questions from the teacher, they answer The forward primer adds bases in the 5’ to 3’ end, while the backward primer add bases from 3’ end to 5’, Students are able to understand and analyze transgenic plants and plasmids, but in some cases students are unable to explain in depth what is a plasmid, The teacher continues to ask questions related to plasmids, but the students are unable to answer and provide arguments, students cannot yet explain the answer comprehensive. While in some cases, the questions were not answered by either the lecturer or the learner, for example.

What is the role of the reporter genes? and then, how it is going to play the major role in development of the different types of genetic sequence, genetic sequence and also the continuation of the plant.” (Lecturer in lesson 4)

Therefore in terms of the hierarchical rules, knowledge selection, sequencing, pacing and criteria of the knowledge the framing was strong (F+) in all the lessons observed. The lecturer was in control in the communication, selection, sequencing, pacing and in the evaluation criteria of the knowledge since the learners did not interfere in any way in all the lessons observed. The learners only answered the questions asked by the lecturer. The lecturer decided on the order in which the knowledge was to be presented. What to be done in the classroom.

Relations between discourses in the BT 440 course in this sub-section, we have presented the discourses in the three BT 440 lessons observed. We have also presented the findings on the analysis of the relations in the discourses that is the inter-disciplinary, intra-disciplinary and inter-discursive relations.

Analysis of the BT 440 lessons revealed that the lessons were focused on polymerase chain reaction (PCR) used to identify organisms. The discussions in the lessons were on primers, DNA molecule, marker genes. For example see the data extracts below, How you are going to identify the different types of organisms at molecular level identification, Polymerase chain reaction (PCR).

So today we are going to discuss the importance of polymerase chain reaction. What is meant by PCR?

Lecturer: Can anyone tell me what do we mean by reverse primer? What do we mean by reverse primer, what is meant by forward primer?

Learner: The forward primer adds bases in the 5' to 3' end, while the backward primer add bases from 3' end to 5'.

Lecturer: Yah, ok, so when you are moving from the 5' to 3', the 3' to 5' you can assume that there is the forward primer and the reverse primer. You know, when you are running that particular moving general process, ok, in one of the picture you can see, What is a double strand? DNA double strand? Complimentary strands comprising of the units of Deoxyribose sugar and phosphates, What is meant by replication? What do we mean by replication? what do we mean by replication?

So you can see the bases, Adenine, Thymine, Cytosine, Guanine, so these are the bases which must come together to form the hydrogen bonds, ok.

The marker genes. What is the importance of the marker genes? What is the importance of the marker genes? You know very well the role the importance of the marker genes. And then what is the meaning of the marker genes? What is the importance of the marker genes in the plant biotechnology. The marker genes can help with the identification of the genes. In the previous lecture I taught you on the role of genes. So can you tell me what we mean by marker genes? What do we mean by marker genes.

The discourses were then analysed for the relations between discourses using the classification concept of Bernstein. The analysis revealed that classification is weak (C-) in the inter-disciplinary, intra-disciplinary and in the inter-discursive relations.

See the extracts, The recombinant DNA and the vector DNA has been made in one. You can see this in genomics, biotechnology, and in pathology, to manipulate the DNA. So we can see the bases Guanine, Thymine, Cytosine, Adenine, these are the bases which must come together to form the hydrogen bonds. So these are the enzymes for replication.

The analysis indicated that framing was strong in the hierarchical rules, selection, sequencing, pacing and in the evaluation criteria. Framing was weak in the evaluation criteria. The discourses in the teaching and learning of the BT 440 knowledge were focused on PCR reactions and on the marker genes as indicated earlier. Analysis on the discourses showed that, there is a relationship between everyday knowledge and the BT 440 knowledge. Hence intra-disciplinary classification is weak (C-), inter-disciplinary relation is weak (C-), while the inter-discursive relation was strong (C-).

The findings on the analysis of the pedagogic practices in the BT 440 class indicated a strong framing (F+) in the hierarchical rules, selection, sequencing, pacing and criteria of knowledge. The classification in the knowledge was weak in the inter-disciplinary, intra-disciplinary and in the inter-discursive relations. A strong framing in the selection and sequencing of the knowledge imply that the knowledge taught in the BT 440 class was selected by the lecturers. In such a situation, it makes sense that the lecturer who understand what was taught sequence the learning in the BT 440 class. The students did not contribute much in the learning of the course. The analysis showed that the learners only answered the questions asked by the lecturer. The lecturers also decided on the time in which the learners were expected to learn the content. These characteristics were also evident in the training of mathematics teachers in Sweden in which the learners had little participation in the teaching and learning (Player-Koro, 2011). Player-koro (2011), notes that, the focus in the teacher pedagogic practice was to finish teaching all the topics in the course so that the students are prepared for their end of year examinations. This could also be a reason for a strong framing indicated in the pedagogic practices in the BT 440 class.

Such a pedagogic practice leads to marginalising the knowledge taught to the learners. Such an approach to teaching and learning contracts Bernstein's views and other scholars (Martin & Rose, 2021; Morais & Neves, 2010; Rose, 2014) who have pointed that for successful learning, the framing need to be strong in the selection, sequencing and in the evaluation criteria of the knowledge in which the lecturer have the control. The pacing and the hierarchical rules must be weakly framed (F-) in which the learners must be placed at the centre of their learning and training. Learners have to be actively involved in their learning if meaningful learning was to take place (Biesta, 2005).

A weak framing entails increasing the learning time of the learners. An increase in the acquisition time has the cost implications on the part of the providers of the education, in most cases who are the governments. To avoid the high costs associated with a weak framing in pacing, there is a need to explicate the evaluation criteria by weakening the classification between the knowledge and weakening the framing in the hierarchical rules. Such an approach would enable all the learners to have access to the school code. In the case of prospective teachers, the approach will enable them to acquire the knowledge and the desired skills which will enable them practice the desired pedagogic practices in their teaching profession (Ensor, 2004; Morais et al., 2005). Such an approach to teaching and

learning will enable all the learners to have access to the school knowledge desired by all the learners. In this way, schools will be able to meet their goal of enabling all the learners to have access to the school code (Deng, 2016; Hoadley, 2005). By doing so, schools will achieve their intended goal of providing equal access of the school code to all the learners in school regardless of the differences in social background. Unlike schools being the reproduction of inequalities in the learners which is the case in most pedagogic practices (Young & Muller, 2013). There is therefore a need for educators to understand .

the type of knowledge being transmitted to the learners as every learner needs access to the vertical discourse of the school which Young and Muller (2013) has called the powerful knowledge, which schools are expected to provide.

CONCLUSION

The classification was weak (C-) in the inter-disciplinary relations, inter-discursive relations and in the intra-disciplinary relations. These findings indicate that biology education students were not adequately prepared to teach biology in secondary schools.

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