

**UCWANINGO LOKUHLOLA UKUFUNDISWA KWESIFUNDO SESAYENSI
KUSETSHENZISWA UBULIMIMBILI EMABANGENI APHEZULU EZIKOLENI
ZASEMSINGA**

NGU

PHINDISIWE SITHANDIWE MCHUNU

UMBIKO WOCWANINGO OWETHULWE UKUFEZA IZIMFANELO ZEZIKU ZE-

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ISIFUNGO

MINA, PHINDISIWE STHANDIWE MCHUNU, NGIYAFUNGA NGIYAGOMELA UKUTHI:

- i. Ucwangingo okubikwa ngalo kulo mqingo, ngumsebenzi wami othi mina, ngaphandle kwalapho kukhonziswe khona.
- ii. Lo mqingo awukaze wethulwe kunoma yiliphi iqhuzu kumbe ukuhlolwa okuthile kunoma yiyiphi inyuvesi.
- iii. Akukho lwazi nazithombe, nanoma yikuphi okunye okuqukethwe kulo mqingo okungumsebenzi wabanye abantu, ngaphandle kwalapho okuchazwe khona.
- iv. Akukho msebenzi wabanye abantu osikwe waphinde wananyekwa kulo mqingo otholakale kwi-*internet*, ngaphandle uma lokho kuveziwe, kwaphinde kwavezwa kahle ohlwini lwemithombo endaweni efanele.
- v. Lo mqingo awuqukethe mibhalo noma amazwi abanye abacwaningi ngaphandle uma lokho kucaciswe ngendlela efanele. Lapho amazwi abanye esetshenzisiwe:
 - (a) Amazwi abo abhalwe kabusha kodwa kwacaciswa kahle ukuthi amazwi abo.
 - (b) Lapho amazwi abanye ecashunwe enjengoba enjalo, kwenziwe lokhu ngokuthi afakwe kokhulunyiwe kumbe abhalwa ancishiswa, ukuze abonakale ukuthi angamazwi acashuniwe enjengoba enjalo, futhi lokhu kwabe sekuvezwa ngendlela efanele ukuthi akabani lawo mazwi.

Signed by: PHINDISIWE S MCHUNU: 

Day 6 in the month of February 2025.

1. 

DKT. ZINHLE P NKOSI

2.

DKT. REJOICE LG CELE

UMNIKELO WALO MSEBENZI

Ngethula lo mqingo wami kulaba abalandelayo:

- Ubaba wami uMthembeni Mchunu owadlula emhlabeni ngonyaka we-1998 ngesikhathi ngisafunda ibanga lesi-6. Uyena ubaba owangifundisa ukuthanda ulimi. Ngiyazi ubuzoziqhenya kakhulu Macingwane ngithi sengihambe ngafika kuleli zinga ngokufunda ngolimi, ikakhulukazi lwesiZulu. Ngibonga angiphezi wena waseNgonyameni.
- Umama uBusaphi Zuma owangiseka ekufundeni ngaze ngafika enyuvesi nokulapho adlula khona ngonyaka wezi-2008 ngisenza unyaka wokuqala kuziqu zokuqala zokufundela ubuthishela. Ubeyojabula kakhulu uma esebona ukuthi ukuqinisekisa kwakhe ukuthi ungikhulisa ngemfundo nakuba yena engafundanga kungibeke kuphi. Ngiyabonga wena kaMaphum' ephethe.
- Umalume wami uZwelabantu Zuma owadlula emhlabeni ngonyaka wezi-2023, owangeseka kusuka ekuvolontiyeni esikoleni ayekade ewuthishanhloko kuso kuya ekufakeni isicelo sesikhala sokufunda enyuvesi nokungeseka ukuthi ngiphothule iziqu zokuqala kwaze kwafika ekuqaleni lezi zeMasters, asehambe engasangibonanga ngizethweswa, Lugaju!
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Ngifisa ukubonga kubo bonke abebebambe iqhaza elibalulekile ekwakhiweni kwalo mkhumbi ukuze ube yimpumelelo. Kubo bonke abalandelayo ngiswele amazwi okuzwakalisa ukubonga okujulile:

1. KuJehova, uThixo engimkhonzayo, ongengamele, ongumqalisi nomphelelisi wendlela yami. Kubo bonke ubunzima ebengidlula kubo ngezingqinamba zempilo ezangikhungatha ngesikhathi ngiqala lezi ziqu angizange ungilahle. Ngiyohlala njalo mina ngikudumisa ngoba kukufanele.
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3. KuSolwazi Phumlani E. Myende owangifundisa ukuthanda ucwaningo ngesikhathi ngisaqedela iziqu zokuqala ze-*B.Ed.* Lokho kungifundisa kwakho ukubhala phansi (*transcribe*) izingxoxo zababambiqhaza kwangenza ngalangazelela kakhulu ukubamba iqhaza emfundweni ngokucwaninga. Ukuqinisekisa ukuthi uyangigqugquzela noma sengisebenza njengothisha ukuthi ngiqhubeke nokufunda ngiyakubonga kakhulu. Ukungiseka, unginike amacebo okulwisana nezingqinamba ezinkingeni ebengihlangabezana nazo kulolu hambo, ngiyakubonga. Kwande Mhleni!

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11. USolwazi uVitalis Chikoko, uDokotela Sebenzile Ngema, uSolwazi Angela James, uDokotela Bongani Ndlovu, uNkosikazi Marry-Anne Good abangeseka ngokungigqugquzela ukuthi ngiqhubeke nale ndlela yocwaningo. Ngibonga nokungihlola njalo ukuthi sengihambe ibanga elingakanani nomsebenzi. Ngibonga nakubasebenzi bonke baseNyuvesi yaKwaZulu-Natali ababehleli bevule izandla ukungilekelela ukuhamba le ndlela, nibaningi kakhulu, ngeke nginiqede. Ngibonga angiphezi.

ISIFINGQO

Isifundo seSayensi sikhungethwe yingqinamba yokungaphumeleleki kahle kubafundi abaningi ikakhulukazi emibuzweni edinga ukuthi abafundi baveze ukuqonda kwabo ulimi lwesifundo namakhonsepthe aso. Le nkinga iyaqhubeka nakuba uMnyango wezeMfundo eyiSisekelo usuke wakhipha isekhula ethi *English Across the Curriculum* ngenhloso yokugqugquzela ukusetshenziswa kolimi lwesiNgisi ekufundiseni zonke izifundo okungezona ezolimi, kodwa le nkinga isaqhubeka.

Lolu cwaningo luhlose ukucwaninga ngokufundiswa kwesifundo seSayensi ekuthuthukiseni ukuqonda kubafundi kusetshenziswa ubulimimbili emabangeni aphezulu ezikoleni. Inhlosongqangi yalolu cwaningo ukuphendula le mibuzo emithathu: (i) Othisha abafundisa isifundo seSayensi bakuqonda kanjani ukusebenzisa ubulimimbili ekufundiseni isifundo seSayensi kubafundi bebanga le-10 nele-11? (ii) Othisha bebanga le-10 nele-11 babusebenzisa kanjani ubulimimbili ekufundiseni isifundo seSayensi? (iii) Kungani othisha besifundo seSayensi besebenzisa ulimi ngendlela abenza ngayo lapho bethula izifundo zeSayensi emakilasini ebanga le-10 nele-11?

Lolu cwaningo lwenziwe endaweni yaseMsinga ezikoleni ezimbili ezingaphansi kobukhosi baseMabomvini naseMachunwini. Le ndawo umphakathi oyakhele ukhuluma isiZulu njengolimi lwebele kodwa izikole eziyakhele zisebenzisa ulimi lwesiNgisi njengolimi lokufunda nokufundisa olusemthethweni kuzo.

Lolu cwaningo lulucwaningo oluyikhwalthethivu (*qualitative case study*) futhi lusebenze ngaphansi kwepharadaymu yomhumusho (*interpretivist paradigm*). Lusebenzise izingxoxo ezisakuhleleka (*semi-structured interviews*), ukubukela othisha ngesikhathi befundisa (*observations*), kanye nokuhlaziywa kwamadokhumenti (*document analysis*) njengezindlela zokukhiqiza imininingo etholakele. Ucwaningo lusebenzise izindlela zekhwalthethivu ukuhlaziya imininingo. Kusetshenziswe uhlaka lwenjulalwazi ka Vygotsky (1978) njengensizakuhlaziya kanye nohlaka lwemicabango ukuhlaziya imininingo ekhiqizwe kulolu cwaningo.

Kulolu cwaningo kugqame izindikimba eziyisithupha emininingweni oluyikhiqizile. Eyokuqala indikimba emayelana nobumqoka bolimi olusabalele nekharikhulamu. Lapha kuvele ukuthi othisha basebenzisa ulimi olusabalele nekharikhulamu ngokuthi uma bechazela abafundi amakhonsepthe esifundo seSayensi baqale ngokubachazela asolimini lwesiNgisi abhalwa futhi abizwe njengalawa eSayensi, bese bebefundisa ngawesifundo seSayensi. Eyesibili emayelana nolwazi lukathisha lwesifundo nolwazi lwakhe lokufundisa. Okutholakale lapha ukuthi othisha banolwazi olwanele ngesifundo seSayensi futhi bayakwazi ukusifundisa. Lokhu kubonakale ngokuthi othisha basethula kahle lesi sifundo futhi bayakwazi

ukuhlonza izingqinamba ezingathikameza ukufundisa kwabo bese beqhambuka nezisombululo ngaphambi kokuthi zivele. Okunye futhi ukuthi bahlobanisa okufundwa ngalelo langa nesifundo esisuke sesifundiwe. Eyesithathu imayelana nolimi lwasEkhaya neqhaza lwalo ekufundiseni isifundo seSayensi. Lapha kuvela ukuthi kuyabasiza abafundi nothisha ukusebenzisa ulimi lwesiZulu ukufunda nokufundisa amakhonsephe esifundo seSayensi.

Eyesine evelile emayelana nokusetshenziswa kwezinsizakufundisa ezibulimimbili esifundweni seSayensi. Lapha kuvela ukuthi othisha basebenzisa izinsizakufundisa ezakhiwe zaba solimini lwesiNgisi kodwa baye bazenze zibe ezibulimimbili ngokuthi bachazele abafundi ngolimi lwesiZulu lapho befundisa ngazo. Eyesihlanu indikimba emayelana nokusetshenziswa kwezichazamazwi eziqondene namatemu esifundo seSayensi ezibulimimbili. Lapha kuvela ukuthi othisha basebenzisa izichazamazwi zolimi lwesiNgisi, ezolimi lwesiNgisi nolwesiZulu kanye nesichazamazwi sesifundo seSayensi. Eyesithupha indikimba emayelana nothando lolimi lwasekhaya nomthelela wakho kuthisha nakumfundi. Kule ndikimba kuvelile ukuthi othisha nabafundi bayathanda ukusebenzisa ulimi lwesiZulu ukufunda nokufundisa isifundo seSayensi ngoba othisha babonakala benentshisekelo yokuchazela abafundi ngolimi lwesiZulu kanti abafundi babonakala bezimbandakanya ezingxoxweni zesifundo seSayensi uma sethulwa ngokuthi bachazelwe ngolimi lwabo lwasekhaya.

Imiphumela yocwaningo iveza ukuthi okwenziwa nokushiwo othisha ngezingqinamba ababhekana nazo ekufundiseni abafundi ngolimi lwesiNgisi kumbandakanya nokuntuleka kwezinsizakufundisa ezifana namalabhorethri esifundo seSayensi nawamakhompyutha. Okunye okunomthelela kwabakwenzayo ulwazi lokufundisa abanalo kanye nolwesifundo seSayensi okuyikhona okubalekelelile ukukwazi ukubhekana nezingqinamba ezilwisana nokufundisa kwabo. Okunye okwenza benze ngendlela abenze ngayo othisha uthando lwabo ngolimi lwesiZulu nokungazinyezi ukulusebenzisa ukuze ukufundisa kwabo kugcine kulandela inqubo yobulimimbili esifundweni seSayensi.

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UHLU LWEZIFINGQO NEZIFINYEZO (*LIST OF ACRONYMS & ABBREVIATIONS*)

1. DBE: Department of Basic Education
2. CD: Compact Disc
3. SGB: School Governing Body
4. KZN: KwaZulu-Natal
5. ATP: Annual Teaching Plan
6. ZPD: Zone of Proximal Development
7. F_g : Force of Gravity
8. $F_{g\parallel}$: Force of Gravity (component) parallel to the slope
9. $F_{g\perp}$: Force of Gravity (component) Perpendicular to the Slope

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ISAHLUKO SOKUQALA

Isingeniso Nesendlalelo Socwaningo

1.1. Isingeniso

Imfundo iyisikhali sempilo esimqoka nokufanele ukuthi abayingxenywe yayo, abasemagunyeni futhi abayengamele bayiphathe ngobunyoinco nangothando ukuze kuthi uma seyehliselwa kubafundi bese ifezekisa izinhloso zayo ukuze abafundi bakwazi ukubhekana nezinselelo zempilo yanamuhla edinga imfundo. Lolu cwaningo lumayelana nokufundiswa kwesifundo seSayensi ekuthuthukiseni kubafundi ulimi olusabalele nekharikhulamu, kusetshenziswa ubulimimbili emabangeni aphezulu ezikoleni. Lesi sahluko siyinkombandlela ecacisa indlela esengiyihambile nengiyilandelile ukwenza lolu cwaningo. Kulesi sahluko kuzokwethulwa isendlalelo socwaningo, okungifake ugqozi lokwenza lolu cwaningo, lapho lolu cwaningo lugxile khona, izinhlosongqangi zalolu cwaningo, imibuzongqangi yocwaningo, ubumqoka bocwaningo, izingqinamba zocwaningo, ukuhleleka kwezahluke bese siphetha ngokwethula iqoqa lesahluko.

1.2. Isendlalelo socwaningo

ENingizimu-Afrika abafundi bavumeleke ukukhetha isifundo seSayensi kusukela ebangeni leshumi kuya kweleshumi nambili nokuyisifundo ngokuvamile othisha nabafundi abasithatha njengesilukhuni (Hlabane, 2016). Lokho kubonakala nangenani elincane labafundi abathatha lo mkhakha wayo iSayensi, emakilasini ngokuvamile kuba nesibalo esincane sabafundi ngenxa yokuthi ithathwa njengesifundo esingaphumeleleki kahle. UKhan nabanye (2023) bavumelana nalokhu ngokuthi bethi ukuncipha kwesibalo sabafundi emakilasini emikhakha yeSayensi kubandakanya ukungaphumeleli kahle kwabafundi ezifundweni zeSayensi kanye nokungagququzeleki kwabafundi ukuthi bayikhethe imikhakha yeSayensi.

USebatana noDudu (2022) bagcizelela ukuthi isifundo seSayensi siyinhlanganisela yemikhakha emibili okuyi-*Physics* ne-*Chemistry*. Ukungaphumeleli kahle kwabafundi abaningi kulesi sifundo seSayensi kwenza ukuthi izwe lishode ngabantu abanamakhono alungele ukulithuthukisa leli lizwe ngakwezeSayensi

nobuchwepheshe. Ezweni laseNingizimu-Afrika isifundo seSayensi sifundiswa kusukela ebangeni leshumi kuya ebangeni leshumi nambili njengesifundo esihlanganise ndawonye i-*Physics* ebizwa ngephepha lokuqala uma kubhalwa izivivinyo, bese kuthi ingxenye yesibili kube i-*Chemistry* ebizwa ngephepha lesibili ekuhlelweni kwezivivinyo.

U-Ogegbo, uGaigher noSalagaram (2019) bagcizelela ukuthi njengoba ukuthuthuka ngakwezomnotho kuncike emaswini amasha ancike olwazini nokusebenza kweSayensi, kubalulekile ukufundisa iSayensi ngendlela ezokhiqiza abafundi abaphumelela ngamalengiso ukuze kulangatshezwane nezidingo zezobuchwepheshe eNingizimu-Afrika. Nokho, isibalo sabantu abanamakhono asemqoka adingekayo afana nawokuhlaziya, ukuxazulula nawezobuchwepheshe abadingeka ukuthi bangene emikhakheni yeSayensi eNingizimu-Afrika sibukeka singanele. Lokhu kungenxa yokungaphumeleli kahle kwabafundi esifundweni seSayensi. Lokhu kushoda kwabanamakhono emkhakheni wezeSayensi kwenza kuchithwe izimali eziningi ezinhlelweni zokuthuthukisa imiphumela yeSayensi kumatikuletsheni kepha iphinde ingathuthuki ngokugculisayo imiphumela yabafundi ngoba kwenyuka kakhulu abaphumelela phakathi kwamaphesenti angama-30 kuya kwangama-49.

Isibalo sabafundi ababhala izivivinyo zesifundo seSayensi onyakeni wezi-2024 sehle ngezinkulungwane ezi-5684 uma kuqhathaniswa nonyaka wezi-2023. Ithebula elingezansi liveza ukukhuphuka kwamazinga okuphumelela kwabafundi emiklomelweni engamaphesenti aphakathi kwama-30 nama-39 kanye namaphesenti aphakathi kwama-40 nama-49 ikakhulukazi kule minyaka emine eyedlule. Isizathu sokuveza la mazinga okuphumelela kwabafundi yingoba yiwona akhombisa ukwenyukelwa kakhulu yisibalo sabafundi abawatholile kule minyaka eyedlule uma kuqhathaniswa nangaphezulu.

Abafundi abaphase kusuka kuma-30% nangaphezulu banciphile besuka kuma-76,2% kowezi-2023 baya kuma-75.6% kowezi-2024. Kuphinde kwaba nokwehla kwesibalo sabafundi abaphase isifundo seSayensi ngemiphumela esezingeni lama-40% kuya phezulu kowezi-2024 ngoba bathole ama-49,9% kanti kowezi-2023 isibalo sasenyukele kusuka kumaphesenti angama-49,7% (2019) kuya kwangama-51,1%.

Ngenxa yokuncipha kwabafundi kunyaka wezi-2024 ababhale isifundo seSayensi, isibalo sabafundi abaphase ngamalengiso sehlele ezinkulungwaneni eziyi-5680 uma kuqhathaniswa nonyaka wezi-2023 lapho isibalo sasiyizi-eziyi-6398 sabafundi abaphumelela ngamalengiso (Department of Basic Education (DBE), Republic of South Africa, 2025).

Ngezansi ngizoveza uhlaziyo lwemiphumela yebanga leshumi nambili eyenziwa kusukela ngonyaka wezi-2019 kuze kube unyaka wezi-2024.

Unyaka	Isibalo sababhalile	Isibalo sabathole 30% nangaphezulu	% labathole 30% nangaphezulu	Isibalo sabathole 40% nangaphezulu	% labathole 40% nangaphezulu
2019	164 478	124 237	75,5	85 034	51,7
2020	174 310	114 758	65,8	73 982	42,4
2021	196 968	135 915	69,0	88 164	44,8
2022	209 004	155 877	74,6	103 811	49,7
2023	206 399	157 368	76,2	105 414	51,1
2024	200,715	151,839	75.6	100222	49,9

Ithebula: 1

Nakuba uMnyango WeMfundo eyiSisekelo (Department of Basic Education (DBE), Republic of South Africa, 2025) uveza ukuthi imiphumela yesifundo seSayensi yonyaka wezi-2024 iva ukuncipha kwesibalo sabafundi abasibhalile, abaphumelele ezingeni lama-30% kunyaka kuye esibalweni sabaphase ngamalengiso. UMyango weMfundo eyiSisekelo uveze ukuthi ukwehla kwesibalo sabafundi abaphumelela kahle isifundo seSayensi kuveza ukuthi kunesidingo esikhulu sokuthuthukisa isisekelo solimi nezibalo ezikoleni ukuze izikole zikhiqize abafundi abazokhetha lo mkhakha baphinde baphumelele kahle.

Kule minyaka engamashumi amabili eyedlule sekube nocwaningo oluningi mayelana nokungaphumeleli kahle kwabafundi isifundo seSayensi ezikoleni zaseNingizimu-Afrika ngenhloso yokufuna ukuthola izisombululo kule ngqinamba. Lolu cwaningo selokhu lwenzeka, kugqama ukuthi kuwo wonke amaqhinga nezindlela zokungenelela ekulekeleleni ukuthuthukisa imiphumela yabafundi esifundweni

seSayensi, ucwaningo oluningi lugxile ekuphenyeni ngemithelela efana nokushoda nokungaqeqeshwa ngokwanele kothisha nokuqonda okusadinga ukuthuthukiswa kakhulu ngesifundo seSayensi kothisha njengezingqinamba ezinkulu ezilwisana nokuphuyelelwa kahle kwesifundo seSayensi ezikoleni eziningi zaseNingizimu-Afrika (Mafukata, 2016).

Miningi imizamo eseyenziwe eminyakeni eminingi eyedlule ukushintsha imfundo yaseNingizimu-Afrika ngokuthuthukisa ukwenza kahle kothisha ekufundiseni kwabo, ukuqeqeshwa ngolwazi lwezifundo, ukuziphatha, ukufundisa emaklasini abo, amakhono njalonjalo (Hofmeyr, 2015). Le mizamo imbandakanya amaklasi ahlelwa isifundazwe abizwa nge-*Provincial winter vacation revision*, kanye nezinye izinhlelo ezigxile ekulekeleleni abafundi abangaphumeleli kahle nabathwele kanzima esifundweni seSayensi. Kanjalo, ama-*workshop* athuthukisa ukuqonda kothisha, afana ne-*Physical Sciences lead teachers' training and British Council-facilitated training*, ukunikwa kothisha amafayela anezinto ezelekelela ukufundisa iSayensi kanye nama-*CD*, ama-*workshop* ahlelwa ama-*cluster* kungeminye yemizamo yokungenelela eyenziwa uMnyango wezeMfundo eyiSisekelo esifundazweni iKwaZulu-Natali ukuthuthukisa izinga lokufunda nokufundisa (KZN DBE, 2019). Nokho, uBantwini (2019) uqakulisa ukuthi nangaphezu kwakho konke ukusebenza ngokuhlanganyela kwalezi zinhlelo zokungenelela ekuthuthukiseni ukufunda nokufundisa kepha uhlobo lwekharikhulamu enezikhathi ezibekelwe ukufundisa kuthikameza ukusebenza kothisha. Kanjalo namaklasi anabafundi abaningi ngokweqile anomthelela ekuthikamezeni ukusebenza kothisha bese kuba nomthelela omubi emiphumeleni yabafundi esifundweni seSayensi.

Izikole ezisezindaweni zasemaphandleni yizona ezivame ukuthinteka ekungaphumelelini kahle isifundo seSayensi. Ukwentuleka kwezinsizakufundisa ezifana namalabhorethri kanye namakhompyutha kuvama ukuthi kube yizona zinto ezibukeka njengeziyimbangela kulokhu, nanxa kubalulekile ukwenza ucwaningo ukuze kuqinisekise okuyizona zizathu zokungenzi kahle kwabafundi kulesi sifundo. Lokhu yikhona okwelekelela ukuthi abafundi bathole ukusiqonda kangcono isifundo ngenxa yokwenza ama-eksperimenti namasimuleshini.

UNcube (2014) ugcizelela ukuthi izingqinamba zokungenzi kahle kwabafundi esifundweni seSayensi zibandakanya othisha abangaqeqeshiwe ngokwanele,

ukwentuleka kwengqalasizinda, amalabholethri ashoda ngezinsizakusebenza kanye nokungaqondi kahle kothisha nabafundi ulimi lokufunda nokufundisa. Ngenxa yalokhu, abafundi bangalahlekelwa ukuzethemba ekufundeni konkana bese beyeka ukufunda. Inkinga ekhona-ke ukuthi laba bafundi abayeka ukufunda bangacina benxena abanye ukuthi babe yingxenye yokuyeka ukufunda bengakafiki kumatikuletsheni.

Umbiko obhalwe uMnyango Wemfundo eyiSisekelo kuzwelonke (Department of Basic Education (DBE), Republic of South Africa, 2024) uveza izingqinamba abazibone emaphepheni ezivivinyo zokuphela konyaka wezi-2023. Ezinye zezingqinamba abazivezile zimbandakanya ukuphendulwa kabi kakhulu kwemibuzo eyayidinga ukuthi abafundi bakhombise ukukhumbula lokhu abakufundile ngoba amagama amqoka namabinzana babengawafaki ekuchazeni kwabo amakhonsepthi esifundo seSayensi. Imiphumela yabafundi ikhombisa ukuthi ukuhunyushwa kwamagrafu kuseyingqinamba kakhulu kubafundi abaningi. Kuphinde kuvele emibuzweni eminingi ukuthi abafundi banengqinamba yokungaqondi kahle amakhonsepthi esifundo seSayensi njengoba bekulokhu kuvela eminyakeni eyedlule. Ukungaqondisisi kahle ulwazi lwezihloko ezafundwa ebangeni le-10 nasebangeni le-11 kungenye ingqinamba edala ukungaphumeleli kahle kwabafundi ukuphendula ngokugculisayo embuzweni wesi-7 nowesi-8 ephepheni lokuqala.

Lokhu okuvezwa umbiko woMnyango Wezemfundo eyiSisekelo (2024) kungenxa yokungaqondisisi kahle ulimi lokufunda nokufundisa isifundo seSayensi ngoba abafundi abaningi ulimi lokufunda nokufundisa lululimi lwesibili kubona. UKibirige noMogofe (2021) bagcizelela lokhu ngokubalula ukungabi namakhono kwabafundi olimini lokufunda nokufundisa njengokubeka engcupheni ukufunda ngokuqondisisa kwabo isifundo seSayensi. Laba bacwaningi bagcizelela ukuthi ngenxa yobuthaka ekuqondeni ulimi lokufunda nokufundisa, abafundi abaningi banengqinamba yokubamba amakhonsepthi esifundo seSayensi futhi baveze okuqukethwe kuSayensi, ukuyiqondisisa kwabo njengesifundo kanye nolwazi abanalo ngayo. Abafundi bathatha okusha abakufundayo ngaleso sikhathi bese belibala abakufunda ngaphambilini ngoba vele akwakhele kahle ngenxa yokuthi kwethulwa ngolimi lwesibili nolungaqondakali kahle kubona. Ngenxa yalokhu kungaqondisisi ulimi

lokufunda nokufundisa isifundo seSayensi, abafundi bagcina sebefundela ukukwazi ukuphendula izivivinyo kuphela ukuze baphumelele, badlulele eklasini elilandelayo.

Kuzona zonke izifundo ukuxhumana kwenziwa ngolimi oluthize. Kukhona ulimi lwezohwebo, lwemibhalo yobuciko, izibalo, umculo, njalonjalo. Ngenxa yalokho ubumqoka bolimi ekufundeni iSayensi sekugcizelelwe kakhulu ocwaningweni oluningi ngenhloso yokukhombisa ukuthi lwehluke kangakanani ulimi olusetshenziswa kuSayensi kunendlela abafundi abazikhulumela nababhala ngayo empilweni yabo yansuko zonke (Unsal, 2017). Lokhu kwenzelwa ukuthi ezikoleni othisha nabafundi bakwazi ukusebenzisa ulimi lwesifundo seSayensi nolimi lokufunda nokufundisa ukuxhumana. Ukwehluka kolimi lweSayensi nolukhulunywa ngaphandle kwamakilasi eSayensi kwenza ukuthi kube ulimi olusha kubafundi. Lolimi lweSayensi luphinda lube yingqinamba kubafundi bese kudinga ukuthi uthisha alucacise kabanzi ukuze baqonde abakufundayo esifundweni seSayensi.

U-Ünsal (2017) uqhubeka agcizelele ukuthi izihloko zosuku nosuku zibandakanya amagama amasha kubafundi abaningi futhi amanye awo njengo-*energy, power, work*, angamagama asebenza nsuku zonke empilweni kunasesifundweni seSayensi. Ngaphezu kwalokho ukuqonda amakhonsepthe esifundo seSayensi akwanele ekusifundeni. Abafundi kudingeka ukuthi baqonde ubudlelwano phakathi kwamakhonsepthe esifundo seSayensi nokuthi axhumana kanjani. UKilibirige noMogofe (2021) babalula ukuthi eNingizimu-Afrika zimbili izilimi zokufundisa, ulimi lwesiNgisi nolimi lwesiBhunu ukusuka ebangeni lesi-4 kuya ebangeni le-12. Zilinganiselwa emaphesentini angama-80 izikole ezifunda isifundo seSayensi ngolimi lwesiNgisi, nokungelona ulimi lwasekhaya kubafundi. Ngenxa yalokho, ilitherasi yesiNgisi izezingeni eliphansi kakhulu ezikoleni eziningi (Turkan & Schramm-Possinger, 2014). Uma ilitherasi yolimi kubafundi ingathuthukiswa, abaphumeleli kahle ezivivinyweni zabo. Izivivinyo zesifundo seSayensi azihloli ukuqonda kwabafundi iSayensi kuphela kepha nolimi lwesiNgisi imbala (Baker et al., 2014) ngoba abafundi basebenzisa amagama ukuchaza abakufundayo.

UMnyango Wemfundo eyiSisekelo kwiNqubomgomo Yolimi yemfundo (DBE, 1997) ubalula ukuthi isigungu esengamele isikole (*School Governing Body*) (*SGB*) kufanele sibalule ukuthi isikole sizobuthuthukisa kanjani ubuluminingi ngokusebenzisa ulimi olungaphezu kolulodwa ukufunda nokufundisa. Kufanele i-*SGB* iqinisekise ukufaka

izilimi zokwengeza njengezifundo, noma ukubandakanya izinhlelo ezithuthukisa nezinakekela ulimi noma ngezinye izindlela ezigunyazwe yinhloko yoMnyango Wezemfundo esifundazweni. Lokhu kuvumela ukuthi ezindaweni zasemaphandleni ikakhulukazi lapho abafundi abaningi bengasheleli kahle khona olimini lwesiNgisi, isigungu esengamele isikole singavumelana ngolimi lwasekhaya njengolimi lokufunda nokufundisa. Ngokwenza njalo bengacina sebechazela abafundi amakhonsephti eSayensi anqala ngolimi lwasekhaya ukuze bawaqonde kangcono. Lokhu kungathuthukisa ulwazi nokuzethemba kwabo kuso uqobo isifundo seSayensi. Lokhu kungalekelela ukuthi abafundi baphume nemiphumela emihle kumatikuletsheni nezobasiza ukuthatha imikhatha yezifundo zeSayensi emanyuvesi nokuyiyona mikhakha esenamathuba amaningi emisebenzi umhlaba wonke.

UKordíková noBrestenská (2022) ocwaningweni abalwenzela ngobulimimbili eSlovakia baveza ukuthi balinganiselwa kumaphesenti angama-24 othisha abaveza ukuthi abakhululeki kahle uma bekhuluma isiNgisi. Abangamaphesenti angama-46 babika izinkinga ababhekana nazo uma befundisa izifundo ngesiNgisi namatemu alo ulimi lwesiNgisi, abangamaphesenti angama-44 bathi banobunzima ekuxhumaneni ngolimi lwesiNgisi kunqubo yabo yokufundisa ngenkathi beqala ukufundisa ngobulimimbili.

UMthiyane (2016) uveza ukuthi othisha abasaqala ukufundisa abaningi kakhulu abaveza ukuthi banezingqinamba ekufundiseni ngolimi lwesiNgisi uma kuqhathaniswa nothisha esebenamava amaningi. Lokhu kuchaza ukuthi ngeke kube lula futhi kube khona ukuzethemba ekufundiseni ngolimi lwesiNgisi ngenxa yokuthi basuke bengakathuthuki kahle ekulusebenziseni. Othisha baveza ukuthi kungcono ukufundisa ngolimi lwabo lwebele. Othisha abasaqala ukufundisa isifundo seSayensi babika ukuba nengqinamba yokungazethembi kahle olimini lwesiNgisi kanti futhi lokho kwehlisa ukuzethemba ekufundiseni kwabo iSayensi (Nomlomo, 2007; Mthiyane, 2016).

Isifundo seSayensi njengazo zonke izifundo sinamagama asetshenziswayo ahambisana naso nakuba sethulwa ngolimi lwesiNgisi njengolunye lwezilimi zokufunda nokufundisa lapha eNingizimu-Afrika. Ngakho-ke kunamakhonsephti ayo iSayensi imvamisa angawesiNgisi, nanxa ekhona amanye asetholakala nangezilimi zoMdabu zase-Afrika, njengawo lawo asetholakala ngesiZulu. U-Oyoo

(2016) uveza ukuthi umsuka omkhulu wezingqinamba abafundi ababhekana nazo ukungakwazi ukwehlukana phakathi kwamagama ajwayelekile olimini nencazelo yawo entsha neyehlukile uma esesetshenziswa emkhakheni weSayensi. Bayahambisana nalo mbono o-Oyoo noNkopodi (2019) ngokuthi bagcizelele ukuthi abafundi baseNingizimu-Afrika baphinde babe nezingqinamba zezincazelo zamagama asebenza nsuku zonke ezilimini zabo uma sekufanele bawahumushele olimini lwesibili (lwesiNgisi) futhi bawaxhumanise nesifundo seSayensi.

1.3. Okungifake ugqozi lokwenza lolu cwaningo

Ugqozi lokwenza lolu cwaningo lwaqutshulwa yisethulo esethulwa umfundisi wesifundo esibizwa nge-*Language in Education* emfundweni yami yeziqo ze-*Bachelor of Education* (Honours) ngonyaka wezi-2014. Lesi sethulo saqubula ugqozi nentshisekelo kimi ukwenza lolu cwaningo ngenxa yokuthi ngaphambi kwalelo kilasi sasiyalelwe umfundisi wethu ukuthi siyokhetha i-athikili eyodwa, siyifunde bese futhi silungela ukwenza izethulo ngayo. Mina-ke ngakhetha eyabhalwa uFillion esihloko sithi "*Language across the curriculum: Examining the place of language in our schools*". Ngasenza isethulo, kanti kuzoqondana nokuthi umfundisi wethu naye wayehlele ukuzosifundisa ngayo nokwayicacisa bha kimi le athikili, ngaqonda kangcono ngolimi olusabalele nekharihulamu.

Ulimi olusabalele nekharihulamu kwakuyisihloko engangiqala ngqa ukuzwa ngaso empilweni yami. Intshisekelo yaqubuka kimi ngenxa yokuthi ngangibuka ukuthi wayefundisa ngolimi lwesiNgisi, kodwa abuye achaze ngolimi lwesiZulu ukuze thina njengekilasi siqonde. Ngasizwa kahle lesi sifundo, ngigqugquzelwa yindlela ayechaza ngayo amakhonsepthe. Wayesikhombisa ukuthi ulimi lusebenza kanjani ngokusabalele nekharihulamu. Ngalibona iqhaza lobulimbili lingelibalulekile lapho kufundiswa isifundo okungesona esolimi, njengayo iSayensi, okuyisona sifundo esinezinkinga ngenxa yokuthi abafundi abaningi abenzi kahle kuso. Ngabuka ukuthi ulimi luyithuluzi lokufundisa noma yisiphi isifundo, ngakho ayikho indlela uthisha angafundisa ngayo isifundo noma ngabe yisiphi, uma engasebenzisi ulimi.

Ngamava esenginawo ekufundiseni isifundo seSayensi iminyaka eyisikhombisa kumatikuletsheni, eyisithupha ebangeni le-11, emihlanu kwele-10, emithathu ebangeni lesi-8 nelesi-9, kukhona engakuqaphela ekufundiseni lesi sifundo seSayensi. Ukusuka ebangeni leshumi kuya kweleshumi nambili ngaqaphela

ukungaphumeleli kahle kwabafundi kulesi sifundo esikoleni engaqala ukusebenza kuso ngonyaka wezi-2015. Ngonyaka wezi-2016 ngacela ukulekelelwa ozakwethu asebenamava athe thuthu ekufundiseni ukunawami ukuze ngithole ukuthuthuka kangcono njengothisha ekufundiseni lesi sifundo, ngibheke nendlela okufanele ngisebenzise ngayo ulimi ukuze baqonde abafundi. Lokhu ngangikwenzela ukufunda izindlela zokwethula isifundo seSayensi ngenhloso yokuthi abafundi basiqonde kangcono, bangaxakwa ulimi. Nangaphezu kwaleyo mizamo kwaqhubeka ukungaphumeleli kahle kwabafundi.

Ngonyaka wezi-2017 ngathola isibindi nokuzethemba kulokhu engangikufunde enyuvesi, ezingeni leziqu ze-*Honours* ikakhulukazi. Ngaqala ngafundisa hhayi ngokuyalelwa umphathi kuphela kepha ngabakhipha abafundi ekuchazeni izimo ngesiNgisi kuphela kepha ngaqoka ukuchaza nangolimi lwesiZulu. Lokhu ngangikwenza noma ngazi ukuthi lelo gama liyavela esiNgisini kodwa linencazelo engefani neyeSayensi. Wabhala umatikuletsheni kulowo nyaka, yathi ukuthuthuka kancane imiphumela noma kungangigculisanga. Ngonyaka wezi-2018 ngathola isikhala sokusebenza eMsinga. Ngazimisela ukusebenza ngokuzikhandla, ngizame izindlela ezahlukene zokufundisa, engangizibona ziwusizo ekutheni ngithuthukise abafundi esifundweni seSayensi. Ngabhekisisa kabanzi ukusebenzisa ulimi lwesiNgisi, kodwa ngibachazele abafundi nangolimi abalujwayele, okuyisiZulu, ukuze baqonde kahle amakhonsephtsi, nokusebenza kwawo lapho esetshenziswa ezimweni ezahlukene.

Ngaqinisa kowezi-2019 unyaka ukusebenzisa lezi zilimi zombili, isiNgisi nesiZulu, ukuze abafundi baqonde abakufundayo. Ngonyaka wezi-2020 ngenza isiqiniseko sokuthi lapho ngifundisa, ngizame ukusebenzisa ulimi ngendlela ezobalekelela abafundi ekutheni baqonde lesi sifundo, futhi bathuthuke nasekuqondeni amakhonsephtsi esifundo seSayensi. Ngaqaphela ukuthi izibonelo ezisetshenziswa othisha kwakuba yilezi ezisezincwadini zabafundi. Lezi zibonelo ziqhelelene kakhulu nempilo yabafundi ngoba zikhuluma ngokuvamile ngempilo yasemadolobheni nokuyimpilo abafundi basemaphandleni abangayiqondi kahle. Lokhu kwenza bengaziqondisisi izibonelo, ngenxa yalokho amatemu okukhulunywa ngawo bagcina bengawaqondi kahle bese kuba nomthelela wokuthi kwaSayensi qobo lwayo bengayiqondi kahle futhi bengayithakaseli kahle.

Okukhuphule ugqozi lokwenza lolu cwaningo ukuthi zombili izikole esengike ngafundisa kuzo ngafika zinenkinga efanayo yokungaphumeleli kahle kwabafundi isifundo seSayensi, kwathi uma ngilandela ulimi olusabalele nekharikhulamu ngokusebenzisa ubulimimbili ekufundiseni lesi sifundo, kwanyuka ukuqonda kwabafundi kanjalo nemiphumela.

1.4. Indawo yocwaningo

Lolu cwaningo ngilwenze ezikoleni ezimbili zaseMsinga, ngaphansi kobukhosi baseMabomvini nobaseMachunwini okuyizindawo ezingaphansi komasipala wesifunda soMzinyathi KwaZulu-Natali eNingizimu-Afrika. Njengezikole ezisendaweni esemakhaya, umphakathi ozakhele ukhuluma ulimi lwesiZulu njengolimi lwasekhaya bese olwesibili kuba isiNgisi. Nakuba isiNgisi silulimi lwesibili kepha yilona lulimi lokufunda nokufundisa kuzona zonke lezi zikole. Ezindaweni zasemakhaya njengalezi ezakhele indawo yaseMsinga, izikole zakhona ezikahulumeni eziningi kakhulu. Lokhu kusho ukuthi njengoba kusesifundazweni iKwaZulu-Natali nje abafundi bakhuluma ulimi lwesiZulu. Kuba nzima kubafundi ukuqonda amakhonsephtsi eSayensi ngoba kufanele baqale baqonde ulimi lwesiNgisi kuqala ngaphambi kokuqonda isifundo seSayensi namakhonsephtsi aqondene nalesi sifundo.

1.5.Lapho lolu cwaningo lugxile khona

Lolu cwaningo lugxile ekufundisweni kwesifundo seSayensi ebangeni leshumi neleshumi nanye. Luzogxila ekucwaningeni ukuthi isifundo seSayensi sifundiswa kanjani ngolimi lwesibili, okululimi lwesiNgisi. Isifundo seSayensi sethulwa ngolimi lwesiNgisi kepha kuyavela ezikoleni eziningi ukuthi lolu limi lwesiNgisi lunomthelela ongemuhle emiphumeleni yabafundi nasekuqondeni kwabo isifundo seSayensi. UPetrus (2018) ocwaningweni ayelwenza mayelana nokufundiswa kweSayensi uthi othisha abangamaphesenti angama-57 (57%) bathatha isiNgisi njengolimi lokufundisa njenganolunomthelela omkhulu ekungaphumelelini kahle kwabafundi. IsiNgisi silulimi okuyilona oluqhwakele phezulu kwezemfundo eNingizimu-Afrika kuwo wonke amazanga. U-Elbeshti nabanye (2022) baveza ukuthi izinsizakufundisa zesifundo seSayensi kufanele zithuthukiswe kuwo wonke amazanga emfundo ukuze kubhekwane nezidingo zezilimi zomDabu zabafundi baseNingizimu-Afrika.

Ucwaningo luveze imiphumela emihle ngokusebenzisa izinsizakufundisa zolimi ezikhona emaklasini kanye nokuhlanganisa izilimi zase-Afrika kulokhu njengoba ulimi lunomthelela ekuzuzweni kwemfundo yeSayensi (Msimanga et al., 2017; Prinsloo, Rogers & Harvey, 2018). UBaloyi nabanye (2023) ocwaningweni olwalucwaninga ngezinsalelo ezibhekene nothisha beSayensi ezikoleni ezisemakhaya ekuthuthukiseni imiphumela yabafundi, uveza ukuthi izikole eziningi ezisezindaweni zasemakhaya zidinga izinsizakufundisa ezingeziwe zokuthuthukisa ukufundiswa kwesifundo seSayensi. Ukushoda kwezinsizakufundisa ezikoleni kuphazamisa indlela isifundo seSayensi esifundiswa ngayo.

1.6. Izinhlosongqangi zalolu cwaningo

Izinhlosongqangi zalolu cwaningo yilezi ezilandelayo:

- i. Ukuphenya ukuthi othisha bakuqonda kanjani ukusetshenziswa kobulimimbili ekufundiseni isifundo seSayensi ebangeni le-10 nele-11
- ii. Ukuhlola ukuthi othisha bebanga le-10 nele-11 babusebenzisa kanjani ubulimimbili ekufundiseni isifundo seSayensi
- iii. Ukuthola ukuthi kungani othisha bebanga le-10 nele-11 besebenzisa ulimi ngendlela abakwenza ngayo ekufundiseni isifundo seSayensi

1.7. Imibuzongqangi yocwaningo

Lolu cwaningo luphendula imibuzo emithathu elandelayo:

- (i) Othisha abafundisa isifundo seSayensi bakuqonda kanjani ukusebenzisa ubulimimbili ekufundiseni isifundo seSayensi kubafundi bebanga le-10 nele-11?
- (ii) Othisha bebanga le-10 nele-11 babusebenzisa kanjani ubulimimbili ekufundiseni isifundo seSayensi?
- (iii) Kungani othisha besifundo seSayensi besebenzisa ulimi ngendlela abenza ngayo lapho bethula izifundo zeSayensi emaklasini ebanga le-10 nele-11?

1.8. Ubumqoka bocwaningo

Lolu cwaningo njengoba luhlose ukuphenya ngokusetshenziswa kobulimimbili ekufundiseni isifundo seSayensi ebangeni le-10 nele-11, luzosiza othisha besifundo seSayensi kula mabanga ukuba bahlomule ngamasu okusebenzisa ubulimimbili lapho befundisa. Luzophinda lwenze nokuthi babuqonde kangcono ubulimimbili ekufundiseni iSayensi. Lokhu kuyosiza ekutheni bakwazi ukulekelela izingane abazifundisayo ukuba ziqonde kangcono isifundo seSayensi. Ucwaningo luzovundulula okuyizingqinamba bese lwenza izincomo neziphakamiso ezingalekelela ukuthuthukisa ukufunda nokufundisa lesi sifundo seSayensi.

1.9. Izingqinamba zocwaningo

Ngenxa yokuthi lolu cwaningo ngangizolwenza ezikoleni kwakungenzeka ngingalitholi kahle ithuba elanele lokukhiqiza imininingo yocwaningo ngenxa yokuthi othisha kwakungenzeka ukuthi bangabi naso isikhathi ngoba bephuthuma ukuqeda i-*Annual Teaching Plan (ATP)*. Ngangihlele ukucela ukubabona ngezimpelasonto ikakhulukazi ngoba imvama bayafundisa ngemiGqibelo uma kwakuyoba kuwukuthi abanaso isikhathi esanele sokuba nami ezikoleni ngesikhathi sokufundisa. Abanye othisha kwakungenzeka bangathandi ukuba yingxenye yocwaningo noma bangatholakali ngesikhathi sebedingeka ukuze kukhiqizwe ulwazi bese beyashoda-ke ababambiqhaza ngaleyo ndlela. Ukulwisana naleso simo, ngangihlele ukuthi ngicele bona ukuthi bazikhethela ukuthi kukuphi lapho esasingahlanganela khona, futhi ngasiphi isikhathi, okuyobe kuvumelana nezinhlelo zabo.

1.10. Ukuhleleka kwezahluko

Isahluko sokuqala sethula isingeniso nesendlalelo kocwaningo. Sicacise ukuthi lumayelana nani saphinde sahlahla indlela ezohanjwa ucwaningo ukuphendula imibuzo yocwaningo, sasebenza njengenkombandlela eveza kusuka ekuqaleni kuya esiphethweni socwaningo. Lapha-ke ngikwethulile okwaba yisisusa nokwaqubula ugqozi lokuthi ngenze lolu cwaningo ngaphinde ngaveza izinhloso nemibuzo yocwaningo.

Isahluko sesibili sethula ukubuyekezwa kwemibhalo yocwaningo oselwenziwe eNingizimu Afrika kanye nasemazweni ahlukehlukene. Lesi sahluko sizowethula nohlaka lwenjulalwazi okungeye-*Social constructivism* kanye nohlaka lwemicabango.

Isahluko sesithathu sethula umklamo nezindlela zocwaningo. Lesi sahluko sivezile ukuthi luyikhwalthethivu futhi lusebenza lulandela indlelakubuka yomhumusho, luwucwaningo lwesimo, lusebenzisa izingxoxo ezisakuhleleka, ukubukela okwenziwa othisha, lubuye luhlaziye namadokhumenti.

Isahluko sesine sidingida ukwethulwa nokuhunyushwa kwemininingo yocwaningo, ekuphenduleni umbuzongqangi wokuqala wocwaningo.

Isahluko sesihlanu sidingida ukwethulwa nokuhunyushwa kwemininingo yocwaningo, ekuphenduleni umbuzongqangi wesibili wocwaningo.

Isahluko sesithupha sethula ukuhlaziywa kwemininingo yocwaningo, ekuphenduleni umbuzongqangi wesithathu wocwaningo. Kulesi sahluko kuphinde kwethulwa isiphetho nezincomo.

1.11. Iqoqa lesahluko

Lesi sahluko sethule isendlalelo socwaningo, isisusa socwaningo, izinhlosongqangi zalolu cwaningo, lapho lolu cwaningo lugxile khona, imibuzongqangi yocwaningo, ubumqoka bocwaningo, izingqinamba zocwaningo, nokuma kwezahluko Isahluko esilandelayo sizokwethula ukubuyezwa kwemibhalo.

ISAHLUKO SESIBILI

Ukubuyezwa Kwemibhalo

2.1. Isingeniso

Esahlukweni esedlule kwethulwe isingeniso nesendlalelo socwaningo. Kuvezwe okwangigqugquzela ukwenza lolu cwaningo, nenkombandlela elandelwe yilolu cwaningo. Ngixoxe ngezingqinamba zalolu cwaningo ngaxoxa nangemingcele yalo. Ngivezile izinhlosongqangi nemibuzongqangi yocwaningo, lapho lolu cwaningo lugxile khona, ubumqoka bocwaningo, ukuma kwezahluco ngase ngiphetha ngokwethula iqoqa lesahluko. Lesi sahluko sethula ukubuyezwa kwemibhalo yocwaningo olwenziwe phambilini ngokusetshenziswa kobulimimbili ukufundisa isifundo seSayensi emabangeni aphezulu ezikoleni. Lokhu ngizokwenza ngaphansi kwalezi zihlokwana: ucwaningo oselwenziwe ngokufundwa kweSayensi kusetshenziswa ubulimimbili, imfundo engobulimimbili, ukwethula isifundo seSayensi ngolimi lwesibili, iqhaza lolimi emfundweni, ubunzima bamagama asebenza nsuku zonke olimini jikelele nasesifundweni seSayensi. Lesi sahluko sizophinde sethule uhlaka lwenjulalwazi nohlaka lwemicabango.

2.2. Ucwaningo oseluke lwenziwa ngokufundwa kweSayensi kusetshenziswa

ubulimimbili

Ocwaningweni olwehlukene sekubhalwe kaningi ngokufundisa isifundo seSayensi ngezilimi ezimbili. Ezikoleni zaseNingizimu-Afrika emabangeni aphezulu, ikakhulukazi esifundazweni iKwaZulu-Natali, lesi sifundo sifundiswa ngolimi lwesiNgesi, kodwa kuyenzeka uthisha asebenzise nolimi lwabafundi, okuyisiZulu ngokwalolu cwaningo ukucacisela abafundi, njengoba iningi labo likhuluma isiZulu. Othisha baye basebenzise ulimi lwesiZulu ngenhloso yokuqinisekisa ukuthi abafundi bayasiqonda lesi sifundo njengoba sethulwa ngolimi lokuQala lokwEngeza. UNTshangase benoBosch (2020) bagcizelela ukuthi ulimi lwesiZulu esifundazweni iKwaZulu-Natali luwulimi olukhulunywa abantu abaningi kodwa nakuba kunjalo alusetshenziswa ngokusemthethweni njengolimi lokufunda nokufundisa ezikoleni. Ocwaningweni oselwenziwe ngokungaphumeleli kahle kwabafundi isifundo seSayensi kugqama ulimi lokufunda nokufundisa njengokuyiyona mbangela enkulu

yokungaphumeleli kahle kwabo. Abacwaningi abafana noNcube (2014), Oyoo (2016), Zulu (2018), Fung (2020), Oyoo & Nkompodu (2019), Mncube, Mkhasibe no-Ajani (2021), Semeon noMutekwe (2021) bagcizelela ukuthi ukungaphumeleli kahle kwabafundi isifundo seSayensi kunomthelela wokuthi kushode isibalo sabafundi abathatha imikhakha yobunjiniyela neminye yeSayensi emanyuvesi. Lokhu kungenxa yobunzima bamakhonsephe eSayensi ikakhulukazi kubafundi basemakhaya, ngenxa yokuthi bafundiswa ngolimi lwesiNgisi okululimi lokuqala lokwengeza kubona abafundi.

Luningi ucwaningo oselwenziwe eNingizimu-Afrika, ezwenikazi i-Afrika kanye nasemazweni aphesheya kwezilwandle mayelana nokufunda nokufundisa isifundo seSayensi kusetshenziswa ubulimibili. UNtshangase benoBosch (2020) ocwaningweni olwaluphenya ngokuthuthukisa amava okufunda kwabafundi abakhuluma ulimi lwesiZulu KwaZulu-Natali baphakamisa ukuthi inzuzo yomqondo yileyo elethwa yimfundo engezilimi ezimbili ukuze abafundi bakwazi ukucabanga ngokuhlolisisa futhi baveze imicabango yabo ngokukhululeka. Lokhu kubavumela ukuthi babambisise isifundo ngomdlandla lapho kufundwa emaklasini noma sekubhalwa izivivinyo. Ngenxa yokubambisisa emaklasini nomdlandla lapho sekubhalwa izivivinyo iyathuthuka imiphumela yabafundi.

Imiphumela yocwaningo luka Chiramba (2020) lapho ayecwaninga khona ngokuthuthukiswa kokufundwa kweSayensi emaklasini anezilimi eziningi kusetshenziswa izilimi ezimbili okululimi lwesiNgisi nolwesiShona eZimbabwe, ikhombisa ukubandakanywa kwezilimi zama-Afrika ekufundeni futhi iyakwesekela lokhu. Ikwesekela ngokuveza ukuthi ukusebenzisa izilimi zase-Afrika emaklasini eSayensi kukhuthaza ukuxhumana kwezilimi ezahlukene ngokusebenzisa kanyekanye ulimi olungaphezu kolulodwa eklasini elilodwa. Lokhu kwenzeka ngokuthi abafundi baxoxe ngesifundo seSayensi ngolimi lwesiShona bese benza izethulo zabo eklasini ngolimi lwesiNgisi. Abanye abacwaningi bathi ukungaqondisisi kwabafundi ulimi lokufundisa kunomthelela omkhulu ezingqinambeni abafundi abahlangabezana nazo ekufundeni isifundo seSayensi eNingizimu-Afrika (Mji & Makgato, 2007).

U-Oyoo (2015) uveza ukuthi ukuze kulwisanwe nobunzima bolimi lwesifundo seSayensi, kungabalekelela abafundi ukuthi basithande isifundo seSayensi uma

othisha bangasebenzisa izibonelo nemibuzo okuthinta izimpilo noseke kwenzeka ezimpilweni zabo kumbe bakubona abafundi. Lokhu othisha bangakwenza ngokuthi uma isibonelo noma umbuzo kumayelana nedolobha, uthisha awakhe kabusha umbuzo noma isibonelo esebenzisa idolobha abafundi abalaziyo noma isehlo abasaziyo. Amathaski nezivivinyo, kufanele kubhalwe ngolimi lwesiNgisi nolwesiZulu ukuze abafundi KwaZulu-Natali banikwe ithuba lokubhala ngolimi abazikhethela lona (Ntshangase & Bosch, 2020). Lokhu kuhunyushelwa kwezinye izilimi kwamaphepha ezivivinyo namathaski kungenzeka nakwezinye izilimi zomdabu ukuze abafundi babe nelungelo lokuzikhethela ulimi abazohlolwa ngalo.

Ocwaningweni olwenziwa e-*Applied University* ngokucwaninga ngokusetshenziswa kobulimimbili ekufundiseni ngolimi lwesiNgisi nolwesiShayina kuvela ukuthi inhloso yobulimimbili esifundweni esethulwayo ukuvukuzisa amakhono obulimimbili kubafundi (Mu, Liu & Luo, 2019). Ngakho-ke othisha kufanele bakwazi ukuzibandakanya nolwazi olusha futhi bazame ukwethula izindlela ezintsha zokufunda nokufundisa emaklasini. Laba bacwaningi okungoMu, Liu kanye noLuo (2019) baqhubeka baveze ukuthi othisha kufanele futhi babe nokuqonda ulimi lwesiNgisi ngokusezingeni eliphezulu bese futhi beluphimisa ngokwezinga elilingana nokuqonda nezinga abakulo abafundi.

Kubalulekile ukuthi othisha bazithuthukise bona qobo ekucabangeni kwabo ngolimi lwesiNgisi ngokuthi basebenzise izinto eziningi ezifana nokuhlanganyela ekuqeqeshweni emfundweni ebulimimbili, ukufunda ama-*course* esiNgisi emanyuvesi asemazweni angaphandle njalonzalo (Mu, Liu & Luo, 2019). Konke lokhu kungathuthukisa kakhulu izinga lokuqonda kothisha kepha uKordíková benoBrestenská (2022) ocwaningweni lwabo ngemfundo yeSayensi ebulimimbili lapho babecwaninga khona ukuqonda kothisha beSlovak baphakamisa ukuthi bayashoda kakhulu othisha abaqeqeshelwe ukufundisa iSayensi ngezilimi ezimbili. Lokhu kuphinda kwelekwe ukwentuleka kokuqeqeshwa kothisha okuqhubekayo. Ngakho-ke kubalulekile ukusungula uhlelo lwemfundo yabafundi beziqo zokuqala kanye neziphezulu oluzocija amakhono obuchwepheshe bolimi kothisha besifundo seSayensi emaklasini asebenzisa ubulimimbili.

U-Ünsal nabanye (2016) ocwaningweni abalwenza ezweni laseSweden mayelana nokufundiswa kweSayensi emaklasini anezilimi ezimbili baveza ukuthi nakuba

uthisha owayengumbambiqhaza wayengakwazi ukuhumushela abafundi amagama esifundo seSayensi olimini lwesiSwedishi, olukhulunywa yidlanzana labafundi kodwa wayebalekelela ngokusebenzisa ezinye izindlela ezifana nokudweba isithombe ebhodini ukuze abacacisele ngekhonsephti alifundisayo. Lolu cwaningo lwathola ukuthi kunezinye izinsizakufundisa ngale kolimi olubhalwayo nolukhulunywayo emaklasini angazisebenzisa uthisha lapho yena nomfundi bengakhulumi ulimi olulodwa. Laba bacwaningi baqhubeka baveze ukuthi othisha besifundo seSayensi kufanele bacabange ukuthi bangabanika kanjani abafundi ababulimimbili amathuba okuqondisisa ukufundwa nokufundiswa kwesifundo seSayensi uma sethulwa emaklasini.

2.3. Imfundo engobulimimbili

Ngokwe-*Cambridge dictionary* imfundo ebulimimbili yimfundo eyethulwa kusetshenziswa izilimi ezimbili kubafundi abakhula bekhuluma ulimi okungelona olokufundisa esikoleni. Leli temu “imfundo ebulimimbili” lichaza ukusetshenziwa kwezilimi ezimbili okuhlelwe ngobunyoinco emkhakheni wokufunda komfundi esikoleni (Nord Anglia School Jakarta 2018). Lokhu kuhlelwa kwezilimi ezizosetshenziswa kuncika olimini lokufunda nokufundisa (okuvame ukuthi kube olwesiNgisi) kanye nolimi lwasekhaya lomfundi.

UMthombeni no-Ogunnubi (2021) ocvaningweni lapho ababehlaziya khona inqubomgomo yobulimimbili emfundweni yaseNingizimu-Afrika baveza ukuthi ulimi lokufunda nokufundisa luyithuluzi elibaluleke kakhulu ekunciphiseni imingcele yokufunda endaweni yokufunda nasekusabalaliseni imfundo ifinyelele kubantu abaningi. UNtshangase benoBosch (2020) bathi uhulumeni kufanele aphasise inqubomgomo yolimi evumela ukuthi izikole zaKwaZulu-Natali kube wumgomo ukusebenzisa ulimi lwesiZulu nolwesiNgisi kanyekanye njengezilimi zokufunda nokufundisa, ukufunda nokubhala kulokhu-ke okubizwa ngemfundo elimimbili.

UMoore, Evnitskaya kanye noRamos-de Robles (2017) baveza ukuthi ukufundisa ngokusebenzisa izilimi ezimbili kuyindlela yokufundisa okufanele isetshenziswe othisha bezikole ukunciphisa izinkinga zemfundo kubafundi abakhuluma ulimi okungelona olokufundisa nokufunda. Bonke othisha abafundisa ezikoleni ezinobulimimbili kufanele bagqoguzelwe ukwenza izinsizakufundisa ezimqoka, ezinothe ngolwazi futhi ezihlinzeka ubulimimbili ukuze abafundi baqondisise

okufundwayo. Laba bacwaningi baveza ukuthi ukufundisa ngobulimimbili akugcini ngokwelekelela abafundi ukuqonda nokusebenzisa izilimi kepha kuphinda kukhuphule ukuqonda kwabo ngokusebenza kwalezo zilimi zombili. Laba bacwaningi bagcizelela ukuthi inhloso yabo ukuthi abafundi bakwazi ukuxhumana futhi baqonde kahle lezo zilimi ezisetshenziswayo lapho imfundo yethulwa ngolimi lwesibili.

Ngale kwezingqinamba ezimbandakanya ukwentuleka kwezinsizakufundisa nokuthuthukiswa kwamatemu ezifundo abe solimini lwesiZulu, kunobufakazi obukhona olwazini oluqokelelwe ocwaningweni oluveza ungabazane lothisha ekufundiseni ngokusebenzisa ulimi lwesiNgisi nolwesiZulu kanyekanye. Lolu ngabazane lubangelwa yizikole nabazali abalindele ukuthi izingane zabo zifundiswe ngesiNgisi kuphela. Le ngcindezi isukela ezinkolelweni ezifana nale yokuthi ulimi lwesiNgisi yilona limi kuphela olungolwempumelelo ngoba luhlotsaniswa namathuba omsebenzi. UMthombeni (2021) uthi abafundi kufanele bagqugquzelwe ukuthatha imikhakha engolimi lwesiZulu esibala kuyo ubuntatheli, ukuhumusha, ucwaningo, ubuciko, ezobumnandi, ukubhalela imisakazo nomabonakude.

2.4. Ukwethula isifundo seSayensi ngolimi lwesibili

Abafundi abaningi emazweni asezansi ne-Afrika bathola imfundo yabo ngolimi lwesibili okuyisiNgisi ngokuvamile. Nakuba lilikhulu iqhaza elibanjwa othisha besiNgisi ukwelekelela abafundi ukuthola amakhono olimi (ukubhala, ukukhuluma, ukufunda nokulalela) lokufunda nokufundisa kodwa othisha bezifundo okungezona ezolimi banezingqinamba ngokusebenzisa ngokudidiyela amakhono omane olimi nokuyikhona okunomethela ongemuhle ekuphumeleleni kwabafundi (Morton, 2012). UQuansah, Sakyi-Hagan kanye no-Essiam (2019) bagcizelela ukuthi uma abafundi bengakwazi ukwethula baphinde babelane ngemibono emakilasini eSayensi, lokho kwenza ukuthi ukufunda nokufundisa iSayensi edidiyelwe kube nzima futhi kungahelisi kubafundi abaningi.

Njengoba ulimi lokuqala lokwengeza luvunyelwe ukusetshenziswa njengolimi lokufunda nokufundisa, kufanele kufinyelelise abafundi ekuqondiseni kahle ulimi lwesiNgisi ukuze bafike ezingeni elikhombisa ukuthuthuka ekufundeni okusabalele nekharihulamu (Morton, 2012). UHorne noHough (2005) baveza ukuthi ucwaningo olwenziwa kubafundi ababenza ibanga le-11 ngonyaka we-1998 bangamaphesenti angama-20 kuphela abafundi abatholakala bekwazi ukufunda nokubhala isiNgisi

esisezingeni elamukelekile, bangamaphesenti ayi-12 kuphela abafaka izicelo zemifundaze eyayizobalekelela ukufunda ezikhungweni zemfundo ephakeme ngonyaka wezi-2005 abakwazi ukuveza ikhono lokubhala ulimi lwesiNgisi ngendlela efanele. Konke lokhu kuveza ukuthi ukufunda ngolimi lwesibili njengokunomthelela ongemuhle kubafundi abaningi ngoba kufanele baqonde lona kuqala ngaphambi kokuqonda isifundo okungesona esolimi njengaso lesi seSayensi.

2.5. Iqhaza Lolimi Emfundweni

UGreenberg (2022) uchaza ulimi ngokuthi luyithuluzi lokucabanga ukuze kutholakale amakhono adingekayo olimini nokuyiwona anika abafundi ithuba lokuthola ulwazi lwesifundo. Lokhu kusho ukuthi ukufunda isifundo seSayensi angeke kwehlukaniswe namakhono olimi. UMnyango Wezemfundo eyiSisekelo (2011) uveza ukuthi ulimi luchazwa njengethuluzi lokucabanga nokuxhumana. Luphinde lube yindlela esetshenziswa abantu ngokwehlukahlukana kwabo ukuqonda umhlaba abaphila kuwo. Ukufunda ukusebenzisa kahle ulimi kwenza ukuthi abafundi bathole ulwazi, baziveze futhi bazichaze ububona, bachaze imizwa nemicabango yabo, ukuxhumana nabanye nokwenza ngokuqonda kahle izinto ezahlukene. Lo Mnyango uqhubeka uthi ulimi luphinde lunike abafundi izithombe nemibono eyahlukene, enothile nenamandla engasetshenziswa ukuzithuthukisa ngokwezinga le mfundo abakulo. Ukwehlukana ngokwezilimi kuvezwa futhi kwakhiwe ngolimi futhi kungalungiswa ngalo. Umphumela walokhu okungenhla ukuthi ukuthola amakhono olimi kunikeza abafundi ithuba lokufunda ukukwazi ukufunda izifundo ezahlukene.

2.6. Ubunzima bamagama asebenza nsuku zonke olimini nasesifundweni seSayensi

Abacwaningi bagcizelela ukuthi abafundi bayehluleka ukuqonda amakhonsepothi eSayensi amqoka uma ezochazwa ngolunye ulimi noma ngolimi abangakaluqondi kahle (Ncube, 2014). ENingizimu-Afrika kuvame ukuba nomthelela kakhulu kubafundi basezindaweni zasemakhaya lokhu ngoba iningi labo aliluqondisisi kahle ulimi lwesiNgisi nokuyilona ulimi lokufunda nokufundisa. Lo mcwaningi uqhubeka aveze ukuthi abafundi kufanele baqondisise kuqala ulimi lokufunda nokufundisa ukuze bafike esigabeni sokuqonda kahle amakhonsepothi eSayensi.

Ucwaningo oluningi oseluke lwenziwa ngaphambilini luthole ukuthi kuzo zonke izingxenye ezahlukene zamagama olimi lokufundisa isifundo seSayensi alukhuni ngokuvamile kubo bonke abafundi (Smith-Walters, et al., 2016; Oyoo & Nkompodu, 2019; Singh & Geeta, 2021). Lobu bunzima bala magama eSayensi akuyi ngabulili, ulimi lwasekhaya namasiko omfundi kepha kwenzeka kubo bonke ngokwehlukahlukana kwabo (Oyoo, 2016).

2.7. Uhlaka lwenjulalwazi kanye nohlaka lwemicabango

Kule ngxenye yesahluko lolu cwaningo luzokwethula uhlaka lwenjulalwazi kanye nohlaka lwemicabango. Lokhu kuzokwenza ngokuqala ngokucacisa ukuthi iyini injulalwazi, uhlaka lwenjulalwazi, injulalwazi ye-*social constructivism* bese iveza isizathu sokwethula nohlaka lwemicabango. Uhlaka lwemicabango ngizolwethula njengesihlokwana sokugcina lapho ngizokwethula khona amakhonsepthe alolu cwaningo anqala. La makhonsepthe anqala kulolu cwaningo ngizobe sengiwachaza ngalinye.

2.7.1. Injulalwazi

Ngokuchaza kwabacwaningi abahlukahlukene kuvela izincazelo zenjulalwazi eziningi kodwa ezihlobene kakhulu. Abacwaningi abangoCohen, Manion noMorrison (2018) noKivunja (2018) bachaza injulalwazi njengesitatimende, imibono eyinhlanguyisela yamakhonsepthe ahlobene naxhumanayo. La makhonsepthe aqukethe indlela enobuchule yokubuka ukwenzeka kwezinto ngokugqamisa ukuxhumana kokucwaningwayo ngenhloso yokuchaza nokuhlawumbisela okwenzekayo. UMurphy (2001) uchaza injulalwazi njengohlelomgomo olusamaqiniso noma izimiso ezasungulwa, zaqanjwa ngenhloso yokuchaza iqoqo noma isenzeko. Leso senzeko sisuke sesike sahlolwa ngokuphindelela abantu abathile noma esesamukelwe kakhulu emhlabeni wonke. UCohen, uManion noMorrison (2018) baveza ukuthi indlela esichaza ngayo injulalwazi icaciswa kahle yilokho esifuna kwenziwe yiyo. Injulalwazi ingachazwa ngemisebenzi yayo okungaba ukuchaza, ukucacisa, ukuqonda kabanzi nangokujulile, ukuhlaziya, ukuhlawumbisela, ukulinganisa, ukuletha izimpendulo nokunye.

2.7.2. Uhlaka lwenjulalwazi

Uhlaka lwenjulalwazi luhlangukisa lokho okushiwo yizingcithabuchopho emkhakheni wocwaningo ngombuzongqangi wocwaningo, ngenkinga umcwaningi ahlele ukuyicwaninga. Lokhu futhi kungambandakanya neziphakamiso zokusombulula leyo nkinga nendlela yokuhumusha imininingo yocwaningo (Cohen, Manion & Morrison, 2018; Kivunja, 2018). UKivunja (2018) uthi injulalwazi yisibuko sekhethelo umcwaningi azosisebenzisa ukucubungula nokuhlolisisa imininingo ekhiqiziwe, nokuhumusha okutholakele ocwaningweni. Injulalwazi iphinde ilekelele umcwaningi ukuba akwazi ukukhuluma kabanzi ngemininingo kanye nokwenza izincomo nemiphumela yocwaningo. UKivunja (2018) uqhubeka aveze ukuthi uhlaka lwenjulalwazi lungabhekwa njengesibuko sokubukisisa bese silekelela ukuhlaziya imininingo yocwaningo sisebenzisa ulwazi oselwenziwa abacwaningi ngaphambilini emkhakheni umcwaningi akuwo ukuze ayiqonde kahle imininingo yocwaningo lwakhe.

2.7.3. Injulalwazi ye-social constructivism

Injulalwazi ye-*social constructivism* yathuthukiswa isazi sokusebenza kwengqondo sase-Soviet uLev Vygotsky. U-Alkhudiry (2022) uthi i-*social constructivism* inezinkolelo zokuthi ukufunda kwenzeka ngokusebenzisana nomphakathi kanye nosizo lwabanye. I-*social constructivism* njengenjulalwazi yezemfundo igcizelela ukuthi othisha kufanele baqale bacabangele ulwazi lwabafundi babo futhi babavumele ukuthi basebenzise lolo lwazi (Heydari et al., 2021). Ngamanye amazwi, uHeydari nabanye (2021) bahambisana nombono we-*socio-constructivism* njengenywe yezinjulalwazi ezihamba phambili kwezemfundo. Laba bacwaningi baveza ukuthi njengoba i-*socio-constructivism* ingenayo incazelo eyodwa, abanye bayibheka njengenjulalwazi yokufunda, abanye njengenjulalwazi yolwazi; nakuba ezinye izifundiswa kanye nezazi zezemfundo ziyithatha njengenjulalwazi yokufunda nokufundisa.

UVan der Veer (2019) uveza ukuthi ithiyori ka Vygotsky (1978) yethula ikhonsepthe ye-*Zone of Proximal development (ZPD)* esaqhubeka ukulolonga nokuqondisa izinjulalwazi zemfundo nokufundisa emhlabeni wonkana. I-*ZPD* yaziwa njengegebe elikhona phakathi kwalokhu umfundi akwazi ukuzenzela khona ngokuzimela nalokhu akwazi ukuphumelela kukho kuphela ngokulekelelwa nokwesekwa umuntu onolwazi

okungaba umuntu omdala noma onamakhono athe thuthu nokungaba uthisha esikoleni noma omunye umfundi. Isibonelo, kungaba ukuthi esifundweni seSayensi ebangeni le-11 engaba nolwazi lokusebenzisa ama-*equations of motion* afana nale ethi $\Delta x = V_i \Delta t + \frac{1}{2} a \Delta t^2$, $V_f = V_i + a \Delta t$ namanye afuze wona awafunda ebangeni le-10.

Lokhu kuchaza ukuthi umfundi usengakwazi ukuzenzela ngokwakhe ukuphendula imibuzo, abale esebenzisa la mafomula ngoba angaphansi kwe-*Zone of Proximal Development (ZPD)* yakhe njengoba engasakhunjuzwa wona, esezikhumbulela ngoba usake wawafunda futhi wawasebenzisa ngaphambilini. Kodwa-ke uma esezozibonela yena ukuthi angawafaka kanjani uma kukhulunywa nge-*Newton's Second Law of motion* eyaziwa nge-formula $F_{net} = ma$, nakhona okusuke kufanele kwesinye isikhathi asebenzise la mafomula $\Delta x = V_i \Delta t + \frac{1}{2} a \Delta t^2$, $V_f = V_i + a \Delta t$ nosekungaphezu kwe-*ZPD* yakhe, usuke esedinga ukwelekelelwa uthisha noma umfundi ophiwe ukuqonda kangcono kunaye. Uma uthisha wesifundo seSayensi elekelela umfundi ukuqonda ukwenza lo msebenzi wakhe usuke enza i-*scaffolding* ngokumsusa ekungaqondini ukubala ngokubandakanya la mafomula emyisa ekuqondeni kokukwazi ukubala ngokudidiyela amafomula awafunda ebangeni eledlule.

UTzuriel no-Tzuriel (2021) baveza ukuthi i-*sociocultural theory* ka Vygotsky (1978) igcizelela ukuthi isimo senhlalo namasiko kunomthelela ekuthuthukisweni kwengqondo futhi ukufunda nokuthuthuka kwenzeka ngokusebenzisana komphakathi nemisebenzi yokuhlanganyela. I-*social constructivism* yethula umqondo wokwenza i-*scaffolding*, obandakanya ukuhlinzeka ngosizo lwesikhashana kubafundi ngaphakathi kwe-*ZPD* yabo ukuze kube lula ukutholwa kwamakhono nokuthuthukiswa kwengqondo.

USoozandehfar no-Souzandehfar (2022) uqakula ukuthi kuwo wonke umsebenzi wakhe uVygotsky (1978) ugcizelela ukuthi izingane zisebenzisa inkulumo ukuze ziziveze ukuthi zazi kangakanani ngamagama athile, kodwa esikhathini esithile amagama awahlali enezincazelo ezifanayo ezinganeni nakubantu abadala. Incazelo yamagama iyashintsha ngokuhamba kwesikhathi. Nakuba izingane kanye nabantu abadala bengase bakhethe into efanayo futhi, bakwazi ukuxhumana ngokukhululekile, izincazelo abazinamathisela ezintweni zingase zihluke kakhulu. Isibonelo esisobala ukuthi, enganeni encane igama elithi *to rest* lichaza ukuphumula,

ungalokhu uyaluza noma wenza imisebenzi, kungaba ngokuhlala phansi noma ukulala. Kepha uma sebefika emakilasini eSayensi kukhulunywa ngesitatimende esithi ... *car B came to rest at point 2 after collision...* lo *to rest* awusasho ukuphumula ngempela nakuba imoto imile futhi ngeke uwuchaze ngokuphumula kodwa unomqondo ongekho obala ochaza ukuthi imoto imile. Lokho kufanele aziqondele ngokwakhe umfundi ngoba ngeke atshelwe esitatimendeni sombuza ukuthi imoto imile kodwa kuyofanele uma esefundisiwe aqonde ukuthi lokho kusho ukuthini.

UVygotsky wayekhohlelwa ukuthi ukuqonda kwabantu abadala amakhonsepthi kufinyeleleka kukho ngenxa yethonya lemfundo yesikole ebuncaneni babo. Amakhonsepthi anqala ezinto ezisezingeni lengane uVygotsky uwabiza ngamakhonsepthi ansuku zonke, kanti awabantu abasha abasakhula abawafunda esikoleni uwabiza ngamakhonsepthi eSayensi. Ngokombono wakhe uVygotsky, amakhonsepthi eSayensi anqala futhi amqoka kakhulu ngenxa yokuthi ayingxenyeye yochungechunge lwamakhonsepthi. U-Oyoo noNkopodi (2019) baveza ukuthi abafundi baseNingizimu-Afrika banezingqinamba zezincazelo zamagama asebenza nsuku zonke olimini uma esethulwa esifundweni seSayensi. Kuba yincazelo entsha neyindida kumfundi futhi okuhlalukayo ukuthi idinga ubuchule nobunyoninco ukuyicacisa kahle. Lokho kwenzeka kahle uma ukufunda nokufundisa kungokwenzeka ngobulimimbili, uthisha acacise amakhonsepthi eSayensi ngolimi lwasekhaya lomfundi.

Lolu cwaningo lukhethe injulalwazi ye-*social constructivism* ka Vygotsky ngoba yona imayela nokufunda kwengane kusukela izithuthukisa ekuqondeni amakhonsepthi ingakaqali isikole kuya lapho isifike khona esikoleni. Ifanelekile le njulalwazi ukusebenza kulolu cwaningo ngoba igxile ekufundeni nasekufundisweni kanti nalolu cwaningo lumayelana nokufunda nokufundiswa kusetshenziswa ubulimimbili esifundweni seSayensi ezikoleni zamabanga aphezulu. Le njulalwazi iyakuqhakambisa ukuthi umfundi kufanele athathelwe kulokho akwaziyo bese ethulelwa ulwazi olusha kususelwa kukho lokhu akwaziyo ukuze aqonde kangcono. Ngenxa yokuthi kukhona amakhonsepthi abalulekile kulolu cwaningo injulalwazi i-*socio-constructivism* engagxilile kuwo, kuzosetshenziswa uhlaka lwemicabango ukuwacacisa. Uhlaka lwemicabango luzochazwa ngezansi.

2.7.4. Uhlaka lwemicabango

Uhlaka lwemicabango ocwaningweni luyinto eyakhiwa umcwaningi, akuyona into ayitholayo nje. Lolu hlaka luhlanganisa iziqeshana ezibolekwe kolunye ulwazi lwababhali nabacwaningi (Maxwell, 2022). Abacwaningi abangoKivunja (2018), Salawu, Shamsuddin & Bolatitio (2023) kanye noMoschis (2024) bavumelana ngokuthi uhlaka lwemicabango luyiqoqo, ukuhleleka kokuma nokuxhumana kwakho konke okwakha ukucabanga. Lolu hlaka nokuhleleka kumbandakanya izakhiwo, izinhlelo nakho konke ukwenzeka kwayo yonke iphrojekthi yocwaningo. Laba bacwaningi babuka uhlaka lwemicabango njengokuqakulisa komcwaningi ngenhloso yokuveza ukubaluleka kwesihloko umcwaningi afisa ukusicwaninga, ukubaluleka ubumqoka nokufaneleka kwezindlela ezihlongozwayo ukucwaninga.

Uhlaka lwemicabango luyisiqondiso socwaningo olunohlonze futhi olubeka imibuzo ethile kanye namasu okuhlola. Ukufuna kanye nokwakha ukuxhumana kumakhonsepthi ocwaningo kungumsebenzi womcwaningi (Kivunja, 2017). Lesi sihlokwana sethula uhlaka lwemicabango ngokuluchaza ukuthi luyini bese lwethula futhi luchaza amakhonsepthi anqala kulolu cwaningo okuyilawa: ubumqoka besifundo seSayensi; izindlela zokufundisa esifundweni seSayensi, ukubukeka kwekilasi lesifundo seSayensi, ukubaluleka kolwazi lukathisha esifundweni seSayensi; ulimi olusabalele nekharihulamu, ikharihulamu, ulimi lokufunda nokufundisa, ulimi lwesibili, ukuthola ulimi lwesibili, ubuliminingi, nenqubomgomo yolimi lwesikole.

2.7.4.1. Ubumqoka besifundo seSayensi

Intuthuko yezomnotho incike kakhulu emaswini nasekusetshenzisweni kweSayensi, ngakho-ke kubalulekile ukufundisa isifundo seSayensi ngendlela ehlangabezana nezidingo zezobuchwepheshe besimanje eNingizimu-Afrika (Ogegbo, Gaigher noSalagaram, 2019). Sibaluleke kakhulu isifundo seSayensi ngoba ukuphumelela kahle kwabafundi kwenza ukuthi sande isibalo sabafundi abazimbandakanya nomkhakha wezeSayensi nokuyiwo obamba iqhaza elikhulu emnothweni wezwe. U-Ogegbo, Gaigher noSalagaram (2019) baqhubeka bathi ubuncane besibalo sabantu abanamakhono adingekayo emkhakheni weSayensi nezobuchwepheshe eNingizimu-Afrika sinomthelela omubi ngoba sivimbela ukukhula komnotho wezwe.

ISayensi ithathwa njengethuluzi elibalulekile ekubumbeni umhlaba ngokusebenzisa amathuluzi eSayensi nobuchwepheshe. EzeSayensi nobuchwepheshe ziyakhula kakhulu emikhakheni emikhulu njengeyobudokotela nezempilo zonkana, ezolimo nakwezokuxhumana. Ukufunda izifundo zeSayensi emfundweni yamabanga aphezulu kulekelela umfundi ukukhetha umkhakha weSayensi azowufunda enyuvesi bese esebenza ngawo (Sasson, 2020).

2.7.4.2. Izindlela zokufundisa isifundo seSayensi

Isifundo seSayensi sithathwa njengesilukhuni (Hlabane, 2016). Ngakho-ke kubalulekile ukuthi othisha bayo iSayensi babe nezindlela abazisebenzisayo ukuze babethule ngendlela ezokwenza ukuthi abafundi basiqonde lesi sifundo. Izindlela othisha abazisebenzisayo ukulekelela ukufundisa kwabo ukuze bathuthukise ukuqonda kwabafundi zibandakanya ukusetshenziswa kwama-eksperimenti, amavidiyo ka-*Youtube*, amamodeli eSayensi kanye namasimuleshini. UHickling-Hudson noMcMeniman (2021) uveza ukuthi izinjongongqangi zokufundisa amaphrakthikhali okungama-eksperimenti esifundweni seSayensi zibandakanya ukugqugquzela nokuqubula intshisekelo kubafundi beSayensi. Lokhu akukushiyi ngaphandle ukuthuthukiswa kokufundwa kwamakhonsephti eSayensi, ukuthuthukisa ukuvuleleka komqondo wabafundi ngezinjongo zeSayensi.

2.7.4.2.1. Ama-eksperimenti namaphrakthikhali

UHickling-Hudson noMcMeniman (2021) uveza ukuthi ukufundisa amakhono ama-eksperimenti kulekelela abafundi ukuthi bakwazi ukubamba nokusebenzisa izinsizakusebenza zokwenza wona ama-*investigation* noma ama-eksperimenti nokugcina kugcizelela futhi kuveza izindlela zeSayensi nokuthuthuka kobuchweptheshe ekuzisebenziseni. U-Akuma noGaigher (2023) bagcizelela ukuthi ngesikhathi kwenzeka ama-eksperimenti emalabholethri kuyathuthuka ukuqonda kwabafundi amakhonsephti esifundo seSayensi. Othisha banethuba eliyinqayizivele lokulekelela abafundi esifundweni seSayensi ukuqonda futhi bazihluphe ngomhlaba abaphila kuwo, ukwethamela izinto nezenzeko ezikhanga amehlo, ukuqaphela amathiyori nemibono ecacile bese bebakhulisa ngaleyo ndlela ekuqondeni ngeSayensi. Ilabholethri yeSayensi esikoleni iyinsizakusebenza eyahlukile eyelekelela ukuqubula intshisekelo, ulwazi nokuqonda amakhonsephti

esifundo seSayensi nokwenza amaphrakthikhali, kanye nolwazi lwamathuluzi abalulekile namakhono angathuthukisa ukuqonda okusha.

2.7.4.2.2. Amavidiyo

U-Ahmad nabanye (2023) baveza ukuthi amavidiyo ka-*Youtube* athuthukisa ukuphumelela kwabafundi ezifundweni ezahlukene uma kuqhathaniswa nokufundisa ngendlela eyejwayelekile kuphela. Amavidiyo ka-*Youtube* enza ukuthi abafundi bakuthakasele ukufunda bese ngenxa yalokho kuthuthuke imiphumela esifundweni seSayensi. Abacwaningi abangoMbwile benoNtivuguruzwa (2023), Shoufan benoMohamed (2022) kanye noBeautemps benoBresges (2021) bavumelana ngokuthi ocwaningweni lokufundisa kwaselabhorethri olwesekelwe ngamavidiyo okufundisa ama-*opticts e-light* bathola ukuthi ukusetshenziswa kwamavidiyo kugqugquzela kakhulu abafundi ukuthi bafunde. La mavidiyo aphinda enze abafundi baqonde amakhonsepthi eSayensi. Othisha bathola izindlela namathuluzi okufundisa kula mavidiyo. Lokhu kuyakwenyusa ukuzethemba ekwethuleni isifundo seSayensi kothisha ngoba bayazibukela amavidiyo ngabodwana emakhaya bese bethula isifundo bahlanganise nolwazi abaluthola kumavidiyo.

2.7.4.2.3. Amamodeli

U-Akilli (2021) uchaza ukuthi imodeli iyisimeleli sombono noma umqondo kanye nokwenzeka kwento. UPedrerera noBarrutia kanye noDíez (2025) baveza ukuthi abafundi bahlangabezana neSayensi nsuku zonke noma bengazelele. Laba bacwaningi bathi abafundi bonke bavela njengabantu abanokuqonda okusadinga ukuthuthukiswa ngesifundo seSayensi nangokwenza kososayensi. Uma ososayensi bezama ukuchaza ukwenzeka kweSayensi okungabonakali ngamehlo nesimo esingacacile ukuthi senzeka kanjani baye bakhethe ukusebenzisa amamodeli ukuze sichazeke kahle.

2.7.4.2.4. Amasimuleshini

Amasimuleshini angamathuluzi alekelela abafundi ukubona amakhonsepthi eSayensi ngokomhlaba wamakhompyutha. Abakhombisa okufanayo nokubonwa emalabhorethri amakhulu eSayensi. Ngakho-ke isimuleshini inomthelela omuhle ekuthuthukiseni ngesivivini ukuqonda kwabafundi izihloko ezilukhuni zeSayensi (Tsivitanidou, Georgiou kanye no-loannou, 2021). ULiu nabanye (2020) baveza

ukuthi amasimuleshini abuye asetshenziswe esikhundleni sama-eksperimenti okunzima ukuwalawula, ayingozi noma okungelula ukuwenza emalabhorethri njengokusebenza kwengqondo, umbani noma i-*dynamite*. Wonke la makhonsephthi achazeka kahle ngamasimuleshini ekhompuyutha (Makransky, Petersen & Klingenberg, 2020; Matovu et al., 2023). ULiu nabanye (2020) bayakufakazela lokhu ngokuthi bathi amasimuleshini asiza abafundi nothisha ukuzibonela izinto ezingabonakali ngamehlo kodwa ezibonakala ngama-*microscope*. UKotoka noKriek (2023) baveza ukuthi amasimuleshini athuthukisa ukuqonda kwabafundi nemiphumela yabo ngenkathi befunda nge-*quantum mechanics*. Amasimuleshini alekelela abafundi ukuthi bakwazi futhi baqonde amakhonsephthi anqala *in electromagnetism*.

2.7.4.3.Ukubukeka kweklasi lesifundo seSayensi

Iklasi lesifundo seSayensi kulindeleke ukuthi libe nezinto ezahlukahlukene ngaphakathi ukuze ukufunda nokufundisa iSayensi kube yimpumelelo. UHotaman (2010) uveza ukuthi uthisha wesifundo seSayensi ikhosi lakhe kulindeleke ukuthi alenze lihlobo ngezithombe zeSayensi eziveza ubuhle beSayensi ukuze abafundi baheheke futhi bagqugquzeleke ukuyithanda. Kuqala endleleni yokuhlala kwabafundi. Ngokujwayelekile abafundi bahlaliswa ngamaqembu anesibalo esingaze sifinyelele kwabane iqembu ngalinye. Indlela yokuhlala kufanele ivuleleke ukuze igqugquzele ukubambisana, ukunethezeka nokuyaluyaluza ngaphakathi eklasini.

UWillingham (2021) uthi kufanele kube nendawo eyakhelwe ukuthi abafundi bakwazi ukufinyelela ezinsizenikufundisa zokwenza imisebenzi yekhosi, ezokuphepha, izihlahla nakho konke okulekelela ukufunda. Kufanele kubekhona indawana yezobuchwepheshe besimanje ezoba namakhompuyutha ukuze abafundi bawasebenzise ukuthola ulwazi nokufunda ngamasimuleshini. Umtapo wolwazi wekhosi kufanele ube khona futhi ube yishalofu lezincwadi ezahlukahlukene futhi ezibandakanya izihloko ezahlukene zokufundwayo. Lo mcwaningi uthi ikhosi leSayensi kulindeleke ukuthi libe nendawana yokufunda lapho abafundi bekwazi ukusebenza njengamaqembu noma ngokuzimela. Ngokwalo mcwaningi kufanele kubekhona indawana yokusebenza yeqenjani ukuze abafundi bezokwazi ukwenza amaphrojekthi ndawonye njengeqembu. Izindonga zekhosi leSayensi ziba

nezithombe ezahlukahlukene ezinemibala emihle. Lezi zithombe kufanele kube ezimayelana nokufundwayo eklasini. Zifakelwa ukuqubula ugqozi lweSayensi kubafundi.

2.7.4.4.Ukubaluleka kolwazi lukathisha esifundweni seSayensi

Ulwazi lwesifundo seSayensi, amakhono okufundisa, ukuziphatha kukathisha kungumgogodla obalulekile emfundweni yonkana ukuze imfundo ifezekise izinjongo zayo (Hotaman, 2010). UTanak (2018) uveza ukuthi uthisha wesifundo seSayensi kufanele abe nolwazi olumbandakanya amakhono okuba yiciko ngenkathi elungisa iklasi lakhe ukuthi lihlobe ngezithombe zesifundo seSayensi eziveza ubuhle beSayensi ukuze abafundi baheheke futhi bagqugquzeleke ukuyithanda ukuze bayiphumelele ngamalengiso. Lo mcwaningi ugcizelela ukuthi othisha kufanele bakwazi ukwethula ulwazi olusha kubafundi, ukubekezelelana nokukhathalelana.

Othisha banejoka elikhulu lokuqukatha nokuthuthukisa ulwazi namakhono emfundweni nokuqoka ukuthi bangakwenza kanjani lokhu ngempumelelo. Kumqoka kakhulu ukuthi uthisha abe nolwazi olunzulu ngesifundo sakhe (Tanak, 2018). UKönig nabanye (2021) baveza ukuthi ulwazi okufanele abe nalo uthisha lumbandakanya ukuhlela izinjongo zesifundo, ukuhlela ukulandelana kwezifunjwana, ukwethula isifundo, ukwethula ngokungenisa izihlokwana zesifundo nokuhlela isikhathi esanele ukucolisisa wonke amakhonsephtsi amqoka esifundo seSayensi.

UTufail (2021) uveza ukuthi kubalulekile futhi ukuthi uthisha aqonde kabanzi iklasi lakhe, okungabafundi abafundisayo. Lo mcwaningi ugcizelela ukuthi ulwazi uthisha analo ngabafundi bakhe luqondwa wuye kuphela, ongabafundisi labo bafundi akalwazi. Lolu lwazi futhi luyakhula futhi luyaqhubeka ngokuthuthukiswa ngoba uthisha kulindeleke ukuba abuyekeze izindlela zakhe zokufundisa ngokuzeyamanisa nezingabunjalo lokuqonda kwabafundi bakhe ngenhloso yokuthuthukisa ulwazi lwabo lwesifundo seSayensi (Tanak, 2018). Uthisha wesifundo seSayensi kubalulekile ukuthi abe nolwazi lokucwaninga ngeSayensi ukuze ezoba nolwazi olungaphezu kolusencwadini yomfundi futhi ezobachazela kabanzi abafundi ngokwenzeka kwezinto ngokomkhakha weSayensi. Lokhu kuqubula ugqozi nentshisekelo yokuthi abafundi bafunde ngokuzimisela ukuze bezothatha imikhakha yeSayensi emanyuvesi (Tufail, 2021).

2.7.4.5. Ikharihulamu

UMaphosa noMudzielwana kanye noNetshifhefhe (2014) baveza ukuthi ziningi izincazelo zekharihulamu futhi zonke zinciphe ekuqondeni komuntu ngale khonsepthe. Laba bacwaningi bathi ikharihulamu iwuhlelo olucacisa ngezihloko ezizofundiswa kuzo zonke izifundo kanye nezindlela ezizosetshenziswa ekufundeni nokufundisa konkana futhi icacisa ngezinhloso nezinjongo ezihleliwe ukuze kubonakale ngazo ukuthi ukufundisa konke kwenzekile. Okugcizelelwa ukuthi kubalulekile ukuveza injongo okufanele ikharihulamu yakhele kuzo. Laba bacwaningi bathi ikharihulamu iyinhlanganisela yemisebenzi yokuhlola ukuqonda kwabafundi, amathuba namava okufunda okwenzeka kuqhamuka ngokuhlela kukathisha noma kuzenzakalela.

Ngokuka Palmieri (2023) kuMnyango Wezemfundo wase-State of Rhodes Island (2023) ikharihulamu ukulandelayo okusekelwe emazingeni kwamava ahleliwe lapho abafundi bezozuza ubungoti kokuqokethwe kanye namakhono okufunda asetshenzisiwe. Ikharihulamu ingumhlahlandlela obalulekile wabo bonke othisha mayelana nokuthi yini ebalulekile ekufundiseni nasekufundeni, ukuze wonke umfundi akwazi ukuthuthuka. Kanti uPrimrose no-Alexander (2013) baveza ukuthi ukufunda kwabafundi kwakhiwa ukuthuthukiswa kwesakhiwo nokuhleleka kwekharihulamu ukuze ukufunda nokufundisa abafundi kube lula. Izinsizakufundisa ezikhethwayo kuba yilezi ezizolekelela abafundi ukuqonda okufundwayo futhi ezibandakanya imibono emayelana nomhlaba esiphila kuwo, bese ibhekelela konke ukwehlukahlukana kwezinkolelo nemvelaphi yomfundi.

2.7.4.6. Ulimi olusabalele nekharihulamu

Ulimi olusabalele nekharihulamu lumayelana nokuxhumanisa iminxa nezingxenywe ezahlukene zolimi zemfundo esikoleni, ikakhulukazi ngokugqogquzela iqhaza lolimi kuzo zonke izifundo ezifundwayo esikoleni (Vollmer, 2007). Ulimi olusabalele nekharihulamu yikhonsepthe ebalula ukubaluleka komsebenzi wolimi nokuqeqeshwa olimini kuzo zonke izifundo okungezona ezolimi. Lokhu-ke kugcizelela ukuthi ulimi alufundwa esifundweni solimi kuphela kepha kufanele lufundwe nasezifundweni okungezona ezolimi ukuze kuthuthuke ukuqonda kwabafundi lesi sifundo. Isifundo noma ngabe yisiphi sifundiswa ngolimi, ngakho-ke kubalulekile ukuba ulimi okufundwa ngalo baluqonde abafundi. Lokhu kufanele

ukwenziwa ngoba isifundo nesifundo sinolimi lwaso nolungaba yindida nengqinamba ekufundeni komfundi uma lungaqasheliswa ngokuthi lufundiswe ngendlela elusabalalisa nekharikhulamu (Fillion, 1979; Vollmer, 2007).

2.7.4.7.Ulimi lokufunda nokufundisa

Ulimi lokufunda nokufundisa lululimi okufundiswa ngalo isifundo noma izifundo, futhi olusetshenziswa ekilasini usuku lonke esikoleni. Uma ulimi lokufundisa kuyisiZulu, lokho kusho ukuthi uthisha uzokhuluma ulimi lwesiZulu uma efundisa izibalo, isayensi nezinye izifundo. Abafundi bazohlolwa ukuqonda kwabo leso naleso sifundo kungagxiliwe olimini lokufundisa siqu salo. Abafundi baye bahlolwe ngalo lolo limi,. Ngaleyo ndlela, kufanele babe nokuluqonda okuthe thuthu lolu limi lokufundisa ukuze baziqonde kahle izifundo ngokwehlukahlukana kwazo namakhonsepthe azo.

UMakupe noMachaba (2024) baveza ukuthi ulimi lokufunda nokufundisa luchaza ulimi lokufundisa izifundo zonke nokuhlolwa kwenziwa ngalo. Noma yiluphi ulimi kulezi eziyi-11 kanye nolimi olukhulunywa ngokulinganisa ngezandla lungasetshenziselwa le nhloso yokufundisa. Ulimi lokufunda nokufundisa luqokwa isigungu esengamele isikole nokuyisona esikhetha ulimi lokufunda nokufundisa kwalezo zikole esizengamele ngokulandela isigaba sesi-6 (2) somthethosisekelo wezikole zaseNingizimu-Afrika. Lesi sigaba somthethosisekelo nenqubomgomo yolimi yezikole eNingizimu-Afrika sithi ukufunda nokufundisa kungenzeka kwenzeke ngezilimi ezimbili ekilasini elilodwa, lokho kusho ukuqhuba imfundo ngobulimimbili.

2.7.4.8.Ulimi lwesibili

UPetrovic noYazan (2021) bachaza ulimi lwesibili ngokuthi luwulimi olukhulunywa njengolimi lokwengeza kulolu lwasekhaya olwaziwa njengolimi lokuqala. Ulimi lwesibili kungaba ulimi olukhulunywa ezweni noma emphakathini kodwa okungelona olokuqala kulowo olusebenzisayo. ENingizimu-Afrika ulimi lwesiNgisi lululimi lwesibili kubantu abaningi futhi yilo olululimi lokufunda nokufundisa ezikoleni eziningi. UFafunwa (2022) uveza ukuthi emazweni afana nelaseNingizimu-Afrika ayekade ebuswa uhulumeni wengcindezelo, amazwe eyengabaqoneli ayefika nezilimi zawo, azenze kube yizo ezisemqoka okwedlula lezo zendawo abayiqonelayo.

Ngenxa yokubusa kwabaqoneli isikhathi eside, abantu basebefundile izilimi zabo futhi bejwayele ukuzisebenzisa, yingakho zigcina zenziwa kube sengathi zisemqoka

ngaphezu kwezinye izilimi futhi kube yizo ezisebenza ezikoleni nasekuxhumaneni. USayedayn (2021) uveza ukuthi abaqoneli baphoqelela izilimi nezinkolelo zabo ngokuphoqa abantu abangekho mhlophe ukufunda ukukhuluma ulimi olwehlukile. Ngenxa yokuzijwayela izilimi zabaqoneli amazwe ayengamakoloni agcina ezisebenzisa njengezilimi zokufunda nokufundisa.

Ulimi lwesibili kwezemfundo yaseNingizimu-Afrika lubizwa ngolimi lokuQala lokwEngeza futhi luyingxenye yekharikhulamu. Abafundi abaningi abaluqondisi ngokuvamile uma kuqhathaniswa nolimi lwabo lwasekhaya kodwa kuye kuhambe kuze kufike ezingeni lapho umfundi ekhululeka khona ukulusebenzisa ukukhuluma, ukufunda nokubhala.

2.7.4.9. Ukuthola ulimi lwesibili

Ukuthola ulimi yisimo lapho abantwana bezuza amakhono okuqonda nokusebenzisa ulimi, okungahleliwe (Tricomi, 1986). Akubi khona uthisha, kodwa ingane ilufunda kubantu ehlala nabo, akudingi ukuthi kube nothisha. Lo mcwaningi uthi kusetshenziswa kakhulu igama lokuthola kunokufunda ulimi ngoba ukufunda kuchaza ukufunda ulimi ngokuhlelekile, lapho kudingeka kube nothisha nomfundi ozofundiswa ulimi lolo, kwenzeke ngendlela ehlelekile.

UKrashen (1982) uveza ukuthi ukukwazi ukufunda ulimi kanye nokuthola ulimi kwenzeka ngezindlela ezahlukahlukene. Ukufunda ulimi kwenzeka ngokufunda imfundo ehlelekile ngemithetho yolimi, imigudu kanye nezindlela ezithile lapho kuba khona uthisha nomfundi (Fillion, 1979). Ukufunda kwenza umuntu akhulume ngento futhi aqhubeke ukusebenzisa ukwazi akutholile. Kanti ukuthola ulimi kona kuvela ngendlela ehlekile ngoba kuqhamuka kuhluke futhi ngendlela ecezile.

2.7.4.10. Inqubomgomo yolimi lwesikole

Inqubomgomo yolimi yezikole yangonyaka we-1997 yaseNingizimu-Afrika ibalula ukuthi isigungu esengamele isikole (SGB) kufanele sibalule ukuthi isikole sizobuthuthukisa kanjani ubuluminingi ngokusebenzisa ulimi olungaphezu kolulodwa ukufunda nokufundisa, nanokufaka izilimi zokwengeza njengezifundo, noma ukubandakanya izinhlelo ezithuthukisa nezinakekela ulimi noma ngezinye izindlela ezigunyazwe yinhloko yoMnyango Wezemfundo esifundazweni. Lolu ulwazi olubalulekile okufanele ludluliselwe futhi lugcizelelwe kubazali, abafundi, othisha

kanye nezinhloko zeminyango ngoba ngaleyo ndlela bayoqonda bonke ukuthi akuphoqi ukuthi lube lunye ulimi lokufunda nokufundisa kodwa banelungelo lokuqoka ulimi lokufunda nokufundisa nokungaba ulimi lwasekhaya kubafundi abaningi uma kuvunyelwana kanjalo.

2.7.4.11.Ubuliminingi

USchroedler (2021) uthi ubuliminingi bungachazwa njengokukwazi kwemiphakathi, izikhungo, amaqoqo nabantu ukuxhumana nsuku zonke ngokuphindelela ngezilimi ezahlukahlukene kusukela kwezimbili kuya phezulu. UCenoz benoGorter (2023) bathi ubuliminingi buchaza ukuthi amakhono omfundi noma ulimi lwakhe lwasekhaya seluthuthuke ngokusezingeni eliphezulu bese lokho kuvumela ukuthi kukharikhulamu yomfundi kwengezwe ezinye izilimi ukuthi umfundi azifunde. Isizathu salokhu ukuthi umfundi uzobe esekwazi ukuhlanganisa ulimi lwakhe kanye namanye amakhono ngolimi lwakhe lwasekhaya futhi uzokwazi kalula ukuthola amakhono ezinye izilimi. Ngenxa yalesi sizathu, ochwepheshe abaningi kwezemfundo bayayisekela le ndlela yokufundisa ngobulimimbili. Abafundi abakhuluma ulimi olubukeka lungekho semqoka ngokwezinga ngokwejwayelekile kuba yibo ababa nobuliminingi ngoba lolu limi oluthathwa njengolusemqoka, lusetshenziswa kakhulu bese kuphoqa-ke ukuthi balufunde.

2.8. Iqoqa Lesahluko

Lesi sahluko sethule ukubuyekezwa kwemibhalo yocwaningo olwenziwe phambilini. Lokhu lukwenze ngaphansi kwalezi zihlokwana: ucwaningo oselwenziwe mayelana nokusetshenziswa kobulimimbili kwiSayensi, imfundo engobulimimbili, ukwethula isifundo seSayensi ngolimi lwesibili, iqhaza lolimi emfundweni, ubunzima bamagama asebenza nsuku zonke olimini nakuSayensi. Lesi sahluko siphinde sethula uhlaka lwenjulalwazi i-*socio constructivism* ka Vygotsky. Ngivezile kulesi sahluko ukuthi kungani ngikhethe yona. Kuso lesi sahluko ngethule nohlaka lwemicabango, ngivezile futhi nakulo ukuthi kungani ngikhethe ukulusebenzisa kulolu cwaningo. Isahluko esilandelayo sizokwethula umklamo nezindlela zocwaningo.

ISAHLUKO SESITHATHU

Umklamo Nezindlela Zocwaningo

3.1. Isingeniso

Isahluko esidlule besibuyekeza imibhalo ngocwaningo oselwenziwe futhi kwethulwa nohlaka lwenjulalwazi kanye nohlaka lwemicabango. Kulesi sahluko kuzokwethulwa umklamo nezindlela zocwaningo. Lokhu kuzokwenzeka ngaphansi kwalezi zihlokwana ezilandelayo: ucwaningo oluyikhwalthethivu, ipharadaymu yocwaningo, ucwaningo lwesimo, izindlela zokukhiqiza imininingo yocwaningo, indlela yokuqoka ababambiqhaza ukuvivinywa kwamathuluzi ocwaningo, ukuhlaziywa kwemininingo yocwaningo, ukwethembeka nobuqiniso bocwaningo bese kuba ukulandelwa kwenkambiso elungileyo yocwaningo.

3.2. Ucwaningo oluyikhwalthethivu

Lolu cwaningo lulandela izindlela zocwaningo oluyikhwalthethivu ukukhiqiza imininingo. UCreswell benoCreswell (2018) bathi ucwaningo oluyikhwalthethivu luyindlela esetshenziswa abacwaningi ukuhlolisisa ukuqonda kwabantu noma amaqembu abandakanyeka kuleyo nkinga ecwaningwayo. Uhlelo locwaningo oluyikhwalthethivu lumbandakanya imibuzo emqoka nezindlela kanye nemininingo ekhiqizwa endaweni yababambiqhaza. Ukuhunyushwa kwemininingo yocwaningo oluyikhwalthethivu kwakhelwa kokutholakala ngemibono yababambiqhaza, bese umcwaningi ekhumusha

UCohen, Manion noMorrison (2018) bavumelana ngokuthi baveze ukuthi ucwaningo oluyikhwalthethivu luveza ngokubanzi imininingo ngokuqondwa kwezincazelo nemibono, izenzeko, okungabonakali nangalokho okubonakalayo, izinhloso nendlela abaziphatha ngayo ababambiqhaza esimweni esicwaningwayo. Lolu cwaningo lunikeza ababambiqhaza izwi bese luphenya izimo ezicashile ezingaba yimbangela yendlela izinto ezenzeka ngayo.

Ucwaningo oluyikhwalthethivu baningi abacwaningi ababhale ngalo beluchaza ngezindlela ezahlukene kodwa ezivumelanayo (Cresswell & Cresswell, 2018; Busetto, Wick & Gumbinger, 2020; Bhangu, Provost & Caduff, 2023; Denny &

Weckesser, 2022; Lim, 2024). Ucwangingo oluyikhwalthethivu lunikeza abacwangingi isibuko esibalulekile lapho bethola khona ukuqonda okunzulu nokunothile ngendlela yokuziphatha kwabantu kuleso simo esicwangingwayo (Busetto, Wick & Gumbinger, 2020; Dehalwar & Sharma 2023). Izindlela zocwangingo oluyikhwalthethivu zivela njengamathuluzi abalulekile okuthola ukuqonda okujulile nokuqonda izenzeko ezahlukene. Ucwangingo oluyikhwalthethivu luqala ngombuzo owodwa wocwangingo noma ngemibuzo, kwesinye isikhathi egcina ishintshiwe. Lolushintsho lwenzeka ngesikhathi lusaqhubeka ucwangingo ngenhloso yokuqoqa nokunciphisa izinhloso zocwangingo (Denny & Weckesser, 2022; Lim, 2024). UBhangu nabanye (2022) bathi izindlela zocwangingo oluyikhwalthethivu zingamasu okucwanginga nokuphenya okuncike ezindleleni zokukhiqiza imininingo engezona izinombolo bese ukhumusha nokukhiqiza ubufakazi bocwangingo kunganciki ezinombolweni (Bhangu, Provost & Caduff, 2022).

Ukukhetha uhlobo locwangingo umcwangingi azolwenza kulawulwa izinhloso anazo ngalo nenqubo afisa ukuyilandela ukuluqhuba. Ngakhetha ukulandela izindlela zocwangingo oluyikhwalthethivu ngenxa yokuthi ngangifuna ukuzitholela ulwazi ngesimo mayelana nesihloko nombuzo wocwangingo kubabambiqhaza. Ngangifisa ukucubungula imininingo yocwangingo bese ngiyibhala phansi kungamagama afundekayo ukuze kucace futhi kufundeke kungamagama konke okuyimiphumela yocwangingo. Abacwangingi abangoBhangu, Provost noCaduff (2022) bagcizelela ukuthi izindlela zocwangingo oluyikhwalthethivu zingamasu okucwanginga nokuphenya okuncike ezindleleni ezikhiqiza imininingo engezona izinombolo. Lolu hlobo locwangingo luhumusha futhi luqhiqize ubufakazi ngocwangingo ngokunganciki ezinombolweni.

Ngikhethe lolu cwangingo oluyikhwalthethivu ngoba bengifuna ukuzitholela imininingo yocwangingo ngokubukela ababambiqhaza befundisa emaklasini ukuze ngibone ekufundiseni kwabo ukuthi babusebenzisa kanjani ubulimimbili ukufundisa isifundo seSayensi. Bengifisa nokuthi ngenze izingxoxo ezisakuhleleka ukuze ngizizwele kusuka kubona ababambiqhaza ngokuphendula imibuzo yocwangingo ukuthi babusebenzisa kanjani ubulimimbili futhi babuqonda kangakanani esifundweni seSayensi. UCresswell (2003) uyakufakazela lokhu ngokuthi aveze ukuthi ocwangingweni oluyikhwalthethivu umcwangingi uvamise ukunikeza ngemininingo

ekhiqizwe ngokuhlanganyela nababambiqhaza, ngenxa yalokho lusekeleke emaveni ahlukene, nezincazelo ngesimo senhlalo sababambiqhaza.

3.3. Ipharadaymu yocwaningo

Ipharadaymu yocwaningo iyinhlanguanisela yemibono nezinkolelo ezihlahla indlela noma imodeli ezolandelwa ucwaningo (Omodan, 2024). Ipharadaymu yocwaningo ichaza ulwazi oluvele lukhona, ubunjalo benkinga noma bezinkinga ezizocwaningwa, izindlela ezilungele lolo cwaningo nendlela okufanele kuhunyushwe ngayo imininingo yocwaningo (Omodan, 2024). Lolu cwaningo lulandela ipharadaymu yomhumusho. Abacwaningi abasebenzisa ipharadaymu yomhumusho babona iqiniso ngenhlalo yabantu nokwenzeka kwezimo njengokulawulwa yindawo umuntu emzungezile. Lokhu kungenxa yokuthi bachaza izimo ngokusebenzisa ukuqonda kwabo kunokuhlambulisa ngenhloso yokuyamanisa amava nokuqonda kwababambiqhaza nezinkolelo zabo ngesimo esicwaningwayo (Pervin & Mokhtar, 2022).

U-Omodan (2024) uthi ipharadaymu yomhumusho ingenye yezindlela ezisetshenziswa abacwaningi ukuqonda izinkolelo, izisusa, nokucabanga kwabantu ukuze kuqondwe incazelo yemininingo yocwaningo engakhiqizwa kuleyo ndawo. UCreswell benoCreswell (2018) baveza ukuthi inhloso yomcwaningi ngokusebenzisa ipharadaymu yomhumusho ukweyama noma ukwethembela kakhulu emibonweni yababambiqhaza ngaleso simo acwaninga ngaso. Imibuzo iba nokujula bese ivuleleka ukuze ababambiqhaza bezokwazi ukuzakhela ukuqonda kwabo ngesimo esicwaningwayo. UKivunja benoKuyini (2017) bathi kwipharadaymu yomhumusho ucwaningo alunciki emibonweni yomcwaningi kuphela kepha kwenziwa kubhekwa ukuqondisisa izimvo zababambiqhaza ngocwaningo olwenzekayo. Le ndlela incike kakhulu ekuqondeni komuntu ngamunye nendlela ahumusha ngayo okwenzeka ocwaningweni abambe iqhaza kulo endaweni akuyo.

Kulolu cwaningo ngikhethe ukusebenzisa ipharadaymu yomhumusho ngoba ngifuna ukuthi ngibukele othisha befundisa ukuze ngikwazi ukuhumusha futhi ngihlaziye izinhlelo zezifundo zabo nendlela abafundisa ngayo isifundo seSayensi ngokusebenzisa ubulimibili. UBetram benoChristiansen (2014) baveza ukuthi umcwaningi kufanele angene ngqo esimweni asicwaningayo kodwa angene ngokuthi abe sezinyathelweni zababambiqhaza futhi isimo asibheke ngehlo labo. UCreswell,

benoCreswell (2018) bagcizelela ukuthi inhloso yomcwaningi owenza ucwaningo ngaphansi kwepharadaymu yomhumusho ukhumusha izincazelo zabanye abantu (ababambiqhaza) ngokomhlaba abaphila kuwo.

3.4. Ucwaningo lwesimo

Ucwaningo lwesimo luyindlela yocwaningo esetshenziswa abacwaningi ukuchaza izenzeko ezijulile nezidinga ukuhlaziywa ngobuchule, lugxile esimweni leso esicwaningwayo (Lapan, Quartaroli & Riemer, 2011; Hancock & Algozzine, 2017). UCohen, benoManion noMorrison (2018) bagcizelela ukuthi ucwaningo lwesimo luwumongo obalulekile ekukhiqizeni imininingo yocwaningo. Kungenzeka luzimele noma lulekelelane nezinye izindlela zokukhiqiza imininingo yocwaningo, luphinde lwakhe eyalo indlela yocwaningo. UCreswell nabanye (2016) baveza ukuthi ucwaningo lwesimo lwemukela futhi luvumelane nokuthi kungaba nezindlela eziningi ezisebenza ukucwaninga isimo esisodwa, futhi ngaleyo ndlela kudingeka elingaphezu kwelilodwa ithuluzi kanye nezizinda zolwazi ezahlukene ukukhiqiza imininingo yocwaningo. Ocwaningweni lwesimo, ucwaningo oluyikhwalthethivu nocwaningo oluyikhwalthethivu kungasetshenziswa ndawonye.

Uma ucwaningo lungolwesimo ngokujwayelekile umcwaningi ukhetha ababambiqhaza esebenzisa isampula eliqokwe ngokwenhloso. Ukuqoka ngokwenhloso yikhona okunikeza ucwaningo lwesimo amandla angeziwe ngoba umthombo wolwazi okungababambiqhaza noma izimo ezicwaningwayo kuqokwa ngokubuka izingabunjalo lemininingo yocwaningo efundwa noma etholakala kubona (More, Lapan & Quartaroli, 2012). Lolu cwano ngilwenze ngomklamo wocwaningo lwesimo ngoba ngihlose ukuqoka ngokwenhloso ababambiqhaza engizosebenza nabo ukuze ngithole ulwazi olubanzi nolujulile kulolu cwano.

Ababambiqhaza kulolu cwano gothisha abane abafundisa isifundo seSayensi emabangeni eshumi neshumi naye ezikoleni ezimbili ezahlukene futhi ngabaqoka ngoba nginokuqonda amava abo ekufundiseni lesi sifundo. Ngangihlose ukucwaninga isimo okungukufundisa isifundo seSayensi ngokusebenzisa ubulimimbili ngokuthi ngibukele ababambiqhaza ngesikhathi befundisa futhi ngibabuze nemibuzo ezingxoxweni ezisakuhleleka. Okunye okwenza ukuthi ngikhethe ucwaningo lwesimo yingoba luyindlela yocwaningo ehambisanayo nocwaningo oluyikhwalthethivu.

3.5. Izindlela zokukhiqiza imininingo yocwaningo

Ocwaningweni kunamagxathu alandelwayo ukukhiqiza imininingo yocwaningo. U-Walliman (2021) uthi lokhu kubandakanya ukubeka imibandela yocwaningo, ukukhiqiza imininingo ngokubukela okwenziwa ababambiqhaza, izingxoxo, nokunye okuningi okusebenzelanayo. Kulolu cwaningo ngikhethe ukusebenzisa izingxoxo ezisakuhleleka, ukubukela okwenziwa ababambiqhaza kanye nokuhlaziya amadokhumenti. Imininingo yalolu cwaningo ngiyikhiqize ngokuthi ngicwaninge ezikoleni ezimbili zaseMsinga, ezisebukhosini baseMachunwini, iGabangaye Sekhondari (okungelona igama langempela) nakobaseMabomvini, iNgonyameni Sekhondari (okungelona igama langempela). Ngasinye isikole ngacwaninga ngokusebenzisana nothisha ababili ngoba lolu cwaningo beludinga umfundisi webanga leshumi neleshumi nanye kanti kuzo zombili izikole la mabanga afundiswa othisha abehlukene.

3.5.1. Izingxoxo ezisakuhleleka

Izingxoxo ezisakuhleleka iyingxoxo eyenzeka phakathi kwabantu ababili lapho umcwaningi ebuza khona imibuzo kumbambiqhaza ngenhloso yokukhiqiza imininingo yocwaningo nokufunda ngemibono, izinkolelo, izimvo, nokuziphatha kombambiqhaza (Creswell et al., 2016). Izingxoxo ezisakuhleleka zingezinye zezindlela ezisetshenziswa kakhulu ukukhiqiza imininingo uma inhlosongqangi yomcwaningi kuwukuqondisisa isimobunjalo sokuqonda kombambiqhaza ukuze engahlawumbiseli ngesihloko asicwaningayo (Adeoye-Olatunde & Olenik, 2021). USurawy-Stepney nabanye (2023) baveza ukuthi inhloso yezingxoxo zocwaningo oluyikhwalithethivu ukubuka umhlaba ngeso lababambiqhaza futhi ababambiqhaza bangaba inqolobane yolwazi ebaluleke kakhulu uma bezosetshenziswa ngendlela efanele.

USurawy-Stepney nabanye (2023) baveza ukuthi izingxoxo ezisakuhleleka zivumela ukuthi umcwaningi ahlele imibuzo evulekile azoyibuza ababambiqhaza. Lokhu kuvumela umcwaningi ukuthi kuleyo naleyo ngxoxo afike enemibuzo anayo emqondweni ahlele ukuyihlola ezingxoxweni nababambiqhaza kodwa futhi umcwaningi uyabavumela ababambiqhaza ukuthi bambuze imibuzo abafisa ukuyibuza ngenhloso yokuthi bangaphenduli imibuzo abangayiqondisisi (Adeoye-Olatunde & Olenik, 2021; Surawy-Stepney, et al., 2023). Ngakhethe ukusebenzisa

izingxoxo ezisakuhleleka ngoba nganginenhloso yokuthola ulwazi nokuqonda kanye nokwenza kwababambiqhaza mayelana nokufundisa isifundo seSayensi kusetshenziswa ubulimimbili. Ngangenzela ukuthi ababambiqhaza bakhululeke ukuphendula ngokwenaba umbuzo ngamunye ukuze ngithole ulwazi oluzolekelela lolu cwaningo ukuthi umbuzo walo uphenduleke.

Kubalulekile ukuhlela kahle izingxoxo, ukulungiselela indawo ezizokwenzekela kuyo, ukuvula kumbe ukuyingenisa ingxoxo, izinga lesivini nesikhathi sokuqhutshwa kwayo, ukulawula ukuthi ingxoxo iqhubeke nokuqoqa ulwazi, kanye nokuyiphetha ingxoxo (Cohen, Manion & Morrison, 2018). Kuzona zombili izikole ngangicele ikhosi elalingenamuntu esasizokwazi ukuthi sibe sobabili kuphela nombambiqhaza ngamunye. Esikoleni ngasinye babenginike igumbi elalinesicabha esivalekayo ukuvikela umsindo owawungaqhamuka ngaphandle ukuthi ungathikamezi ukuqhubeka kwenhlololwazi, ikakhulukazi ukuqoshwa kwayo. Esikoleni eGabangaye banginika ihhovisi leNhloko yoMnyango kanti eNgonyameni banginika ikhosi elalingenamuntu. Kuzona zombili izikole ngangiqala ngokuhlola izindlela abazisebenzisayo lapho befundisa isifundo seSayensi, nokuthi bakuqonda kanjani ukusetshenziswa kobulimimbili ekufundiseni izifundo ezahlukene. Ngangihlele ukuthi inhlololwazi nothisha ngamunye ibe yisikhathi esiyimizuzu engamashumi amane nanhlano ngenhloso yokungathathi isikhathi sabo sokusebenza kakhulu nokuthi nganeliseke ukuthi ngiphendulekile. Ngenxa yokuthi uthisha waseGabangaye nothisha waseNgonyameni babenikeza imininingo eminingi futhi bebuza imibuzo, sadlula esabo isikhathi kulesi engangisihlelile ngemizuzu eyishumi nanhlano nengamashumi amabili nambili ngokulandelana. Ngababuza bonke ababambiqhaza bocwaningo imibuzo engangiyihlelile.

IGabangaye Sekhondari yisikole engaqala ngaso ukwenza ucwaningo, ngakho-ke izingxoxo ezisakuhleleka ngaqala khona ukuzenza nababambiqhaza. Kwathi ngemuva kwekhefu, eGabangaye Sekhondari beza ngokwehlukana uThisha A noThisha B ukuthi sizokwenza ingxoxo esakuhleleka. Ngamunye uthisha ngangimchazela ukuthi ngiphethe isiqophamazwi ukuze ngiqophe inkulumo yethu ukuze uma sengibhala phansi inkulumo ekhulunyiwe kungenzeki ngibhale okungekhona kepha ngithathe amagama akhe enjengoba ewashilo. Abakhombisanga ukuba nenkinga futhi bakhombisa ukukuthakasela lokho.

Bayiphendula bonke imibuzo baze baqeda. Ngabe sengibonga, ngabazisa nokuthi uma sengiwuhlanganisile umbiko ophelele wocwaningo ngiyowuletha kubo ukuthi baqinisekise ukuthi bacashunwe kahle yini. Ngavalelisa, ngayolungiselela usuku olulandelayo lapho ngangiya khona esikoleni sesibili, iNgonyameni Sekhondari. Sahlela ukusebenzisa amahora amabili okugcina esikhathini sesikole ukuqhuba izingxoxo ezisakuhleleka. Ngamunye uThisha C noThisha D ngabachazela ukuthi izinkulumo zethu zazizoqoshwa kusiqophamazi njengesinye sezidingo zalolu cwano ukuze kungenzeki bacashunwe ngendlela engeyona. Yaqhubeka ingxoxo esakuhleleka, yaphela, ngabonga, ngathembisa ukubuya ngizobakhombisa uma sengiwuhlanganisile umbiko ophelele wocwaningo ukuze babone ukuthi abacashunwanga yini ngendlela okungeyona ukuze kulungiswe uma kunjalo.

3.5.1.1. Okwakwenzeka ngesikhathi sezingxoxo ezisakuhleka

Ngosuku lokuqala lokukhiqiza imininingo yocwaningo ngaya sesikoleni iGabangaye Sekhondari. Ngafika ekuseni ngaphambi kokuthi kushaye ihora lesikhombisa ngoba isikole singena ngokugamanxa kwalo ihora lesikhombisa. Ngaqala ngaya ehhovisi likathishanhloko, angangamfica kodwa ngathola isekela lakhe, ngazichaza, wangikhumbula, wabe esecela siyoxoxela ehhovisi lakhe. Wangemukela kahle wanginika indawo yokuhlala netafula lokubhalela ukuze ngikhululeke uma kunento engifisa ukuyibhala. Wahamba wayocela othisha besifundo seSayensi bobabili, wangethula kubona. Bakhombisa ukwethuka uma ngibabhekisisa. Ngenxa yalokho ngacela isekela likathishanhloko ukuthi lingishiye nabo kancane. Ngabachazela ukuthi ngangengezile ukuzobahlola ukufundisa kwabo ngenhloso yokubakala izingabunjalo labo lokufundisa bese beklonyeliswa ngalokho kodwa ngangizofunda kubona ukuthi kufundiswa kanjani. Ngaqhubeka ngabazisa ukuthi ngangingazudinga ifayela labo kodwa ngangizocela uhlelo lwesifundo sosuku engangizobabukela besifundisa njengenye yezidingo zalolu cwano. Baswabuluka ebusweni, bahleka nokuhleka. Ngabazisa ukuthi yibona ababezolekelela mina.

Ngosuku lwesibili ngaya eNgonyameni Sekhondari. Ngafika ekuseni, ngabingelela othisha ehhovisi labasebenzi. Ngacela ukuya kwiNhloko yoMnyango (*Departmental Head*) (*DH*) wesifundo seSayensi ngoba yiyo engangixoxa nayo ngocingo. Uthishanhloko wayengilindele, wangena ehhovisi lothisha, wangibona wabingelela wabe eseqinisekisa ukuthi ngize ngodaba locwaningo yini, ngavuma. Washo ukuthi

ungishiya neNhloko yoMnyango weSayensi ukuze izongixhumanisa nothisha webanga leshumi nanye. Ngaxoxisana nabo othisha besifundo seSayensi bobabili ngoba neNhloko yoMnyango weSayensi nayo ifundisa yona isifundo seSayensi ebangeni leshumi. Ngabachazela ngokuyiyona nhloso yocwaningo futhi ngagcizelela ukuthi ngangingezile ukuzobahlola ngenhloso yokubaklomelisa kodwa ngangihlose ukuqonda indlela abethula ngayo isifundo seSayensi, ukuze sizwakale kahle kubafundi.

3.5.1.1.1. Okwakwenzeka ngesikhathi sezingxoxo ezisakuhleleka eGabangaye

Isikole engaqala kuso ukwenza izingxoxo ezisakuhleleka yiGabangaye Sekhondari. Izingxoxo ezisakuhleleka ngangizenza nothisha besifundo seSayensi abafundisa iSayensi ebangeni leshumi neleshumi nanye ngokwehlukana. Ngangiba nengxoxo nothisha ngamunye. Isekela likathishanhloko langinika igumbi eliyihhovisi leNhloko yoMnyango wezifundo zoLimi. Leli gumbi enganginikwe lona lalinesicabha esivalekayo ukuze kungaphazamisi umsindo ngesikhathi sokuqhuba izingxoxo. Ngangihlele ukuthi ababambiqhaza ngizoba nezingxoxo ezizothatha imizuzu engamashumi amane nanhlanu ukuze kungaphazamiseki isikhathini sabo sokufundisa.

Ingxoxo yokuqala ngayenza noThisha A. Ngaqala ngokumchazela ukuthi ingxoxo yethu ngangizoyiqopha ngesiqophamazwi ngenhloso yokucoshela lonke ulwazi ayeluletha ukuze ngilubhale lunjengoba lunjalo lapho sengibhala phansi. UThisha A wayiphendula yonke imibuzo futhi naye kukhona ayekubuza ukuze aqondise esikukhulumayo. UThisha A wayekhuluma ngesineke futhi ekwemukela ukuthi ngimbuze imibuzo elandelela ezimpendulweni zakhe uma ngizwe sengathi impendulo idinga ukucaciswa. Izimpendulo zemibuzo ayeziletha uThisha A zazizinde futhi zazikhombisa ukuthi wayekuqonda lokhu ayekukhuluma mayelana nokusetshenziswa kobulimimbili ukufundisa isifundo seSayensi. Kwathi sesiqedile naye, ngabonga ngase ngilungela ukuxoxisana noThisha B.

UThisha B wafika egunjini lokwenza izingxoxo ezisakuhleleka. Ngamchazela ukuthi ingxoxo yethu ngangizoyiqopha ngenhloso yokubhala lonke ulwazi ayeluletha ngezimpendulo lunjengoba lunjalo. UThisha B wayekhombisa ukukuthakasela ukuba yingxenywe yezingxoxo ezimayelana nokufundiswa kwesifundo seSayensi, ikakhulukazi nokusetshenziswa kobulimimbili esifundweni seSayensi. Ingxoxo

phakathi kwethu yathatha ihora ngoba wayelula ingxoxo ngenxa yokuthi wayenaba lapho ephendula umbuzo nombuzo kanti futhi kwayena wayengibuza imibuzo lapho ayengaqondisisi khona umbuzo noma igama embuzweni.

3.5.1.1.2. Okwakwenzeka ngesikhathi sezingxoxo ezisakuhleleka eNgonyameni

Isikole sesibili engangenza kuso izingxoxo ezisakuhleleka kwakuyiNgonyameni Sekhondari. Kulesi sikole uthishanhloko wayenginike iklassi elingenamuntu njengegumbi engangizoqhubela kulo izingxoxo nababambiqhaza. Leli klassi lalinesicabha esivalekayo futhi okwakungangeni khona umsindo oqhamuka ngaphandle. Ngabacela bobalili ukuthi bafike ehhovisi ukuze ngibachazele ngesasizokwenza. Ngaqale ngabazisa ukuthi ingxoxo yethu nothisha ngamunye ngangizoyiqopha ukuze kulondeke ulwazi oluqokethwe yizingxoxo lunjengoba lunjalo. Ngaphinde ngabazisa ukuthi izingxoxo ngangihlele ukuthi zithathe imizuzu engamashumi amane nanhlano. Savumelana ngokuqala noThisha C ngoba uThisha D kwakusafanele abe nomhlangano nothisha bonke ngokumayela nomsebenzi.

Wasala uThisha C, ngabe sengilungiselela ukuqala inkulamo yethu yezingxoxo ezisakuhleleka. Ngamazisa ukuthi isiqophamazwi sasesivuliwe, ngakho-ke konke esasizokukhuluma kwakuzoqoshwa kwisiqophamazwi. Ingxoxo phakathi kwethu yathatha imizuzu engamashumi amathathu nantathu. Lokhu kwenzeka ngenxa yokuthi uThisha C wayephendula imibuzo ngezimpendulo ezimfushane kakhulu. Ezinye izimpendulo zakhe kwakuba yigama elilodwa. Kwakuthi uma ngiqhubeka ngilandelela ngombuzo wayengenabi ngezimpendulo. Kwathi uma sesifike ekugcineni, ngabonga, wabe esephuma. Ngaphuma ngayoshaywa umoya kancane ngoba sasingakafiki isikhathi sokungena sikaThisha D.

Engxogxweni yethu noThisha D ngaqala ngokumqinisekisa ukuthi isiqophamazwi sasesivuliwe, ngakho-ke yonke into esasizoyikhuluma yayizoqoshwa kwisiqophamazwi njengokuxoxa kwethu ngasekuqaleni. Ngesikhathi kuqhubeka ingxoxo yethu kwacaca embuzweni wokuqala ukuthi sengathi yayizothatha isikhathi esingaphezudlwana ukunalesi engangisihlelile. Lokhu kwakungenxa yokuthi uThisha D wayeyelula impendulo yakhe nokwakwenza sikhiqize imininingo eyisilinganiso esigculisayo. UThisha D ngokwakhe wayengibuza imibuzo ngenhloso yokuqondisisa imibuzo yengxoxo yethu. Ngenxa yakho konke lokhu ingxoxo yethu yathatha ihora nemizuzu eyisikhombisa. Lokho akusiphazamisanga isikhathi sakhe sokufundisa

ngoba wayengenalo iklasi ngalesi sikhathi kanti kwasekuzophuma isikole. Engakuqaphela kuye ukuthi wayezimisele ukuthi singaqhuba ingxoxo nangaphezu kwesikhathi esasibekiwe noma sesiphumile isikole.

3.5.2. Ukubukela Okwenziwa Ababambiqhaza

Ukubukela okwenziwa ababambiqhaza bocwaningo yindlela yokukhiqiza imininingo ngokuzinikela ngokuba yingxenywe yokwenziwa ababambiqhaza noma njengomcwaningi ubabukele ngaphandle kokuba yingxenywe yabakwenzayo. Ababambiqhaza bengabukelwa beyiqoqo noma ngamunye ngokwehlukana kwabo (Adeoye-Olatunde & Olenik, 2021). Ukubukela ababambiqhaza kuyindlela ewubuchule yokuthwebula ukuziphatha noma ukwenza kwababambiqhaza, izinto nokwenzeka kwezenzeko ezithile ngaphandle kokubuza imibuzo kumbe ukuxhumana nabo ngengxoxo.

Ukubukela okwenziwa ababambiqhaza njengendlela yekhwalithethivu yokukhiqiza ulwazi kusetshenziswa ukwelekelela umcwaningi ukuthola kanzulu ngesimo nokuqonda kabanzi ngaso isimo esicwaningwayo (Creswell et al., 2016). UCollins, Neely kanye noKhan (2024) baveza ukuthi ukukhiqiza ulwazi ngokubukela okwenziwa ababambiqhaza kuchaza ukuthi kumele umcwaningi aziyele mathupha ezikoleni noma eklasini, afike azibonele ngokwakhe okwenzekayo. Ngokungena eklasini umcwaningi uzitholela ulwazi lunjengoba lunjalo ngoba ubhala ngento azibonele yona yena siqu sakhe. Kulolu cwaningo nami ngiqoke ukuziyela siqu sami ezikoleni ukuze ngikubukele okwenziwa ababambiqhaza ngesikhathi othisha befundisa ukuze ngizibonele ukuthi uthisha ngamunye ubusebenzisa kanjani ubulimimbili ukufundisa esifundweni seSayensi emabangeni aphezulu ezikoleni.

3.5.2.1. Ukubukela okwenziwa ababambiqhaza esikoleni iGabangaye

IGabangaye Sekhondari yisikole engaqala kuso ukuyobukela okwakwenziwa ababambiqhaza. Ngaqala ngokuxoxa nabo ababambiqhaza ngenhloso yokuhlela ukubukela isifundo sethulwa nguthisha, isikhathi kanye nombambiqhaza engangizoqala ngaye. Ukuma kohlelo lokufunda lwaseGabangaye lwaluveza ukuthi uThisha A uyena owayezongena kuqala eklasini. Ngabazisa ukuthi ekungeneni nabo emaklasini ngangizobe ngingezukuba yingxenywe yokwenziwayo kodwa

ngangizohlala phansi, ngibukele abakwenzayo bese ngibhala lokho engikubonayo ngokulandela ithuluzi lokubukela okwenziwa ababambiqhaza.

Ngaqala nokuya ebangeni leshumi noThisha A njengokuhlela kwethu. Iklasi lalinabafundi abaningi kakhulu ngoba lalinabafundi abangama-65 kanti liyigumbi elejwayelekile. Lalinebhodi elincane okufanele ukuthi uthisha uma esefike ekupheleni kwalo alinde abafundi ukuthi baqede ukubhala ngakule ngxenye aqale kuyo ukubhala ngaphambi kokuthi acishe bese ebhala okusha. Babebaningi abafundi kodwa ngaqaphela ukuxhumana okuhle phakathi kukaThisha A nabafundi naphakathi kwabafundi ngabodwana. Isifundo esasethulwa sathatha ihora. Okunye okwaqapheleka kubafundi ukuthi banenhlonipho ngoba ngesikhathi singena eklasini nothisha basukuma babingelela, bahlala phansi ngemva kokuba uthisha eseshilo ukuthi abahlale futhi babengawubangi umsindo. Kwathi eseqedile, saphuma, mina ngaya egunjini enganginikwe lona, ngalindela uThisha B ukuthi siye ebangeni leshumi nanye.

Safika isikhathi sokuthi ngiye ebangeni leshumi nanye, wangilanda uThisha B. Engakuqaphela ukuthi iklasi lalinabafundi abaningi kakhulu kunesibalo esamukelekile ngoba babengamashumi ayisithupha nesikhombisa. Kuleli klasi indawo yokuhlala yayeswelakele ngoba abanye abafundi babehleli besondele kakhulu ebhodini kanti bahleli ngabathathu. Nalapha ebangeni leshumi nanye kwaqapheleka ukuxhumana okuhle phakathi kukathisha nabafundi naphakathi kwabafundi bebodwa. Odongeni ngabona kunezithombe ezisondelene nesifundo seSayensi. UThisha B wayefike namaphepha ayenomsebenzi owawuzobhalwa futhi uphendulwe abafundi eklasini. Ngemva kokuthi uThisha B ebanikile abafundi ithuba lokubhala umsebenzi wathi ababhale izimpendulo ebhodini. Babeshintshana ngokubhala ebhodini. Kwakuthi uma umfundi ebhala impendulo okungeyona noma ephambuka esitebhini sesibalo seSayensi bese uThisha B enika abafundi ithuba lokuthi bamlekelele uzakwabo ukulungisa. Kwakuthi uma lehluleka iklasi ukumelekelela bese ebanika yena impendulo ngokubakhumbuza asebekufundile nendlela yokufinyelela empendulweni.

3.5.2.2. Ukubukela okwenziwa ababambiqhaza esikoleni iNgonyameni

Isikole sesibili engabukela kuso okwakwenziwa ababambiqhaza kwaba yiNgonyameni Sekhondari. ENgonyameni Sekhondari ngafika ekuseni. Ngaba

nengxoxo nababambiqhaza, savumelana ngothisha engangizokuya naye eklasini kuqala. Lowo thisha kwakunguthisha C ngoba isikhathi sokuya emaklasini sasikhomba ukuthi nguyena owayezoya kuqala. Ngabazisa ababambiqhaza ngokuthi uma sengingene nabo emaklasini ngangizohlala phansi futhi ngangingazokuba yingxenywe yababekwenza kodwa ngangizobhala phansi engangizokubona kwenzeka ngokulandela ithuluzi lokubukela okwenziwa yibo njengababambiqhaza. Ngalinda ehovisi ngoba iklasi lokuqala engangizoya kulo lalizongena ngesikhathi esandulela ikhefu.

Kwafika isikhathi sokuthi ngiye eklasini noThisha C ebangeni leshumi nanye. Iklasi lakhe lalinabafundi abangamane nanhlano. Lalingahlanzekile, ligcwele amaphepha phansi. Kepha ngaqaphela ukuxhumana okuhle phakathi kukathisha nabafundi. UThisha C uma efundisa, abafundi babelalela, babebuza imibuzo futhi babephendula uma kufanele. Babevumelekile ukuba nezingxoxo emaqoqweni ababehleli kuwo, babevumelekile futhi nokuyobhala ebhodini izimpendulo zomsebenzi owabhalwa eklasini. Kwafika isikhathi sekhefu, saphuma eklasini ngahamba ngayolinda eklasini enganginikezwe lona ukuze ngihlanganele kulo nababambiqhaza.

Kwathi uma lidlula ikhefu, saya noThisha D ebangeni leshumi. Iklasi lakhe lalihlanzekile, kwakungekho phepha phansi. Sathi singena babe besukuma besibingelela abafundi, base belindela ukuthi uthisha athi bahlale phansi. Wabe esengethula kubona abafundi uThisha D, wabachazela engangize ngakho kafushane. UThisha D waqala isifundo sakhe ngokuthi enzele abafundi i-ekperimenti. Ngemuva kwalokho wababuza imibuzo ngayo, baphendula ngokuqonda kwabo nangendlela ababeyibona ngayo. Waqala wethula isifundo sosuku nokwavela ukuthi i-eksperimenti yayihlelwe ngenhloso yokwethula isifundo sangalelo langa.

Kwaqhubeka kahle ukufunda nokufundisa futhi abafundi babekhombisa ukusithakasela isifundo sosuku. UThisha D wabhala ebhodini umsebenzi okwakufanele abafundi baphendule imibuzo yawo ngenhloso yokuhlola ukuqonda kwabo isifundo sosuku. Abafundi babebhala ebhodini izimpendulo. Babevumelekile ukwelekelelana ngezimpendulo uma omunye edideka. Engakuqaphela ukuthi uThisha D obondeni lweklasi lakhe kwakunezithombe ezisondelene nesifundo

seSayensi. Kwashaya isikhathi sokuthi siphume siye eklasini elalingenamuntu ngoba nganginikwe lona ukuthi ngiqhubele khona inhlololwazi.

3.5.3. Ukuhlaziywa Kwamadokhumenti

UChanda (2021) uchaza ukuthi ukuhlaziywa kwamadokhumenti kuyindlela yokubuyekeza amadokhumenti angamaphepha aprintiwe noma ukuwahlaziya ekumakhompyutha engaprintiwe. Njengazo zonke izindlela zokuhlaziya, ukuhlaziywa kwamadokhumenti ocwaningo oluyikhwalthethivu kudinga ukuthi imininingo icutshungulisiwe, ihunyushwe ukuze ilethe ukuqonda nolwazi oluzosetshenziswa ocwaningweni. UMorgan (2022) uveza ukuthi ukuhlaziywa kwamadokhumenti ngokwejwayelekile kusetshenziswa kuhlangelelwe nezinye izindlela zocwaningo oluyikhwalthethivu njengezindlela zocwaningo ezelekelelana ukukhiqiza imininingo yocwaningo. Ukuhlaziywa kwamadokhumenti ngokusebenzisa ulwazi locwaningo olukhiqizwe ngezindlela zocwaningo ezingefani kuyamelekelela umcwaningi ukuthi akwazi ukuqinisekisa imininingo yocwaningo ukuze aqinisekise ukwethembeka nobuqiniso bocwaningo (Chanda, 2021).

UMorgan (2022) ucacisa ukuthi kunezinhlalo ezahlukene zamadokhumenti okukhulunywa ngazo uma kuchazwa ukuhlaziywa kwamadokhumenti ocwaningo. Lezi zinhlobo zamadokhumenti zimbandakanya izithombe, amavidiyo, amafilimu, okubhalwe phansi, nokunye okuningi kubandakanywa nokubhalwe phansi. Ukuhlaziya amadokhumenti ngakhetha ukukusebenzisa ngoba ngangifuna ukuqinisekisa imininingo engiyikhiqiza nababambiqhaza ukuze ngibone kahle lapho sengihlaziya imininingo yocwaningo ukuthi othisha babusebenzisa kanjani ubulimimbili ukufundisa isifundo seSayensi. UMorgan (2022) uthi izingxoxo ezisakuhleleka nokubukela okwenziwa ababambiqhaza kungelethe ukuqonda okwanele ngesimo esicwaningwayo kubacwaningi. Yingakho abacwaningi babuye bangeze ngezindlela ezifana nokuhlaziya amadokhumenti.

Khoa, Hung, kanye noHejsalem-Brahmi (2023) bathi ukuthola imininingo ngokubukela okwenziwa ababambiqhaza kuthanda ukuba lukhuni kubacwaningi abangakabi namava ekucwaningeni ngoba basuke bengakaqini emakhonweni okucoshela okwenzekayo ngokukubhala ngasikhathi sinye nokubukela okwenziwa ababambiqhaza. Amadokhumenti engawahlaziya kwaba izinhlelo zezifunwana, amathuluzi okubukela okwenziwa ababambiqhaza, amanothi anemisebenzi

yabafundi kanye nezincwadi zeSayensi ababezisebenzisa ababambiqhaza emabangeni abawafundisayo.

3.5.3. Ukuhlaziya Idokhumenti Yohlelo Lwesifundo

Ngemuva kokubukela okwakwenziwa ababambiqhaza ngesikhathi bethula isifundo seSayensi ebangeni leshumi nakweleshumi nanye eGabangaye naseNgonyameni Sekhondari, ngacela izinhlelo zezifundo zosuku ababezisebenzisa ukufundisa ngalezi zinsuku engangibabukele ngazo emaklasini. Uhlelo lwesifundo ngangiluhlaziya kusuka esingenisweni kuya esiphethweni sesifundo. Ngangikwenza ngenhloso yokubona imininingwane ngokuqhubeka kwesifundo ngokuqaphelisisa okuhlelelwe ukwenziwa uthisha nokuhlelelwe umfundi. Ngangibheka nesikhathi esibhalwe phansi esihlawumbisela ubude baleso naleso sihlokwana. Ukuhlaziywa kohlelo lwesifundo ngakwenza kuhambisana nedokhumenti yokubukela okwenziwa ababambiqhaza. Lokhu ngakwenza ngenxa yokuthi le dokhumenti ihlaziya isifundo esathulwa kanti uhlelo lwesifunjwana lwaluhlelelwe sona isifundo engangisibukele sethulwa.

3.5.4. Ukuhlaziya Idokhumenti Yamanothi Enomsebenzi Wokuhlola Abafundi

Ayemabili amadokhumenti amanothi anomsebenzi wabafundi wosuku engawathola. Kwaba idokhumenti kaThisha B nekaThisha D. Amadokhumenti kaThisha A nakaThisha C ayengenawo amanothi kodwa kwakungamadokhumenti anomsebenzi othisha ababehlola ngawo abafundi ukuthi basiqonde kangakanani isifundo. Kuwona wonke la madokhumenti ngangibheka ukuthi ngabe ihlelwe kanjani ukulungela ukufundisa lesi sifundo kubafundi beSayensi. Kuwo la madokhumenti futhi ngangibheka ukuthi kungabe othisha besifundo seSayensi babusebenzisa kanjani ubulimimbili ukufundisa isifundo seSayensi. Lokhu ngangikubheka kusuka ekuhlelweni kwesingeniso samanothi kuze kuyofika esiphethweni sawo.

Okunye engangikubheka kula madokhumenti ukuthi amakhonsephthi eSayensi ngabe uthisha ngamunye wayewacacisile yini ngokusebenzisa ubulimimbili noma wayegcina ngokubhala ngolimi lweSayensi. Kubona bonke othisha akekho owabhalisa umsebenzi ezincwadini zabafundi kodwa babebahlola ngokubabuza imibuzo, baphendule ngemilomo yabo abafundi futhi othisha babebuye bahlole

ulwazi nokuthi basiqonde kangakanani isifundo ngokuthi bababhalise ebhodini umsebenzi.

3.6. Izindlela Zokuqoka Ababambiqhaza

Abacwaningi kufanele basheshe basithathe lusaqala ucwaningo isinqumo ngendlela abazoyilandela ukuqoka ababambiqhaza. Kufanele bacacise zisuka nje ukuthi bazokhetha ingxenye, isibalo esithile noma wonke umphakathi othintekayo kuleso sihloko socwaningo ukuthi babambe iqhaza ocwaningweni (Cohen, Manion & Morrison, 2018). Lolu cwano lusebenzise indlela yokuqoka ababambiqhaza engokuqoka ngokwenhloso. Ngikwenze lokhu ngoba kulolu cwano ngihlose ukuthola ulwazi locwaningo kothisha abafundisa isifundo seSayensi ezikoleni ezimbili emabangeni aphezulu. Yibona-ke othisha laba engibaqokile ngoba ngethemba ukuthi bazonginika ulwazi oludingwa yilolu cwano ngoba bangabafundisi balesi sifundo kuyo le ndawo.

UMulisa (2022) bafakazela lokhu ngokubalula ukuthi ukuqokwa kwababambiqhaza kumbandakanya ukuthatha izinqumo ngokuthi yibaphi abantu abazobamba iqhaza ocwaningweni, yisiphi isizinda socwaningo nanokuthi yimiphi iminyakazo nokuziphatha kwababambiqhaza okuzocutshungulwa. Lokhu kuhambisana ngqo nokushiwo (Creswell et al., 2016) lapho beveza khona ukuthi ucwaningo oluyikhwalithethivu ngokuvamile lusebenzisa indlela yokuqoka ababambiqhaza ngenhloso.

Ababambiqhaza bayiqoqo eliqokwe ngenhloso ethile ukumelela lesi simo esicwaningwayo, iqoqo, izimo, indawo noma uhlobo oluthile maqondana nezicizibonakaliso zocwaningo. Ababambiqhaza kulolu cwano ngibaqoke ngokulandela indlela yokuqoka ngokwenhloso ngoba ngikhethe othisha abafundisa isifundo seSayensi nokuyisona sifundo engihlose ukucwaninga ngaso. Banamava ahlukeni laba babambiqhaza ekufundiseni isifundo seSayensi ngoba akekho kubona ofundise iminyaka engaphansi kwemine esikoleni ngasinye futhi bonke banolwazi lwesifundo seSayensi futhi baqeqeshelwa ukusifundisa. U-Adeoye-Olatunde beno-Olenik (2021) baveza ukuthi ukukhetha isampula locwaningo, abacwaningi kufanele baqinisekise ukuthi bakhetha abantu abanolwazi ngokucwaningwayo futhi abazokhiqiza imininingo ngokuletha imibono engefani ngqo.

Kulolu cwaningo ngiqoke ukuba nesampula elinithisha abane. Kulab' othisha ababili kubo bafundisa isifundo seSayensi ebangeni leshumi kanti abanye ababili bafundisa isifundo seSayensi ebangeni leshumi nanye. Amagama abo (okungewona awangempela) uThisha A, uThisha B, uThisha C kanye noThisha D. UThisha A ufundisa isifundo seSayensi ebangeni leshumi eGabangaye Sekhondari, uThisha B ufundisa isifundo seSayensi ebangeni leshumi nanye eGabangaye Sekhondari kanti uThisha C noThisha D bafundisa isifundo seSayensi ebangeni leshumi naye neleshumi ngokulandelana kwabo eNgonyameni Sekhondari.

3.7. Ukuvivinywa Kwamathuluzi Ocwangingo

Ukuvivinywa kwamathuluzi ocwangingo kuwucwangingo oluncanyana olwenziwa ngaphambi kokuqala ucwangingo oluhlosiwe ngenhloso yokuhlola amathuluzi ocwangingo ukuthi azosebenza kahle yini futhi yilapho umcwangingi athola khona ithuba lokuhlola imibuzo yakhe azoyibuza ukuthi imi kahle yini, ibuzeke kanjani, ukuze uma kukhona engezwakali, alungise, ayibhale ngendlela yokuthi izwakale kahle (Mocorro, 2017). Ukuvivinywa amathuluzi ocwangingo kuletha ukuzethemba nokuthuthuka kumcwangingi ekuhloleni ulwazi nokuqonda kwababambiqhaza kanye nokwakha ukuxhumana nokusebenzisana nabo, ukwethembana nabo kanye nokukwazi ukubenza bakhululeke ukuze umcwangingi aqinisekise ukuthi uthola imininingo eyisilinganiso esanele kubona (Miranda, et al., 2023). Abacwangingi abangoMocorro (2017) kanye noMiranda nabanye (2023) baveza ukuthi ukuvivinywa kwamathuluzi ocwangingo kuqinisekisa ubuqotho nokwethembeka kombuzo wocwangingo.

Ngasebenzisa isikole iJama Sekhondari (okungelona igama langempela) ukuvivinywa amathuluzi ocwangingo ngoba ngangizofinyelela kalula kuso ngoba siseduze nasekhaya futhi nganginesiqiniseko sokuthi angeke ngisebenzise sona ukukhiqiza imininingo yocwangingo. Amathuluzi okukhiqiza imininingo yocwangingo engawasebenzisa kwaba ingxoxo esakuhleleka, ukubukela okwenziwa ababambiqhaza bocwangingo kanye nokuhlaziya amadokhumenti.

Ngaqoka uthisha wesifundo seSayensi ebesisebenzisana naye kwisekethe yaseMsinga ngenkathi ngisafundisa nami khona ukuthi abe umbambiqhaza. Lokhu kuvivinywa ngakwenza ngenhloso yokuhlola ukuthi uma sengenza ucwangingo lwangempela ngabe lwaluzophumelela yini ngokusebenzisa la mathuluzi.

Ngamchazela ukuthi ngangizongena naye ekilasini ngenhloso yokumbukela lapho efundisa bese ngimbuza imibuzo ezingxoxweni ezisakuhleleka. Ekugcineni ngacela isifundo salolo suku ukuze ngisicubungule ukuze ngibone kahle ukuthi azolusiza ngempela yini lolu cwaningo wonke la mathuluzi okukhiqiza imininingo yocwaningo.

Engxoxweni esakuhleleka kwakunemibuzo emayelana nokusetshenziswa kobulimimbili ukufundisa isifundo seSayensi eyabe ihlelelwe ukuthi ayiphendule. Ingxoxo esakuhleleka kanye nokumbukela ngakwenza ngosuku olulodwa. Wayiphendula yonke imibuzo yocwaningo nokuyilapho akhombisa ukuvuleleka okukhulu ekwethuleni izimpendulo zemibuzo ekhona waze wathi ukwedlulela nakokwakungabuzwanga. Ukumbukela ngesikhathi efundisa kwaba yimpumelelo ngoba ngabona ekugcineni ukuthi ubusebenzisa kanjani ubulimimbili ukufundisa esifundweni seSayensi. Ngaze ngabona nohlobo lwezinsizakufundisa azisebenzisayo nomthelela wazo ekufundiseni kusetshenziswa ubulimimbili.

Kuwo la mathuluzi ngibe sengifunda ukulandelisa ngemibuzo equbukayo ngenkathi kusaqhubeka ingxoxo ngaphandle kokuphazamisa umbambiqhaza ngenkathi esakhuluma. Ngangenzela ukugwema ukuthi engaze adideke, agcine engasanikezanga imininingo ephelele nenothile ngombuzo. Ngaqaphela kodwa ukuthi nakuba ayiphendula yonke imibuzo yengxoxo esakuhleleka kodwa ngenxa yobuningi bayo imibuzo wagcina esekhombisa ukukhathala, lokho ngakubona ngokuthi engabe esaphendula ngomfutho nangokwenaba ngenkathi ephendula imibuzo kusuka kwengasekuqaleni kuya ngaphambi kwemihlanu yokugcina. Ngenxa yalokho ngagcina sengilehlisa inani lemibuzo yezingxoxo ezisakuhleleka ukuze ababambiqhaza engangizosebenzisana nabo bangakhathali baze banikeze imininingo engagculisi nenganele.

3.8. Ukuhlaziywa kwemininingo yocwaningo

Lolu cwaningo inhloso yalo ukuhumusha imininingo etholakale kulo ukuze kuphenduleke umbuzo walo, yingakho ngisebenze ngaphansi kwepharadaymu yomuhumusho ngibe ulwazi ngilukhiqize ngokocwaningo oluyikhwalithethivu. Lokhu kufakazelwa uCreswell nabanye (2016) lapho bethi khona ukuhlaziya imininingo yocwaningo oluyikhwalithethivu kusekeleke enzululwazini yokuhumusha ehlose ukuhlolisisa izimpawu zokuqukethwe ukuthi kwenza mqondo muni. Imininingo yocwaningo ngizoyihlaziya ngokuyihumusha injengoba injalo ngokusebenzisa

izindikimba. Lokhu kusho ukuthi okuzobe kutholakele kuqoshiwe, ngizokubhala phansi ngiveze igama negama elizobe likhulunywa umbambiqhaza ngamunye.

URosairo (2023) uveza ukuthi ukuhlaziya imininingo ngokusebenzisa izindikimba kubandakanya ukuthi umcwaningi ahlonze izindikimba ngokufunda ngokucophelela imininingo yocwaningo ebhalekayo. URosairo (2023) uveza ukuthi umcwaningi uye acubungule imininingo yocwaningo ngobunyoninco ukuze ahlonze izindikimba ezifanayo, imibono namaphethini ezincazelo zemininingo elokhu ivela iphindelela. Ukuhlaziywa kocwaningo ngokusebenzisa izindikimba kubandakanya ukusebenzisa amakhodi ukuhlela imininingo yocwaningo, kanye nokuhlonza izindikimba. Lokhu kuqala ngokuthi umcwaningi azijwayeze imininingo. Lokhu kungabandakanya ukuthi ayifunde ephindelela umcwaningi imininingo ayikhiqizile, nokuthi ayibhale phansi ibe ngamagama imininingo ekhiqizwe ngezingxoxo ezisakuhleleka (Creswell, et al., 2016; Rosairo, 2023).

URosairo (2023) uveza ukuthi abaluleke kakhulu amakhodi ekuhlaziyeni ngezindikimba ngoba alekelela ukuhlonza imiqondo nezihlokwana ezifanayo emininigweni ekhiqiziwe bese kufinyeleleka kalula kuyona uma umcwaningi esefuna ukuyisebenzisa. Abacwaningi abangoCreswell noCreswell (2018) noCreswell nabanye (2016) bathi umcwaningi kumele athole izindlela zokunciphisa imininingo ayikhiqizile ngokuyihlaziya okutholakele okuphuma kuyo ukuze kwenze umqondo. Lokhu ngikwenzela ukuthi lokhu okufanayo ngikuhlaziye ngaphansi kwephuzu elilodwa bese kuthi okwehlukile ngikufake kwamanye amaphuzu ukuze ngingaphindaphindi into eyodwa embikweni wocwaningo. Kulolu cwano ngikhethe ukusebenzisa ukuhlaziya ucwaningo ngokusebenzisa izindikimba ukuze imininingo engiyithola ifana ngiyihlaziye ngaphansi kwephuzu elilodwa.

Ngaqala ngokulalela izingxoxo ezisakuhleleka. Ngesikhathi ngizilalele izingxoxo ngabe ngibhala konke okwakukhulunywa umbambiqhaza ngamunye. Ngazifunda zonke izingxoxo sezibhalwe phansi, ngabe sengizibhala ngombala ofanayo ezinomqondo ofanayo. Ngalandela ngokukhipha izindikimba kuzo lezi zingxoxo ngenhloso yokufinyelela kalula kuzo uma sengizidinga. Nasemathuluzini okubukela okwenziwa ababambiqhaza ngaqala ngokudwebela ngombala ofanayo okunomqondo ofanayo emininigweni engangiyikhiqize ngokubukela othisha ngesikhathi befundisa. Ngemuva kwalapho ngakhipha izindikimba kuwo la makhodi

ukuze ngifinyelele kalula kuzo uma sengizidinga. UCohen benoManion noMorrison (2018) bagcizelela ukuthi ukuhlaziya imininingo yocwaningo oluyikhwalthethivu kubandakanya ukuhlela sakuqoqa, ukuchaza, ukuqonda, ukuchaza imininingo, nokuqondisisa imininingo yocwaningo ngokwezincazelo zababambiqhaza bocwaningo, ukuqaphela amaphethini, izindikimba njalonjalo.

3.9. Ukukholakala nokuthembeka nobuqiniso kocwaningo

U-Adler (2022) uthi ukukholeka kocwaningo kuqiniswa ukuchaza kabanzi ngemininingo. Imininingo yalolu cwaningo ngiyiveze ngokucaphuna okuqoshiwe ezingxoxweni ezisakuhleleka ebengiziqhuba nababambiqhaza, ngaphinda ngayiveza ngokuthi ngiveze engikubukelile kubabambiqhaza ezifunjwaneni ngesikhathi befundisa. Ngicaphune okuvela emathuluzini okubukela okwenziwa ababambiqhaza lapho kuvela khona ukuthi babusebenzisa kanjani othisha ubulimimbili ukufundisa isifundo seSayensi emabangeni aphezulu ezikoleni. U-Ahmed (2024) uyakufakazela lokhu ngokuthi agcizelele ukuthi imininingo kumele ibe ngeyangempela ikhombise amava ababambiqhaza. Ulwazi engilukhiqizile yilolo oluveza kuphela amava nokwenza kwababambiqhaza balolu cwaningo kuphela. Njengoba lwenzeka eMzinyathi ngaphansi kukamasipala waseMsinga ebukhosini baseMabomvini naseMachunwini, angikhulumanga ngezikole ezingekho ngaphansi kwalezi zindawo nalezo engingenzanga kuzo ucwaningo.

Kulo mbiko wocwaningo ngivezile ukuthi ngiyihlaziye kanjani imininingo futhi ngifike kanjani ekutheni ngiphethe ngendlela engiluphethe ngayo ucwaningo. Ukugoqa ucwaningo lwami kuncike eminingweni esiyikhiqize nababambiqhaza. Uma bebusebenzisa ubulimimbili esifundweni seSayensi, kuzovela ukuthi babusebenzisa kanjani, kungenjalo kuyovela lokhu engikutholile njengoba sengibhala umbiko walo. UCloutier benoRavasi (2021) bayakugcizelela lokhu ngokuthi umcwaningi kumele akhombise ngokucacile ukuthi uyihlaziye kanjani imininingo yakhe nanokuthi ufinyelele kanjani esiphethweni sakhe.

3.10. Inkambiso elungileyo yocwaningo

Mina ngokwelekelelwa abeluleki bami ngaqala ngokubhalela uMnyango Wemfundo eyiSisekelo esifundazweni saKwaZulu-Natali, ngacela imvume yokwenza ucwaningo ezikoleni. Ngabe sengicela futhi kothishanhloko imvume yokucwaninga ezikoleni

zabo. Ababambiqhaza okungothisha, ngacela imvume kubo yokuthi ngibaqophe. Ngabaqinisekisa ababambiqhaza ukuthi akukho lapho ingxoxo yethu eqoshiwe iyosebenza khona ngaphandle kwakulolu cwaningo.

UCohen, benoManion noMorrison (2018) baveza ukuthi abacwaningi abacwaninga ngenhloso yokushintsha isimo emphakathini kufanele baqikelele umthelela ucwaningo olungaba nawo kubabambiqhaza kungakhathalele ukuthi hlobo luni lomsebenzi abacwaningi abawenzayo. Ngaleyo ndlela kufanele abacwaningi baluphathe ngendlela evikela isithunzi sababambiqhaza njengabantu ucwaningo. Lokho kuyinkambiso elungile ukuqinisekisa ukuhlonipheka nokuvikeleka kwababambiqhaza njengabantu.

Kwathi lapho sengithole imvume eMnyangweni WeMfundo EyisiSekelo ngase nginikeza ababambiqhaza bocwaningo ifomu elibacacisela ukuthi: (a) ukuba yingxenywe yalolu cwaningo bakwenza ngokuvolontiya, (b) banelungelo lokuhoxa noma inini ngaphandle kokuthi kube nomthelela omubi ezimpilweni zabo, (c) imininingwane yabo ngeke ixhunyaniswe nabo noma nobuluqobo babo, (d) imininingwane emayelana nezikole ngeke ivezwe imataniswe nazo. Ngemuva kokuthola imvume eMnyangweni WeMfundo eyisiSekelo nakothishanhloko ukwenza ucwaningo ezikoleni zaseMzinyathi eMsinga, ngokwelekelelwa abeluleki bami ngabe sengicela imvume eNyuvesi yaKwaZulu-Natali ukucela imvume yokwenza ucwaningo ezikoleni eNyuvesi yaKwaZulu-Natali ngokulandela inkambiso elungileyo yocwaningo.

Imininingo yonke engiyisebenzisile kulolu cwaningo ngiyoyigcina iphephile ngokuthi akekho omunye umuntu oyokwazi ukufinyelela kuyo ngaphandle kwami nabeluleki bami ukuze ngivikele izikole kanye nababambiqhaza. Emuva kweminyaka emihlanu ucwaningo lwaphothulwa ngiyoyishabalalisa yonke imininingo yocwaningo. Imininingo engamaphepha ngiyoyihlephula ibe izingcucu kanti egcinwe ezilululwazini zobuchwepheshe ngiyoyicisha bese izilululwazi ngizibulala ngokuziqhephula nazo. Zonke izincwadi zezimvume engangizithola kusuka ezikoleni, enyuvesi, eMkhandlwini waseMzinyathi woMnyango WeMfundo eyisiSekelo, naseMnyangweni WeMfundo eyisiSekelo esifundazweni saKwaZulu-Natali ngizifake njengezeleko kulo mbiko wocwaningo.

3.11. Iqoqa lesahluko

Lesi sahluko sethule umklamo nezindlela zocwaningo ezalandelwa ukuze lolu cwaningo lube impumelelo. Siwethule ngaphansi kwalezi zihlokwana: Ucwanningo lwekhwalithethivu, ipharadaymu yocwaningo, ucwaningo lwesimo, izindlela zokukhiqiza imininingo yocwaningo, ukuqoka ababambiqhaza, ukuvivinywa kwamathuluzi ocwaningo, ukuhlaziywa kocwaningo, ukwethembeka nobuqiniso bocwaningo, ukulandelwa kwenkambiso elungileyo. Esahlukweni esilandelayo ngizokwethula ngihumushe imininingo yocwaningo eyatholakala ngokuphendula umbuzo wokuqala walolu cwaningo.

ISAHLUKO SESINE

Indlela Othisha Ababuqonda Ngayo Ubulimimbili

4.1. Isingeniso

Isahluko esedlule sethule umklamo nezindlela zocwaningo. Kulesi sahluko ngizokwethula imininingo eyatholakala ekuphenduleni umbuzongqangi wokuqala walolu cwaningo othi: “Othisha abafundisa isifundo seSayensi bakuqonda kanjani ukusebenzisa ubulimimbili ekufundiseni isifundo seSayensi kubafundi bebanga leshumi neleshumi nanye?” Ngizokwenza lokhu ngaphansi kwalesi sihloko: “Indlela Othisha Ababuqonda Ngayo Ubulimimbili Ekufundiseni Isifundo Sesayensi Ebangeni Leshumi Neleshumi nanye”.

4.2. Indlela othisha ababuqonda ngayo ubulimimbili ekufundiseni isifundo

seSayensi ebangeni leshumi neleshumi nanye

Ngaphansi kwalesi sihloko, ngizochaza indlela othisha abakuqonda ngayo ukufundisa isifundo seSayensi kusetshenziswa ubulimimbili ebangeni leshumi neleshumi nanye ngaphansi kwalezi zihlokwana ezilandelayo:

- (i) Ukuchaza ngolimi lwabafundi ulwazi olubhalwe ngolimi lwesiNgisi.
- (ii) Ukuchaza amakhonsephe esifundo seSayensi ngesiZulu.
- (iii) Ukusebenzisa izibonelo zesiZulu.
- (iv) Ukubuza imibuzo ngesiNgisi iphinde ibuzwe ngesiZulu.
- (v) Ukusetshenziswa kwezichazamazwi.
- (vi) Izinsizakufundisa ezihlobene namasiko nezinkolelo zesiNtu ekuchazeni okuqokethwe yisifundo.

4.2.1. Ukuchaza ngolimi lwabafundi ulwazi olubhalwe ngolimi lwesiNgisi

Ngaphansi kwalesi sihlokwana kuyavela ezitatimendeni zababambiqhaza ukuthi bayalusebenzisa ulimi lwabafundi okungokwasekhaya, okuyisiZulu ngokwalolu cwaningo, lapho bechaza imibhalo equkethe ulwazi olubhalwe ngolimi lwesiNgisi ukuqinisekisa ukuthi bayakuqonda lokho okubhalwe ngesiNgisi. Ababambiqhaza balolu cwaningo ngibethe amagama ngokuthi uThisha A, uThisha B, uThisha C

noThisha D, nokuyindlela abavela ngayo kulolu cwaningo. Nazi izibonelo zezitatimende zababambiqhaza ababambiqhaza ngalesi sihlokwana ngezansi:

Kuba nzima ukuthi izingane zithole nokuthi bakuqonde kahle engisuke ngifisa ukukudlulisa kubona uma ngifundisa ngolimi lwesiNgisi kuphela nokuthi bakuqonde kahle ngoba akusilona ulimi lwabo lwebele. Kuye kube sengathi ngingabuye ngithi ukuthi thasi noma ngingangeza ngolimi lwethu lwebele [isiZulu] ukuze baqonde kahle abafundi (Thisha A).

Lokhu kuyahambisana nokushiwo uThisha B lapho ethi:

Ngicabanga kuyinto esiza kakhulu ukuchaza ngesiZulu kubafundi *especially* njengoba kulaba bafundi balapha e-eMzansi [eNingizimu-Afrika], lolu limi lwase-*West* [isiNgisi] lubanika inkinga. Ngiye ngizame ukuthi ngi-*translat(e)* [ngihumushe] yonke into ukuze bezwe engikufundisayo. Ngaqala ngifuna ukubona ukuthi ngeke yini kwalunga noma benze kangcono abafundi, ngawubona umehluko (Thisha B).

Kanti uThisha D ugcizelela ukuthi:

I-English when it comes to Science iyazidida ngempela izingane, kugcine kunaleyo *confusion*. Ngigcina sengichaza ngesiZulu ngoba yisona abasazi kahle futhi bayaqonda kahle impela baze baphase. Uma uzocabanga ukuthi uzokhuluma isiNgisi kuphela ekufundiseni, khohlwa, uzobe ukhuluma wedwa lapho (Thisha D).

Lezi zitatimende zababambiqhaza abacashunwe ngenhla ziveza ukuthi othisha indlela abaqonda ngayo ukusetshenziswa kobulimimbili ukufundisa isifundo seSayensi ukuthi bakholelwa ukuthi ukusebenzisa ulimi lwabafundi, okuyisiZulu

kulolu cwaningo, kuyabalekelela abafundi ukuthi baqonde umbhalo obhalwe ngolimi lwesiNgesi, nalapho uthisha echaza, akushoyo uyaqikelela ukuthi abuye akubeke ngolimi abaluzwa kangcono. Lezi zikole zombili zisendaweni yasemakhaya kanti ulimi lwesiNgesi akulula ukuba lube wulimi olukhulunywa ekhaya njengoba indawo yonke ihlala abantu abakhuluma isiZulu. Lokhu kuyahambisana nokuvezwa uCharamba (2019) eNingizimu-Afrika lapho ayecwaninga khona ukuxhumana phakathi kokufunda nolimi eklasini elinabafundi abakhuluma izilimi ezahlukene. UCharamba (2019) uveza ukuthi ukuchazela abafundi ngolimi lwabo lwebele kuthuthukisa ukuqonda kwabo okufundwayo esifundweni seSayensi nokuphinda kubathuthukise emakhonweni eSayensi. Lokhu kuyabalekelela abafundi ukuthuthuka olimini lwesiNgesi, esiwulimi lwesibili kubo. Ngokwalolu cwaningo lukaCharamba ukuhumushela abafundi ngolimi lwebele kuthuthukisa ukuqonda isifundo seSayensi kubafundi abakhuluma izilimi ezahlukene nalapho okusuke kungukuthi ulimi lwesiNgesi olwesibili kubo.

UDe Los Reyes benoBagona (2020) ocwaningweni lapho ababecwaninga khona ngokuhumusha ekufundiseni nasekufundeni isifundo seSayensi ezikoleni ezazikhethiwe ezweni lasePhilippine, bavumelana nokuvela kulolu cwaningo lwami ngokuthi baveze ukuthi ukuchazela abafundi ngolimi lwabo lwebele kunenzuzo enkulu kubafundi ngoba bathola ukuqonda okwanele esifundweni seSayensi. UDe Los Reyes benoBagona (2020) baqhubeka bathi ukuchazela abafundi ngolimi abalufunda kangcono kuthuthukisa ukuqonda nemiphumela yabafundi.

4.2.2. Ukuchaza amakhonsepthe esifundo seSayensi ngesiZulu

Ngaphansi kwalesi sihlokwana kuyavela ezitatimendeni zababambiqhaza ukuthi ukwethula ikhonsepthe elisha lesifundo seSayensi ngokuchazela abafundi ngolimi lwesiNgesi kuphela kwenza ukuthi abafundi babe nengqinamba ukuqonda amakhonsepthe eSayensi kodwa ukuqonda kwabo okuphelele bakuthola uma uthisha echaza ngolimi lwesiZulu. Nazi izicaphuno zokushiwo ababambiqhaza ngaphansi kwalesi sihlokwana:

Kuba nzima ukuthi izingane zithole engisuke ngifisa
ukukudlulisa kuzona nokuthi *ba-understand(e)*
[baqonde] kahle ngoba akusilona ulimi lwabo
lwebele, kunzima ukuthi *ba-understand(e)*

ikhonsephthi ukuthi. Kufike kube nzima ikhonsephthi ngokwalo bese kuthi ne-*language* [isiNgisi] ngokwayo ibe nomthelela ezinganeni ekutheni zingayi-*understand*(i) into esisuke sikhuluma ngayo ngenxa yokuthi azilu-*understand*(i) [aziluyondeni] ulimi lokufunda nokufundisa. So kuye kube nokuqonda okukhulu uma ngizochaza ngesiZulu futhi ayibe isabalahlekela incazelo yamakhonsephthi abafundi (Thisha D).

Lokhu okuvezwa uThisha D kuyahambisana nokushiwo uThisha C lapho ethi khona:

Mhm, kuyaye kusinike inkinga ukufundisa ngolimi lwesiNgisi kuphela ngoba kufanele wenze *sure* [ukuqinisekisa] ukuthi igama ulichaze ngendlela abazo-*understand*(a) ngayo futhi abazozwa kahle ngayo ngoba kuyenzeka uthole ukuthi kunegama abangezoli-*understand*(a) ukuthi lisho ukuthini kodwa uzame ukubakhela isithombe-magama baze babone ukuthi uqonde ukuthini uma uzobachazela ngolimi lwesiZulu. Abami abafundi abayiphasi nhlobo i-*Physical Sciences* uma amakhonsephthi engachazwanga ngesiZulu (Thisha C).

Kanti uThisha A yena uveza ukuthi:

Eh, ngingathi nje ngi-*introduce*(a) i-*lesson* ngokwenza noma ngisho *a fascinating thing* ngolimi lwesiZulu ukuze ngithole *their undivided attention*. Ngiyaqhubeka-ke ngifundise ngesiNgisi kodwa ngigcizelele amakhonsephthi ngokuwacacisa ngolimi lwesiZulu *coz* [ngoba] *my learners* ngeke baphase uma ngizohamba [ngizofundisa] nge-*English* yodwa (Thisha A).

Kuyacaca ukuthi kulezi zikole ezimbili othisha besifundo seSayensi ebangeni leshumi neleshumi nanye ukusetshenziswa kobulimimbili ekufundiseni isifundo seSayensi bakuqonda ngokuthi kufanele basebenzise ulimi lwebele lwabafundi okungulimi lwesiZulu ukubachazela amakhonsepthe eSayensi. Ngamanye amazwi, abafundi beSayensi baba nezinselelo zesifundo eziphindaphindiwe, ngenxa yokuthi bafike baxakwe wulimi lokufundisa, okuyisiNgisi, baphinde baxakwe amakhonsepthe esifundo seSayensi, nawo okudinga ukuthi bawaqonde ukuze baphumelele kulesi sifundo.

Laba babambiqhaza baveza ukuthi ukuchaza amakhonsepthe eSayensi ngolimi lwabafundi kanjalo nemiphumela yabo abafundi iyathuthuka. Lokhu okwenzeka lapha ukuthi kuthuthuke ukuqonda isifundo seSayensi kubafundi uma bechazelwa ngolimi lwabo lwebele kuyahambisana nokuvezwa uPun benoTai (2021) ocraningweni ababelwenza eHong Kong lapho ababecwaninga khona ngokufunda iSayensi ngokuyihumushela olimimi lwebele ezikoleni zamabanga aphezulu. Kulezi zikole ababecwaninga kuzo laba bacwaningi, ukufunda nokufundisa kwenzeka ngolimi lwesiNgisi. Laba bacwaningi baveza okuvumelanayo nokutholwa yilolu cwaningo ukuthi ukuchazela abafundi amakhonsepthe eSayensi ngolimi lwabo lwebele, isiZulu, kuthuthukisa ulwazi lwabo lweSayensi.

U-Alsaid nabanye (2020) ocraningweni abalwenza eSyria lapho ababecwaninga ngokufundiswa kwezifundo zeSayensi zobudokotela ngokusebenzisa ulimi lwebele ngokulandela ubulimimbili. Bagcizelela ukuthi ukusebenzisa ubulimimbili ngokuhlenganisa ulimi lwebele nolimi lokufunda nokufundisa kugqugquzela uthando lwesifundo seSayensi kubafundi. Bathi kungenxa yokuthi basuke sebesiqonda ngokwanele ngemuva kokuchazelwa amakhonsepthe ayo ngolimi lwabo lwebele. Lokhu kungalekelela amazwe anabantu abaningi abakhuluma ulimi lwesiNgisi njengolimi lwesibili ukuthi athuthukise imfundo yawo ngokusebenzisa izilimi zebele ukuchaza amakhonsepthe eSayensi ukuze abafundi bazuze ulwazi oluningi futhi baqonde kahle isifundo seSayensi.

4.2.3. Ukusebenzisa izibonelo zesiZulu

Okuvela ezitatimendeni zababambiqhaza ngaphansi kwalesi sihlokwana ukuthi ukuzakhela izibonelo ngolimi lwebele lwabafundi ngenhloso yokucacisa kahle isifundo seSayensi kuthuthukisa ukuqonda kwabafundi isifundo seSayensi ngoba

izibonelo ezisuke zakhiwe uthisha zisuke zingolimi lwabo lwebele futhi ziyizinto abazibonayo zenzeka emphakathini empilweni yabo yamihla yonke. Nazi ezinye zezicaphuno zababambiqhaza ezifakazela lokhu lapha ngezansi:

Ngisebenzisa izibonelo ngichaze ngesiZulu futhi, ngisho noma ngabe ngicacisa igama elichaza ukwenzeka kwento, elingasho into ephathekayo, njengegama nje elithi '*friction*'. Ngiyichaza kucace bha ukuthi yenzeka kanjani, ngize ngibacele ukuba nabo banikeze ezabo izibonelo, bese ngiyedlula-ke uma senginelisekile ukuthi bonke baliqonda kahle ikhonsephe, ngenxa yezibonelo abasuke bezinikeza. Ngiye ngibone benza kahle nakuma-*activity* eklasi nakuma-*exams* [ezivivinyweni] ngoba lezi zibonelo zibenyusela ukuqonda isifundo seSayensi. Ngenxa yalokho abafundi bazi-*apply(a)* ezimweni ezahlukene lezi izibonelo (Thisha D).

Kanti uthisha B uveza ukuthi:

Ngiye ngizakhele izibonelo ngolimi lwesiZulu futhi ngisebenzise yona le ndawo isikole esikuyo. Ake ngenze isibonelo nje; uma ngikhuluma ngekhonsephe ye-*catalyst as a factor that increases the rate of reaction* ngiye ngibenzele isibonelo ngokubabuza ukuthi uma uwasha ngamanzi angenayo insipho bese omunye ewasha ngamanzi anensipho, ubani ozoqeda kuqala ukuwasha? Baye baphendule bathi yilo owasha ngamanzi anensipho. Ngiye ngibachazele-ke ukuthi insipho ifana ne-*catalyst* [isikhuthazi] elekelela owashayo ukuthi asheshe aqede ukuhlanza izimpahla zakhe, kanjalo ne-*reaction* ene-*catalyst* isheshe ikhiphe ama-*product* adingekayo *compared*

to the one eyenzeka at room temperature without a catalyst (Thisha B).

Okushiwo uThisha C akwehlukile kokushiwo abanye ababambiqhaza:

Yikho ukuthi ngenze izinto ezithi azibe *practical*, ngibenzele izithombe-magama noma izibonelo abazozibona bazeyamanise ne-*daily life* yabo, abazobona ukuthi lokhu kungumfanekiso wani noma *sometimes* uke ubone ukuthi kungenzeka kukufake engozini *one day* ngokuthi abafundi ba-*interpret(e) wrong* (Thisha C).

Okuvela kulolu cwaningo kucacisa ukuthi othisha besifundo seSayensi bebanga leshumi nabebanga leshumi nanye ukusetshenziswa kobulimimbili ukufundisa isifundo seSayensi kulezi zikole ebengicwaninga kuzo bakuqonda ngokuthi bakholelwa ekutheni uma besebenzisa izibonelo zolimi lwesiZulu okuwulimi lwebele kubafundi bezikole zabo kuyakuthuthukisa ukuqonda kwabafundi isifundo seSayensi. Ababambiqhaza baze baveze nokuthi imisebenzi yokuhlola abafundi ivela inemiphumela emihle yokuphumelela kwabafundi lezo zivivinyo.

UProbyn (2006) ocwaningweni ayelwenzela eNingizimu-Afrika lapho ayecwaninga khona ngokufunda ulimi neSayensi, wathola ukuthi abafundi bathola ukuqonda ababekufundiswa ngoba uthisha wayekuchaza ngolimi lwabo lwebele, okuyisiXhosa, kanti kwamanye amaklasi okwakuchazwa ngesiNgisi kuphela babengakhombisi ukuqonda ngokwanele. UProbyn (2006) uthi othisha kufanele bathole indlela abangasebenzisa ngayo ulimi lwebele lwabafundi njengensizakufundisa ukuthuthukisa ukuqonda kwabafundi. Lokhu kuhambisana nokwenziwa ababambiqhaza balolu cwaningo ngoba basebenzisa ulimi lwabafundi ngokuthi bakhe izibonelo ngolimi lwesiZulu.

UKhanyile beno-Awung (2023) lapho ababecwaninga khona ngezingqinamba zolimi lwebele okuyisiZulu ezikoleni ezazikhethwe eMkhandlwini wasoThungulu KwaZulu-Natali, baveza abakubona kwenzeka ngesikhathi bebukela othisha befundisa nokwavezwa othisha uma sebenezingxoxo nabo. Imiphumela yocwaningo lwabo yathanda ukwehluka kancane kunokuvezwe ababambiqhaza balolu cwaningo.

UKhanyile beno-Awung (2023) baveza ukuthi indlela othisha abaqeqeshwe ngayo iyingqinamba ekulandeleni ukufundisa ngolimi lwesiZulu ngoba abaqeqeshelwanga ukufundisa izifundo ngolimi lwesiZulu. Lokhu kungenza ukuthi ukhumushela olimini lwesiZulu lokhu abakufundisayo kulahlekelwe yincazelo egcwele yesifundo abasifundisayo. Baveza ukuthi ukusebenzisa zombili izilimi (olwesiNgisi nolwesiZulu) kanyekanye ezingxoxweni lapho kwethulwa isifundo, kuyazixazulula izingqinamba zolimi emaklasini ezifundo okungezona ezolimi.

4.2.4. Ukubuza Imibuzo NgesiNgisi Iphinde Ibuzwe NgesiZulu

Ezitatimendeni ezivezwa ababambiqhaza balolu cwaningo kuyavela ukuthi ukubuza abafundi imibuzo yesifundo seSayensi ngolimi lwesiNgisi nokuphinde babuzwe ngolimi lwesiZulu okuwulimi lwabo lwebele kwenza ukuthi abafundi bayiqondisise imibuzo bese beyiphendula ngendlela elindelekile. Izicaphuno zokushiwo ababambiqhaza balolu cwaningo ziyavela ngezansi:

Izinkinga engidibana nazo mhlawumbe yikho ukuthi izingane seziyabhala mhlawumbe ama-*test* noma ama-*exams*, uthole ukuthi umuntu akayiqondi ukuthi *i-question* ifunani *exactly* bese egcina yena eseyiphendula ngenye indlela ngoba uya-*misunderstand(a)* [akaqondi umbuzo] ngenxa yokuthi lolu limi okubuzwa ngalo akalujwayele kahle noma akayizwa ukuthi ithini imibuzo. So, kuba sengathi angalekeleleka ekuthenini mhlawumbe aqonde ukuthi imibuzo ifunani, manje uma si-*revis(a)* [sibukeza] ngiye ngizame ukuthi ngi-*interpret(e)* ngesiZulu, ngiwuguqule umbuzo ngiwubeke ngolimi lwebele ukuze bezoqonda ukuthi umbuzo ubufunani. Kuyasiza ukuthi nangeline ilanga uma behlangana ne-question ekanjalo bakwazi ukuthi isuke idinga ukuphendulwa kanjani? Siye siyiguqule siyibeke ngolimi abazolu-*understand(a)* (Thisha A).

UThisha B uvumelana noThisha A:

I also do a lot of assessment as well because I think assessment plays a very important role uku-check(a) ukuthi ngabe le nto oyenzayo, iyabasizani abafundi. So, ngisebenzisa the assessment beyond the ones that are prescribed by the curriculum, uthole ukuthi sengize nga-spend(a) isikhathi esiningi nabafundi, uthole ukuthi sengenza izinto ezi-extra beyond ukuthi it's actually said we're supposed to do it. For ukuqonda kwabo abafundi I use ulimi lwesiZulu so that they may understand questions better (Thisha B).

Kanti okuvezwa uThisha D ukuthi:

Abafundi bami abaqondi kahle if ngizobanika the questions and expect ukuthi bazo-solver the problem [ukuphendula imibuzo yezibalo zesifundo seSayensi] without ukubachazela ngesiZulu. Lokhu ngikwenza njalo uma ngisethula isifundo each and everyday. Once I'm done with the chapter, ngibanika the previous question papers bese benza umsebenzi wokuphendula those questions ngaphandle kokubachazela ngesiZulu, ngokwenza lokho ngiye ngibone imiphumela emihle nomthelela omuhle wokubaqala ngesiZulu bese ubayeka bazenzele ngolimi lokufunda nokufundisa. But uma kukhona abangacacelwa kahle coz [ngoba] abafundi abefani, ngicacisa ngesiZulu kubona (Thisha D).

Okushiwo yilaba othisha kuyacacisa ukuthi indlela abakuqonda ngayo ukusebenzisa ubulimimbili ukufundisa isifundo seSayensi ukuthi kufanele babuze abafundi imibuzo ngolimi lwesiNgisi baphinde futhi bababuze nangolimi lwesiZulu okululimi lwebele lwabo abafundi. Lokhu kuletha ukuqonda imibuzo ngokwanele kubafundi futhi kwenza ukuthi bathole imiphumela egculisayo.

Ukuthola imiphumela emihle kwabo abafundi kuqubula ugqozi lokusifunda isifundo seSayensi futhi baheha nabanye abafundi ukuthi bakhethe iSayensi njengomkhakha abazowufunda baze bafike emanyuvesi. Ngenxa yalokhu kuzogcina sekunciphakanya inkinga yokushoda kosoSayensi kuleli lizwe laseNingizimu-Afrika. UYuretich nabanye (2001) ocwaningweni lwabo lwezindlela ezihlabahlosile zokuthuthukisa ukuphumelela kwabafundi nogqozi lokuthanda isifundo seSayensi ngobubanzi baveza ukuthi ucwaningo lwabo nezingxoxo abazenza nabafundi ziveza ukuthi ukuphumelela kahle kwabafundi kwanyusela abafundi ugqozi lokuthanda iSayensi.

Ucwaningo lukaChiramba (2020) esengike ngamcaphuna esahlukweni sokubuyezwa kwemibhalo lapho ayecwaninga khona ngokuthuthukiswa kokufundwa kweSayensi emakilasini anezilimi eziningi kusetshenziswa izilimi ezimbili okuwulimi lwesiNgisi nolwesiShona eZimbabwe ikhombisa ukumbandakanywa kwezilimi zama-Afrika ekufundeni futhi iyakwesekela lokhu okuphakanyiswa ababambiqhaza. Ukwesekela ngokuveza ukuthi ukufundisa ngezilimi ezimbili isifundo seSayensi kunika abafundi ithuba lokuthi baxoxe ngesifundo seSayensi ngolimi lwesiShona bese benza izethulo zabo eklasini ngolimi lwesiNgisi.

UPun benoTai (2021) ocwaningweni ababelwenza eHong Kong lapho ababecwaninga khona ngokufunda iSayensi ngokuyihumushela olimimi lwebele ezikoleni zamabanga aphezulu lapho ukufunda nokufundisa kwakhona kwenzeka ngolimi lwesiNgisi bayahambisana nokuvezwa ababambiqhaza balolu cwaningo. UPun benoTai (2021) baveza ukuthi elabhoethri yeSayensi abafundi bayakwazi ukuqonda imibuzo emayelana nalokhu abakucwaningayo uma bechazelwe ngolimi lwabo lwebele.

UNTshangase benoBosch (2020) engike ngabachaphuna esahlukweni sokubuyezwa kwemibhalo basekela lokhu ngokuthi baphakamise ukuthi uhulumeni aphasise inqubomgomo yolimi ezokwenza kube umgomo ukufundisa nokuhlola ngolimi lwesiZulu nolwesiNgisi kanyekanye. Laba bacwaningi baqhubeka baphakamise ukuthi zonke izivivinyo (ngaphandle kwesifundo isiZulu uLimi Lwasekhaya) zihlelwe ngolimi lwesiZulu nolwesiNgisi ukuze abafundi abakhuluma isiZulu esifundazweni saKwaZulu-Natali bezothola ithuba lokubhala ngolimi abazozikhethela lona.

4.2.5. Ukusetshenziswa Kwezichazamazwi

Ezitatimendeni zababambiqhaza mayelana nalesi sihlokwana kuyavela ukuthi izingqinamba ezilethwa ubunqala bamakhonsephe esifundo seSayensi kwaholela ekutheni baqoke ukusebenzisa izichazamazwi ukuchazela kahle abafundi isifundo seSayensi ngoba okwamanje isifundo seSayensi singesinye salezo zifundo ezifundiswa ngolimi lwesiNgisi futhi ezihlolwa ngalo lolu limi. Okwamanje bekungakabi khona ukuhlolwa kumbe imithombo yokufundisa lesi Sifundo yoMnyango weMfundo ebhalwe ngezilimi zesiNtu. Ababambiqhaza bayaye basebenzise izichazamazwi zolimi lwesiNgisi zodwa kodwa uma kuvela ukuthi kusekhona ukungacaci kokufundwayo baye basebenzise izichazamazwi zesiNgisi nesiZulu. Kulesi sihlokwana ngizohlukanisa imininingo ethinta izichazamazwi ngezihlokwana ezimi kanje:

- (i) Ukusetshenziswa kwesichazamazwi solimi lwesiNgisi
- (ii) Ukusetshenziswa kwesichazamazwi solimi lwesiNgisi nesiZulu.

Othisha balezi zikole engenze kuzo ucwaningo baveza ukuthi ukusebenzisa izichazamazwi kuyakuthuthukisa kakhulu ukuqonda kwabafundi isifundo seSayensi.

4.2.5.1. Ukusetshenziswa Kwesichazamazwi Solimi LwesiNgisi

Othisha ababeyingxanye yocwaningo baveza ukuthi ukusebenzisa kwabo isichazamazwi solimi lwesiNgisi kuyabalekelela ukucacisa amakhonsephe esifundo seSayensi nezitatimende ngoba isifundo sethulwa ngolimi lokufunda nokufundisa okuyisiNgisi kulezi zikole engicwaninge kuzo.

Nginayo *i-dictionary ye-Physical Sciences* engisiza kakhulu uma *ngi-prepare(ya) a lesson* ukuze ngithole ukuqonda okungeziwe ngamakhonsephe eSayensi angase anike abafundi inkinga. Eklasini ngiye ngisebenzise *i-Oxford English Dictionary* ngoba yiyona ekhona esikoleni abafundi abanikwe yona. Abafundi baya-*understand(a)* uma ngithi amagama abangawaqondisisi abawabheke ku-*dictionary and they get excited* uma beyiqonda

incazelo coz [ngoba] *it has a positive impact* ekuphumeleleni kwabo (Thisha A).

UThisha D akwehlukile akushoyo nalokhu okushiwo uThisha A:

Well, eh.. ngiye ngisebenzise *i-dictionary* ukucacisela abafundi isifundo ngoba njengoba kufundwa ngesiNgisi nje okuyi-*second language* kubo akulula ukuqonda kwabo iSayensi kahle. *They know* ukuthi *they have to bring dictionaries to our class everyday*. Ngiye ngibone kwenyuka ukuqonda kwabo isifundo futhi unyaka nonyaka iyathuthuka imiphumela yesifundo seSayensi kuwo wonke amabanga engiwafundisayo ngenxa yokwenyuka kwezinga lokuqonda kwabafundi ngokulekelelwa ama-*dictionary* (Thisha D).

Okuvezwa uThisha C kuyefana nokuvezwa abanye ababambiqhaza:

Kubasiza kakhulu nje abafundi ukusebenzisa ama-*dictionary* ngoba bashaya izinyoni ezimbili ngetshe elilodwa [ukuzuza izinto ezimbili kanyekanye ngokwenza into eyodwa] ngoba bathola incazelo ye-*term* enzima ngokuyichaza *in details* nge-*simpler language*, ngaleyo ndlela kwanda i-*vocab* yabo. Sebeyazi nje ukuthi kufanele bahlale bewaphethe ama-*dictionary* coz [ngoba] uma bebona igama elinzima kubo *they have to look for* incazelo yalo kwi-*dictionary* bese bebuza mina *if the explanation ye-dictionary* isenamagama abangawaqondi kahle (Thisha C)

Ngokuqhubeka kocwaningo othisha baveza ukuthi kwesinye isikhathi akweneli ukusebenzisa isichazamazwi sesiNgisi kuphela kodwa kuye kufanele asebenzise esesiZulu ukuze abafundi bathole ukuqonda isifundo sosuku. UNiyazova (2023) lapho ayecwaninga khona ngobumqoka bokusebenzisa izichazamazwi ekufundeni

nasekufundiseni ngolimi lwesibili uveza ukubaluleka nezinzuzo zokusebenzisa izichazamazwi. Lo mcwaningi uveza ukuthi kunokwanda ngesivinini kwamagama amasha (alukhuni isikhathi esiningi) avelayo ngenxa yezimo zokuthuthuka kwezeSayensi emhlabeni wonke. Ngenxa yalokho, kubalulekile ukunothisa ulwazimagama lwabafundi ukuze la magama bawaqonde kahle bese bekhula nolwazi olubanzi. Lokhu kungeminye yemisebenzi nezinhloso ezinkulu zokufundisa ngolimi lwesibili nolimi lwasekhaya lwabafundi.

Ukusebenzisa izinhlobonhlobo zezichazamazwi kulekelela kakhulu ekwandiseni ulwazimagama lwabafundi kanye nokubafundisa ukuqakulisa ngokucacile ngemicabango yabo. Ngakho-ke, kubalulekile ukusebenzisa izinhlobo ezahlukene zezichazamazwi ngoba zilekelela nasekuthuthukeni kwendlela abafundi abahlela ngayo izingxoxo abazethulayo emaklasini noma nasemathekisthini ahlukene.

4.2.5.2. Ukusetshenziswa kwesichazamazwi solimi lwesiNgisi nesiZulu

Ababambiqhaza baveza ngezitatimende zabo ukuthi kuyaye kufanele bangeze ngokusebenzisa izichazamazwi zesiZulu okuwulimi lwebele kubafundi nakubona njengothisha. Baveza ukuthi lokhu kwenza ukuthi abafundi bathuthuke ekuqondeni lawo matemu abebengawaqondi ngolimi lwesiNgisi, ngaleyo ndlela bayathuthuka nasekuqondeni isiNgisi sebesusela ekuqondeni ngesiZulu. Lokhu kwenza ukuthi baqonde isifundo seSayensi ngokuthi uma sebeqonda amakhonsephtsi ayo ngesiZulu bese lokho kwenza ukuthi baqonde la magama olimi lwesiNgisi abhalwe ngokwefana namakhonsephtsi eSayensi bese ekugcineni baqonde izincazelo zawo amakhonsephtsi esifundweni seSayensi enjengoba ethulwa. Okuvezwa ababambiqhaza ezicaphunweni zabo ukuthi:

Uma ngibona kungenele ukusebenzisa *i-dictionary* yesiNgisi ngiye ngithi abakhiphe eyesiZulu (ehlala eshalofini leklasi) ukuze bayifune khona incazelo. *That interests them* kakhulu *coz* uma sebeyitholile incazelo bayakwazi ukuzibuyelela emuva beyoqonda eyesiNgisi *followed by* eyeSayensi. Lokhu kwenza ukuthi bengaphinde bazikhohlwe lezo zincazelo zaleso sifundo ngalawo makhonsephtsi namatemu anqala (Thisha A).

Kanti uThisha C akuvezayo kuthe ukwehluka kancane kokukaThisha A:

I normally use dictionaries uma ngibona ukuthi i-*lesson* yangalelo langa inama-terms anzima. Ngiye ngihlele ngayo ama-*notes* ukucacisa *the complex terms*. Eklasini ngiye ngichaze ngolimi lwesiZulu ngisebenzisa incazelo engiyithola even kwi-*dictionary* yesiZulu (Thisha C).

Ababambiqhaza balolu cwaningo baveza ukuthi indlela abaqonda ngayo ukusetshenziswa kobulimimbili ukufundisa isifundo seSayensi ebangeni le-10 nele-11 bakholelwa ukuthi kufanele basebenzise izichazamazwi ukucacisela kahle abafundi amakhonsephti esifundo seSayensi. Basebenzisa izichazamazwi zolimi lwesiNgisi kuqala ngenhloso yokuthola izincazelo zamagama namakhonsephti esifundo seSayensi abafundi abasuke bengawaqondi. Kuye kuthi uma kusekhona ukungaqondi kahle noma sebesebenzisa isichazamazwi sesiNgisi bese besebenzisa esesiZulu nesiNgisi.

UFrontelle (1997) lapho ayecwaninga khona ngokusebenzisa isichazamazwi sezilimi ezimbili ngenhloso yokwakha ukuxhumana ekufundeni ngolimi lwesibili nokuqonda ngolimi lwebele uveza okuhambisana nokushiwo ababambiqhaza balolu cwaningo. UFrontelle (1997) uveza ukuthi ukufundisa abafundi ngokusebenzisa izichazamazwi ukuchaza amagama angamatemu namakhonsephti angaqondakali kahle kubafundi kuyabalekelela ukuthuthuka olimini lwabo lwebele nasolimini lokufunda nokufundisa kanye nolwesifundo esisuke sethulwa ngaleso sikhathi. Ukusebenzisa izichazamazwi zolimi lokufunda nokufundisa okuwulimi lwesibili kubafundi akwanele ukuthuthukisa ukuqonda kwabafundi kodwa izichazamazwi zezilimi ezimbili (ulimi lwesibili nolwebele) zenza kube lula futhi kusheshe ukuqonda kwabafundi. Abacwaningi abango-Ünsal nabanye (2016) bavumelana nalokhu ngokuthi baveze ukuthi uma abafundi benganikwa amathuba amaningi okusebenzisa izichazamazwi ngesikhathi kuqhubeka isifundo sosuku lingavaleka igebe lokungaqondi kwabafundi isifundo seSayensi.

4.2.6. Izinsizakufundisa ezihlobene namasiko nezinkolelo zesiNtu ekuchazeni

okuqukethwe Yisifundo

Izitatimende zababambiqhaza balolu cwaningo ngaphansi kwalesi sihlokwana ziveza ukuthi baqoka ukusebenzisa ulwazi lwamasiko nezinkolelo zesintu ekuchazeni okuqukethwe yisifundo seSayensi. Ngezansi ngiveze izibonelo zezicaphuno zababambiqhaza ezimayelana nalesi sihlokwana:

Mina kuye kuthi uma ngichaza *the concepts of electrostatics and lightning* kubafundi ngisebenzisa *the transfer of electrons*, ngibafundise le nkolelo yokuthi akufanele uphathe into eyinsimbi ecwebezelayo noma uhlale eduze kwayo uma kuduma izulu ngoba liyokushaya ulimale izulu. Lokhu kungenxa yokuthi *ama-metals are good conductors of electricity*, lokho okwenza ukuthi noma iyiphi *i-metal* umbane oshaye kuyo ingawadlulisela kuwe *ama-electrons* uma izinyawo zakho zimi emhlabathini zombili bese ushokhwa ugesi wezulu, ulimale noma ufe uma umkhulu lowo mbane ngoba kusho ukuthi uqukethe a *lot of electrons* (Thisha D).

UTHisha B yena uveza ukuthi usebenzisa okwehlukile kodwa okuyinkolelo yesiNtu:

Mina ngiye ngisebenzise umkhosi kaNomkhubulwane njengendlela yokufundisa. Ngiye ngihlobanise ukwenyuka intaba nokwehla uma sekubuywa ngokuhlobanisa isivinini sabantu kuzona zombili izimo. Uma amatshitshi enyuka intaba eyocela imvula kuNomkhubulwane asuke ejahe ukuyidundubala leyo ntaba ukuze bafike bakhuleke kuye bese bebuya nemvula kodwa ngenxa yokubakhona komqansa akushesheki ukufika esicongweni sentaba. Lokho kwenza ukuthi isivinini sokuyiqwala intaba siye ngokucipha as benyuka.

Uma sebhla bayashesha futhi baze bagijime ngoba kuyazivumela njengoba sebhla, baze bayohamba kahle uma sebefike phansi la okuqonde khona. Lokhu *means when a projectile is projected vertically upwards, the speed of an object will decrease until siba u-zero at maximum height and speeds down as it travels back down.* Lokhu *it's because of the force of gravity* (Thisha B).

Okuvezwa ababambiqhaza balolu cwaningo kulezi zicaphuno ezingenhla kucacisa ukuthi laba babambiqhaza abangothisha bakulezi zikole ezimbili indlela abaqonda ngayo ukusebenzisa ubulimimbili ukufundisa isifundo seSayensi ebangeni leshumi neleshumi nanye bakholelwa ekutheni basebenzise ulwazi olusondelene namasiko nezinkolelo zesiNtu ekuchazeni okuqukethwe yisifundo seSayensi. Baveza ukuthi lokhu kuyabalekelela abafundi ukuthi baqonde amakhonsephe eSayensi ngoba basuke befundiswe wona ngokuchazelwa kusetshenziswa izinkolelo namasiko esintu abawaziyo. Lokhu kuveza ukubaluleka kokuthi othisha baqonde amasiko nezinkolelo zabafundi ababafundisayo ukuze bezokwazi ukuzididiyela nezifundo abazifundisayo ukuze kuthuthuke ukuqonda nokuphumelela kahle kwabafundi. Lokhu kugcizelela ukuhambisana phakathi kolimi namasiko, njengoba ucwaningo oluningi lukuveza lokhu kuhlobana.

UStephen (2001) ocwaningweni ayelwenzela e-Alaska eMelika lapho ayebhala khona incwadi yokusebenzisa amasiko ukuhlangabezana nesifundo seSayensi uyakugcizelela ukusebenzisa amasiko nezinkolelo zesiNtu ukufundisa iSayensi. Lokhu ukwenza ngokuveza ukuthi ukufundisa abafundi isifundo seSayensi ngokusichaza ngokusiyamanisa namasiko nezinkolelo zabo kubandakanya izindlela zokufundisa ezakhele ekuhlolweni kokuqonda kwabafundi ngolwazi olwakhele emasikweni abo. Lokhu kuqubula ulwazi nokuqonda kwabafundi okubanzi ngesifundo seSayensi, okubandakanya amakhono eSayensi ambandakanya ukubukela ukwenzeka kwezinto, ukuyamanisa ama-*principle* nemithetho yeSayensi nokwenzeka kwezinto empilweni yangempela, ulwazi olubanzi ngesifundo seZibalo, ukujula ngokucabanga, ukuhumusha, ukuxazulula inkinga, amakhono aselabholethri, awokubhala imibhalo ngolimi lweSayensi, namanye amaningi.

UJegede beno-Okebukola (1991) ocwaningweni lapho babecwaninga ngomthelela wokufundisa ngendlela embandakanya izinkolelo namasiko ekufundeni iSayensi baveza okungehlukile kokuvezwa ababambiqhaza balolu cwaningo. Laba bacwaningi baveza ukuthi into enomthelela omkhulu ekufundeni komfundi yilokhu umfundi asuke evele ekwazi ngaphambi kokufundiswa okungamasiko nezinkolelo zesintu sakhe. Lokhu kusho ukuthi kunesidingo esikhulu sokuthi lezi zinkolelo namasiko kudidiyelwe nezinhlaka zokufunda nasocwaningweni. Lokhu kungenxa yokuthi kuba yingqinamba ukuqonda amakhonsepthi eSayensi nakho konke ukwenzeka kwayo uma ulwazi nokuqonda kwabafundi ngamasiko nezinkolelo zabo kungadidiyelwa ekufundisweni kwabo.

4.3. Iqoqa Lesahluko

Lesi sahluko sethule imininingo eyatholakala ekuphenduleni umbuzongqangi wokuqala walolu cwaningo othi: "Othisha abafundisa isifundo seSayensi bakuqonda kanjani ukusebenzisa ubulimimbili ekufundiseni isifundo seSayensi kubafundi bebanga leshumi neleshumi nanye?" Isahluko esilandelayo sizokwethula imininingo eyatholakala ngokuphendula umbuzongqangi wesibili walolu cwaningo othi: "Othisha bebanga leshumu neleshumi nanye babusebenzisa kanjani ubulimimbili ekufundiseni isifundo seSayensi?"

ISAHLUKO SESIHLANU

Izindlela Namasu Okufundisa Okusetshenziswa Othisha Ekufundiseni Isifundo SeSayensi ngobulimimbili

5.1. Isingeniso

Esahlukweni esedlule kwethulwe ukuqonda kothisha ngokusetshenziswa kobulimimbili. Kulesi sahluko ngizokwethula izindlela ezisetshenziswa othisha ukufundisa isifundo seSayensi besebenzisa ubulimimbili. Lokhu ngizokwenza ngokuphendula umbuzo wesibili othi: “Othisha bebanga leshumi neleshumi nanye babusebenzisa kanjani ubulimimbili ekufundiseni isifundo seSayensi?” lo mbuzo ngizowuphendula ngokusebenzisa lesi sihlokwana esilandelayo esithi: “Izindlela namasu asetshenziswa othisha ekufundiseni isifundo seSayensi ngokusebenzisa ubulimimbili”.

5.2. Izindlela namasu asetshenziswa othisha ekufundiseni isifundo seSayensi ngokusebenzisa ubulimimbili

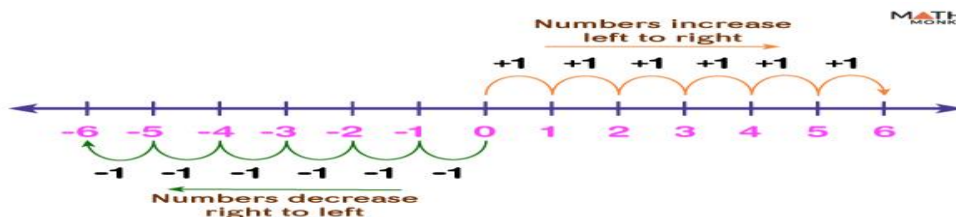
Ngaphansi kwalesi sihlokwana ngizoveza izindlela namasu asetshenziswa othisha ekufundiseni isifundo seSayensi besebenzisa ubulimimbili. Lokhu ngizokwenza ngaphansi kwalezi zihlokwana ezilandelayo:

- (i) Ukuqhathanisa amakhonsephti abhalwe ngokufana kodwa equkethe imiqondo ehlukene.
- (ii) Ukusetshenziswa kwezibonisi.
- (iii) Ukusetshenziswa kolimi lwebele nanxa kufundiswa ngolimi lwesiNgesi.
- (iv) Ukusetshenziswa kwama-eksperimenti.
- (v) Ukusebenzisa amavidiyo eSayensi.
- (vi) Ukusebenzisa amamodeli eSayensi.
- (vii) Ukusebenzisa ama-*simulations*.
- (viii) Ukusetshenziswa kwamaphrakthikhalo.

5.2.1. Ukuqhathanisa Amakhonsepthi Abhalwe Ngokufana Kodwa Aqukethe

Imiqondo Ehlukene

Ngaphansi kwalesi sihlokwana kuyavela ezitatimendeni zababambiqhaza ukuthi ukuchazela abafundi amakhonsepthi eSayensi ngokuthi uthisha aqale abachazele igama elisebenza nsuku zonke olimini ngaphambi kokudlulela ekubathuleleni lona njengekhonsepthi yeSayensi ebhalwa futhi ibizwe njengalo leli gama lesiNgisi kuyabasebenzela bona njengothisha, kanjalo nabafundi. Phakathi kokuvezwa uThisha D ngesikhathi ngimbukele ethula isifundo seSayensi ebangeni le-10 ukwethula ikhonsepthi entsha ngokuchazela abafundi ngolimi lwesiNgisi olukhulunywa nsuku zonke, bese ubasusa olimini lwesiNgisi olwejwayelekile usebenzise ikhonsepthi lelo elifanayo ngokweSayensi ukuze babone umehluko lapho usulichaza ngokweSayensi, kuyasiza ukuthi basiqondisise isifundo sosuku futhi ingene ikhonsepthi ligxile ezingqondweni zabo. Ngesikhathi efundisa uThisha D wadweba i-number line ebhodini kanje:



Umdwebo 1

Wabe esexoxa nabafundi ukuthola ukuqonda kwabo nge-number line kanje:

Thisha D: *ngizodweba i-number line ebhodini bese sixoxa ngayo, siyezwana:*

Abafundi: *Yes teacher.*

Thisha D: *(Wayidweba, wafaka u-zero phakathi nendawo) Ngasesandleni sokudla, ngala (ekhomba ngakwesokudla) kunezinamba ezinayiphi i-sign?*

Abafundi: *(Kanye kanye) Kunezinamba ezinesayina e-positive Miss.*

Thisha D: *Yini oyiqaphelayo ngezinamba ukusuka ku-zero uya esandleni sokudla?*

Mfundi X: *Ukuthi uma usuka kuze-ro uze uyofika ku-6 izinamba ziyakhula ziba nkulu.*

Thisha D: *Good, that is what we call an increase in numbers from 0 to 6 on the positive side. Lokhu kusho ukuthi uma u-add(a) u-1 kuleyo*

naleyo namba ukusuka ku-zero to the right there will be an increase in numbers which is positive, meaning zonke izinamba from zero on the right hand side to infinite zi-increas(a) ngo-1 in this case.

Thisha D: *Ake sibuke inumber line from zero towards left. Yini oyiqaphelayo ngezinamba kusuka from zero to the last number on the left?*

Abafundi: *(Abambalwa) Ziya-decrease(a) [ziyehla].*

Thisha D: *Good. Lokhu kusho ukuthi when you move from zero to -6 kuba ne-decrease in numbers as they become more positive.*

Engxoxweni eyayiphakathi kwabafundi noThisha D kuvela ukuthi abafundi bamphendula ngendlela eyamgculisa uthisha ngoba akazange esayichaza i-*number line* kodwa wadlulela phambili ngokubachazela ngetemu "increase in numbers from zero towards positive no-decrease in numbers from zero towards negative". Ngamuzwa ethi kubafundi "Asisukeni egameni *increase* no-*decrease* siye ku-*loss* no-*gain of electrons*, sizolokhu siphuma esiNgisini siya kwiSayensi ngoba iSayensi ayisona isiNgisi'.

Uthisha D waqhubeka wafundisa wathi "*The gain of electrons is called reduction, indlela yokuyikhumbula lokhu ukuthi ufake lokhu engqondweni, RIG, lapha uhlamvu nohlamvu lumele incazelo ezokusiza kakhulu. U-R umele u-reduction, u-I umele u-is, kanti u-G umele u-gain, ngaleyo ndlela izohlala engqondweni le ncazelo bese ukwazi ukuzikhumbuza njalo nje. Loss of electrons is called oxidation, faka u-LEO njengendlela yokugxilisa incazelo ekhanda, L- loss, E-electrons, O- oxidation*".

Lokhu okwenziwa uthisha D akwehlukile kokushiwo uThisha B lapho ethi:

When introducing a lesson ngiyaqinisekisa to relate isihloko engiqeda ukusifundisa nalesi esisha sangalelo langa. Since ngaqala ukufundisa ngaqaphela ukuthi amagama afanayo esiNgisini anika abafundi inkinga when they are used in the physical sciences context. Ubathola bechaza ama-definitions, ama-laws and principles of science ngendlela okuchazwa ngayo lelo gama ngendlela yaku-English. Lokho kubalahlekisela ngamamaki, so

I looked for a strategy esizobenza bawubone umehluko phakathi kwegama elisolimini lwesiNgisi uma selitholakala esifundweni seSayensi. After ukuqala ukwenza kanje ngabona kwenyuka ukuphumelela kwabo ezivivinyweni, futhi kwangithokozisa kakhulu lokhu (Thisha B).

Kanjalo futhi, uThisha A wabeka kanje:

*Ngesikhathi ngizoqala ukufundisa ngazitshela ukuthi angifisi balinyazwe yinto eyangenza ngangaphasa ngo-*distinction* isifundo se-*Physical Sciences*. Ngafuna icebo elizobenza bakwazi ukuhlukanisa izincazelo zamakhonsepthe eSayensi *and English terms* afana naweSayensi ngokubhalwa nokubizwa. *I decided to start by reminding them about the meaning of that English word* bese ngibachazela ngalo *with the new meaning* ku-*Physics*. Okungilekelela kakhulu ukuthi ngiqala ngokubuyekeza isihloko esidala ngaphambi kokuqala esisha ukuze ngixhumanise ulwazi olusha noludala (Thisha A).*

Lokhu kuchaza ukuthi othisha bakholelwa ukuthi kufanele basebenzise ukuqhathanisa amakhonsepthe abhalwe ngokufanayo kodwa equkethe imiqondo ehlukene njengezinye zezindlela namasu abawasebenzisayo ekusebenziseni ubulimimbili ukufundisa isifundo seSayensi. Othisha baveza ukuthi abafundi baba nengqinamba yokungakwazi ukwehlukanisa amagama asebenza nsuku zonke olimini lwesiNgisi uma bengabahlukaniselanga incazelo yawo uma esesebenza esifundweni seSayensi. La magama ayabadida abafundi kodwa bayakuthola ukuwaqonda uma kungukuthi othisha bayabachazela kahle kusuka ezincazelweni zawo ngokolimi olwejwayelekile lwesiNgisi kuye ekutheni babafundise izincazelo zawo uma esesetshenziswe esifundweni seSayensi.

Lokhu kuyahambelana nokushiwo uNcube (2014) engike ngamcaphuna esahlukweni sokubuyekwezwa kwemibhalo lapho eveza khona ukuthi isifundo seSayensi sinolimi

Iwaso olwehlukile olimini lwakweminye imikhakha futhi lulukhuni. Lolu limi lunamagama abhalwa futhi abizwe ngokufanayo nalawa asolimi lwesiNgisi okuwulimi lokufunda nokufundisa oluphinda lube olwesibili kubafundi nakothisha abaningi eNingizimu-Afrika. La magama anencazelo entsha esifundweni seSayensi nokubasizayo abafundi ukuthi basheshe bakwazi ukuwahlukanisa uma uthisha ezoqala ngokukhuluma ngawo ngokolimi lwesiNgisi, bese ebanika incazelo entsha yeSayensi.

USmith-Walters benoBass noMangione (2016) bacwaninga ngezingqinamba okubhekanwa nazo ukulungiselela othisha abasaqala ukufundisa ezweni laseChina ukuthi bakwazi ukufundisa iSayensi ngolimi lwesibili. Okutholwa yilaba bacwaningi kuveza ukuthi iSayensi inolimi lwayo olubandakanya imisho ehleleke yaba lukhuni futhi nezingxoxo nokucabanga esifundweni seSayensi kwehlukile kunakweminye imikhakha. Lokhu kubafundi abakhuluma ulimi lokufunda nokufundisa njengolimi lwesibili kuba yingqinamba ngoba abanalo ithuba emphakathini nasemakhaya lokuthi bakhulume lolu limi. Lokhu kuletha izingqinamba ekutheni babone umehluko phakathi kwezincazelo zamagama asebenza olimini lwesiNgisi uma esesetshenziswa esifundweni seSayensi njengamakhonsephe.

USmith-Walters benoBass noMangione (2016) baveza ukuthi abafundi laba banomsebenzi omkhulu wokuqale baqonde ulimi lokufunda nokufundisa ngaphambi kokuthi baqonde ulimi lweSayensi. Othisha basebenzisa ulimi lokufunda nokufundisa ukuthi bedlulele ekuchazeni amakhonsephe eSayensi kuqala, ngaleyo ndlela kuyathuthuka ukuqonda kwabafundi. Ukufunda ukuqonda kahle ulwazimagama lweSayensi kanye nolimi lokufunda nokufundisa kulekelela ukuthuthuka kuzo zombili izilimi, olweSayensi nolokufunda nokufundisa.

5.2.2. Ukusetshenziswa Kwezibonisi

Kulesi sihlokwana ngizoveza indlela othisha abasebenzisa ngayo izibonisi njengenyeye yezindlela namasu abawasebenzisayo ekufundiseni isifundo seSayensi besebenzisa ubulimimbili. Ezitatimendeni zababambiqhaza kuvela ukuthi othisha balezi zikole ezaziyingxenyeye yalolu cwaningo bakholelwa ukuthi ukusebenzisa izibonisi ukufundisa isifundo seSayensi ngobulimimbili kuyakuthuthukisa ukuqonda kwabafundi isifundo abathulelwa sona. Baveza ukuthi basebenzisa izibonisi

ezahlukene ababala kuzo amadayagramu, izithombe namagrafu. Ngakho-ke lesi sihlokwana ngizosethula ngaphansi kwalezi zihlokwana ezilandelayo:

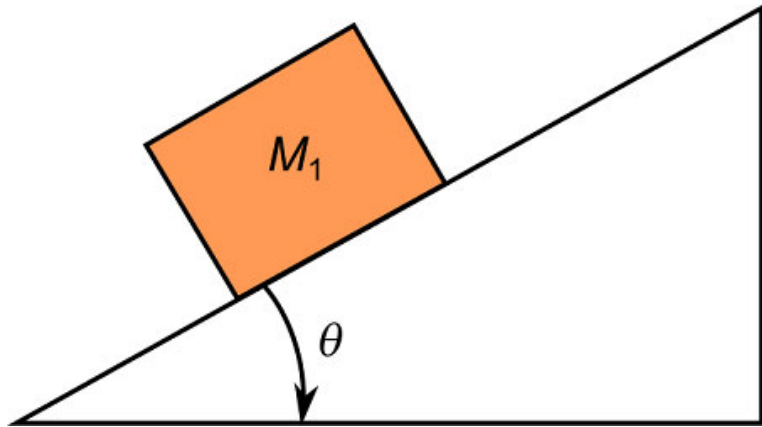
- (i) Ukusetshenziswa kwezibonisi ezingamayagramu
- (ii) Ukusetshenziswa kwezibonisi eziyizithombe
- (iii) Ukusetshenziswa kwezibonisi ezingamagrafu

5.2.2.1. Ukusetshenziswa Kwezibonisi Ezingamayagramu

Ngaphansi kwalesi sihlokwana ngizoveza izitatimende zababambiqhaza eziveza ukuthi ukusebenzisa izibonisi ezingamayagramu kuthuthukisa ukuqonda kwabafundi isifundo seSayensi. Izicaphuno zokushiwo ababambiqhaza ziyavela ngezansi:

Ngiye ngisebenzise amadayagramu asencwadini ye-*Physical sciences* ukuchaza amakhonsepthe anqala eSayensi coz [ngoba] uma uwashiya ungawachazanga *they will never understand them on their own*. Ngibuye ngiwathathe ku-inthanethi amanye ukuze kwande amadayagramu engizowasebenzisa ngoba uma abafundi bezothola uhlobo olulodwa bazoba nenkinga kuma-*exams*. Ngiye ngisebenzise wona ukwenza baqonde *the science laws and principles*. (Thisha A).

Okwenziwa uThisha A akwehlukile kokuvezwa uThisha B ngesikhathi ngimbukela ayekwenza ngesikhathi ethula isifundo sosuku. Wafika wadweba lo mdwebo olandelayo ebhodini:



Idayagramu 1

Waqeda ukudweba wabe eseqala ingxoxo yakhe nabafundi kanje:

Thisha B: *Grade 11, ekuqaleni kwe-term sakhuluma about forces and Newtons laws, angithi?*

Abafundi:(*bavuma*)

Thisha B: *Konje yimaphi ama-forces esifunde ngawo?*

Mfundi P: *Normal force*

Mfundi Q: *Force of gravity*

Mfundi R: *Applied force*

Mfundi S: *Frictional force*

Mfundi T: *Tension*

Thisha B: *Very good. What we need to remember ukuthi any pulling or pushing force iyi-applied force on an object. It can act horizontally, at an angle or vertical.*

Namuhla ngizothanda sigxile kwi-force of gravity esibuye siyibize ngeweight esiyibiza ngo-Fg isikhathi esiningi ngenxa yokuthi isymbol yayo kuba u-Fg osho i-force of gravity, sisakukhumbula lokho?

Abafundi: *Yebo.*

Thisha B: *Kuhleke uma kunjalo. The force of gravity esikhuluma ngayo yini oyikhumbulayo ngayo? How does it act on an object?*

Mfundi Q: *It always acts downwards thisha.*

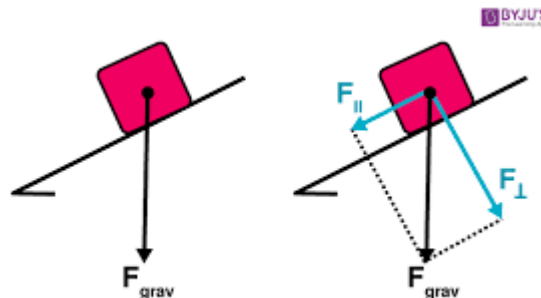
Thisha B: *Good. Nihumbule ngaso sonke isikhathi bafundi ukuthi njengoba u-Fg*

Ehlala e-act(a) downwards kusho ukuthi akukhathalele ukuthi i-direction of an object ithini but F_g will always act downwards. Kuyezwakala?

Abafundi: Yebo thisha.

Thisha B: *Kuhle uma sizwana ngoba idirection of an object inomthelela kusign of F_g . Uma esetshenziswa in calculations, sizobona uma siqhubeka. When an object is on an inclined plane (slope), kanje (ekhomba idayagramu ebhodini) its components for ukuthi sikwazi ukuwasebenzisa in calculations.*

UThisha D wabe esedweba lo mdwebo ngesikhathi echazela abafundi ngama-components of F_g akawabiza ngo F_g parallel no F_g perpendicular.



Idayagramu 2

Waqhubeka nokufundisa uThisha B.

Kuzona zombili lezi zikole okwenziwe kuzo ucwaningo, kuyacaca ukuthi othisha bakholelwa ekusebenziseni amadayagramu njengenyeye yezindlela namasu okusebenzisa ubulimimbili ukufundisa isifundo seSayensi. Baveza ukuthi ukuchaza amakhonsephti usebenzisa zombili izilimi, olwesiNgisi nolwesiZulu, uphinde uwaxhumanise kadayagramu kumelekelela kakhulu umfundi ngoba uthisha usuke enza ukuthi into ibonakale ukuthi yenzeka kanjani, futhi ibe yethuleka kahle, kusetshenziswa nolimi abafundi abalufunda kahle. Lokhu kuphinde kubasize ekutheni bakhele olwazini abasuke benalo ngalelo khonsephti.

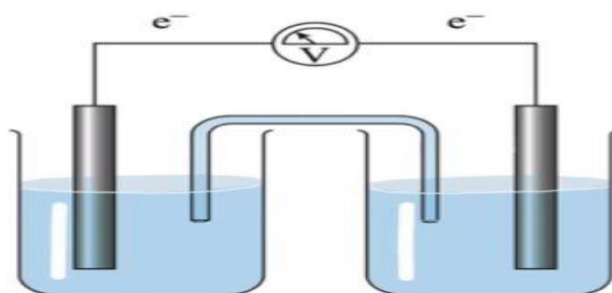
UFiorella benoMayer (2016) ocwaningweni lapho ababecwaninga khona ngomthelela wokubukela okwenziwa uthisha edweba amadayagramu ekufundeni, basekela lokhu ngokuveza ukuthi ukufunda ngokubukela uthisha edweba amadayagramu ukuchaza amakhonsephti kwenyusa izinga lokuthuthuka kokuqonda kwabafundi. Kanti ukufundisa ngamadayagramu kuyabasiza ubafundi

abasuke benolwazi olusadinga ukuthuthukiswa ngoba kubenza ukuthi basebenzise lolo lwazi abasuke bevele benalo ukuze badlulele ekuqondeni okusha okusuke kufundwa.

UMazak benoHerbas-Donoso (2014) ocwaningweni lapho ababecwaninga khona ngo kusebenzisa ubuliminingi emaklasini esifundo seSayensi uveza ukuthi ukuchazela abafundi ngolimi lwabo lwebele (okuyiSpanish kolwabo ucwaningo) amadayagramu eSayensi kwenza abafundi ukuthi bawaqonde kahle amakhonsepthe eSayensi okufundwa ngawo kula madayagramu. Ukuchaza okuqukethwe yidayagramu ngolimi lwebele kwenza abafundi bakwazi ukuqonda isifundo esifundiswa ngolimi lwesiNgisi ngoba uthisha uzisebenzisa kanyekanye lezi zilimi (olwebele nolwesibili) ukuchaza amadayagramu eSayensi. Lokhu kwenza bawaqonde kalula la makhonsepthe abawafundayo ngoba uthisha uchaza abe ekhomba kumadayagramu ukuze abafundi baqonde.

5.2.2.2. Ukusetshenziswa Kwezibonisi Eziyizithombe

Ngaphansi kwalesi sihlokwana ngizoveza izitatimende zababambiqhaza mayelana nokusebenzisa izibonisi eziyizithombe njengenywe yezindlela namasu okufundisa isifundo seSayensi ngokusebenzisa ubulimimbili. Nazi izicaphuno zokwakwenzeka ngenkathi ngibabukele ababambiqhaza. UThisha D wanamathisela lesi sithombe esilandelayo ebhodini. Ngemuva kwalapho wafundisa abafundi eqhubeka nesifundo.



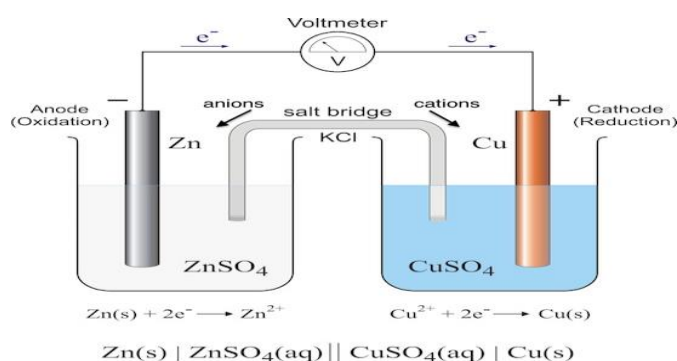
Isithombe 1

Thisha D: Njengoba kade sikhuluma ngo-increase no-decrease in number of electrons at the beginning of the lesson besikhulumela ukuthi kusilekelele ukubamba la makhonsepthe in a redox reaction in these electrochemical reactions esizofunda ngawo. REDOX reactions are Reduction-Oxidation

reactions.

What does that mean? Kusho ukuthi the reduction reaction (Gain of electrons) yenzeka kanye kanye ne-oxidation reaction (Loss of electrons). Isizathu esenza ukuthi kwenzekwe i-reduction ne-oxidation simultaneously ukuthi kufanele kuthi uma kuba ne-electron deficiency kwi-Cathode, afike esuka ngaphandle kokuthi kunqamuke the flow of current in this battery.

UThisha D wabe esechazela abafundi nge-*REDOX reaction* esebenzisa isithombe esingenhla, wabe esebhala izincazelo zakho konke ayekuchaza waphinda wanamathisela lesi esinalokhu ayekuchaza, wagcizelela lokhu abekuchaza esithombeni esingenhla. Nasi isithombe asinamathisela sesinezincazelo zalokho ayekade ekufundisa:



Isithombe 2

Ngalesi sithombe wabachazela lokhu okulandelayo abafundi:

Thisha D: *Ngizocela silalelane kahle: Ngizodweba ithebula elichaza konke okwenzeka in this cell ngoba kahle hle amachemical reactions lawa asesithombeni represents what happens inside a cell, ngamafuphi this is a zinc-copper cell. Ekulidwebeni kwami lizoba empty bese izincazelo engizonichazela ngazo ngizozibhala ezikhaleni ezifanele, niyobe ngalo. senikopisha-ke nani ukuze nizikhumbuze sisesonke learners.*

Abafundi: (bavuma bonke)

ANOX	REDCAT
<i>Anode is where oxidation takes place.</i>	<i>Reduction takes place at the cathode</i>
<p><i>[Disclaimer: Akungoba kungukuthi izindlela ezisetshenziswe ukuthi abafundi bakwazi ukuzikhumbuza ukuthi yiluphi uphawu (- noma +) oluhambisana nama-half-cells zihlale zimi kanje kodwa zivumelana nale Cell yalolu hlobo kuphela. Lezi zimpawu zisetshenzisiwe ngoba zizolekelela abafundi ukukhumbula.]</i></p>	
<i>Oxidation reaction takes place.</i>	<i>Reduction reaction takes place</i>
<i>Loss of electrons</i>	<i>Gain of electrons</i>
<ul style="list-style-type: none"> <i>oxidation half-cell: the beaker containing the anode</i> $\text{Zn} \rightarrow \text{Zn}^{2+} + 2\text{e}^{-}$	<ul style="list-style-type: none"> <i>reduction half-cell: the beaker containing the cathode</i> $\text{Cu}^{2+} + 2\text{e}^{-} \rightarrow \text{Cu}$
<ul style="list-style-type: none"> <i>salt bridge: a porous barrier that maintains electrical neutrality in the half-cells</i> <i>electron flow: electrons flow from anode to cathode through a wire</i> <i>ion flow: anions(electrons) flow through the salt bridge to the anode beaker; cations(protons) flow through the salt bridge to the cathode beaker</i> <i>voltmeter: a device that measures voltage</i> 	

Ithebula 2

Thisha D: Okwamanje sizogcina lana, angifuni ukugcina nginidida, sizoqhubeka kusasa naleli thebula ngoba kuningi okungena kulo.

Othisha baveza ukuthi bakholelwa ekusebenziseni izithombe njengenye yezindlela namasu okufundisa isifundo seSayensi ngokusebenzisa ubulimimbili. Kuyabalekelela kakhulu abafundi ukufunda kusetshenziswa izithombe ngoba ngesikhathi uthisha ekhuluma ngamakhonsephti anqala eSayensi usuke ebakhombisa bebona ukuthi ayinto enjani. Lezi zithombe ziveza ubunjalo bento

esingakwazi ukuyibona ngamehlo enyama kwesinye isikhathi kodwa ngama-*microscope* kuphela.

UMcTigue benoCroix (2010) ocwaningweni lwabo ngokusetshenziswa kwezithombe esifundweni seSayensi baveza ukuthi ukusebenzisa izithombe ukufundisa iSayensi kuthuthukisa ukuqonda kwabafundi ngoba izithombe kungenzeka zibenolwazi olungaveli emibhalweni. Lolo lwazi uthisha aluchaza esithombeni luthuthukisa ukuqonda amakhonsepthe eSayensi kubafundi. Izithombe ziqubula izingxoxo ngesifundo seSayensi kubafundi futhi bakhombisa ukukuthakasela ukubuka izithombe zesifundo seSayensi noma zibekwe odongeni lweklasi njengemihlobiso.

UPem (2019) ekucwaningeni kwakhe ngezindlela zokudlondlobalisa ukusetshenziswa kwelitherasi yezithombe zokufunda isifundo seSayensi kubafundi, uveza ukuthi ngokwejwayelekile uhlelo lwemfundo lunabafundi abajwayele ukufundiswa ngokungamathekisthi abhaliwe. Ngaleyo ndlela abaqeqeshekile ukwazi ukusebenzisa izithombe ukuzitholela izincazelo zamakhonsepthe abafunda ngawo. Lokhu kudinga othisha ukuthi bakhethe izithombe ezihambisana nabakufundisayo esifundweni seSayensi abazozisebenzisa ukwengeza ulwazi lokusebenzisa izithombe ukuqonda kabanzi ngamakhonsepthe nolimi lwesifundo seSayensi. Ukufundiswa ngezithombe kwengeza ulwazi olungaphezu kwalolu olwethulwa ngokubhaliwe kubafundi.

5.2.2.3. Ukusetshenziswa Kwezibonisi Ezingamagrafu

Phakathi kwezitatimende zababambiqhaza kuyavela ukuthi bayakholelwa ekusebenziseni amagrafu njengenywe yezindlela abazisebenzisayo ekufundiseni isifundo seSayensi futhi bebe besebenzisa ubulimimbili besiZulu nesiNgisi ubulimimbili. Izicaphuno zokushiwo ababambiqhaza nababekwenza kuyavela ngezansi:

Ngiye ngisebenzise amagrafu njengendlela yokuchaza kahle amakhonsepthe eSayensi ngiphinde ngihlobanise ukudlelwano *bo-direct proportion* no-*inverse proportion*. Ngiye ngibakhombise ngezibonelo zamagrafu ukuthi u-*direct proportion* usho ukuthi *if you increase one*

variable, the other also increase with the same factor. For inverse proportion, uma u-increas(a) one variable, the other will decrease with the fraction of that factor. Ngiye ngibatshela ukuthi uma sizobeka i-exponential graph eceleni, i-straight line graph represents direct proportion while the inverse proportion is represented by a smooth curve (Thisha C).

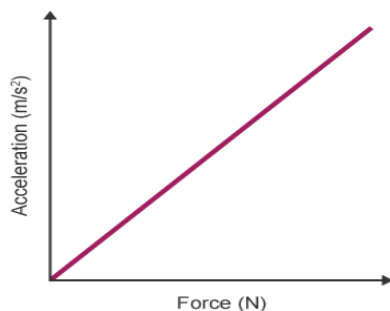
Lokhu okushiwo uThisha C kuyefana nakuchaza eklasini ngesikhathi ngimbukele efundisa:

Thisha C: *Konje njengoba sesifunde ngeNewton's second law of motion, what does the first part of the law say?*

Mfundi G: *When a net force is applied on an object of mass (m), an object will accelerate in the direction of the net force.*

Thisha C: *Great. This takes us to today's lesson. The statement mentioned by Mfundi G means that ubudlelwano phakathi kwe-net force and acceleration is direct proportional. Lokhu kusho ukuthi if you increase F_{net} , the value of acceleration also increases. When you decrease F_{net} , the value of acceleration will also decrease with the same factor.*

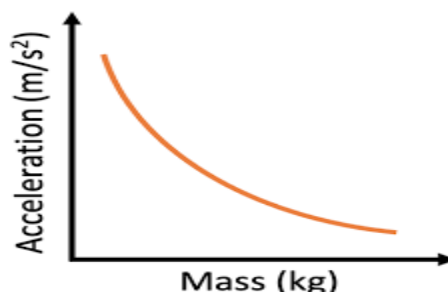
UThisha C wadweba igrafu efana nale elandelayo:



Umfanekiso 1

Thisha C: *Uma sibuka at our horizontal [X] axis sithola a force which represents the net Force (F_{net}). Vertical axis [Y] has acceleration. If you increase i-net*

force moving from zero towards right, check your vertical axis (acceleration) also increases (esho ethinta kwi-graph ayidwebile). If you move from the right towards zero, the acceleration decreases also. This is what is meant by the first part of Newton's second Law of motion.



Umfanekiso 2

UTHisha C wabe esedweba igrafu efana nalena engenhla la khona u-a emele i-*acceleration* kanti u-m emele i-mass.

Thisha C: *What do you notice ngale graph uma uyiqhathanisa nale esisuka kuyo?*

Mfundi H: *Lena thisha iyi-curve.*

Thisha C: *Yes it's a curve, hhayi noma iyiphi but a smooth curve. Ake ningikhumbuze the second part of Newton's second law of motion.*

Mfundi J: *(Waqala ngokukhuluma yedwa ezikhumbuza the first part, waqeda waphendula) The acceleration is directly proportional to the net force and inversely proportional to the mass of an object.*

Thisha C: *Yes, very good. Now that niyakhumbula, let's move to this graph ngoba ichaza khona. When the mass increases (ekhomba esithombeni), the acceleration of an object decreases. Uma kodwa si-decreas(a) the mass, the acceleration of an object increases. Le nto iyefana nokuthi uyahamba uyotheza izinkuni, uhamba ngokushesha okusho ukuthi your acceleration keeps increasing ngoba uziphathele izibopho nembazo or ucelemba. Uma usuthezile usuthwele umnyaba [inyanda yezinkuni] omkhulu, ubani ongangitshela ukuthi kwenzekani?*

Mfundi K: *Usuke utotoba [uhamba kancane] njengoba usuwesindwa umnyaba*

wezinkuni.

Thisha C: Very good. Lokho kusho ukuthi your acceleration decreased when you were carrying a heavy object (umnyaba wezinkuni which increased your mass) but ngesikhathi ungaphethe lutho, ubukwazi nokugijima, that is the relationship between the force acceleration and the mass of an object.

Okusho ukuthi when an object has a greater mass it moves slow, meaning its acceleration decreases kodwa uma i-object inesmaller mass it moves faster, meaning it's accelation have increased.

Le ngxoxo engenhla kanye nezicaphuno kuveza ukuthi othisha balezi zikole kuyabasiza ukusebenzisa amamodeli njengendlela yokufundisa isifundo seSayensi ngokusebenzisa ubulimimbili. Ababambiqhaza baveza ukuthi njengoba kusendaweni yasemakhaya akulula ukufinyelela ezintweni eziningi abangazisebenzisa ukwenza amaphrojekthi amamodeli kodwa ukusebenzisa amakhalibothi nezigubhu zamaplastiki ezilahlwayo uma zingasenalutho kuyabasiza kakhulu. Abafundi luyenyuka kubona uthando lwesifundo seSayensi ngoba bajabulela ukuzakhela amamodeli aveza ukwenzeka kwezinto ngamakhonsepthi eSayensi.

UGunawan nabanye (2017) bafakazela lokhu ngokuthi baveze ukuthi ukufundisa ngokusebenzisa amamodeli kunomthelela omuhle ekuqbuleni ikhono lokwakha nokuzisungulela kubafundi beSayensi. Lokhu kufunda kugxila kakhulu emakhonweni okucabanga, ukuxhumana nokusebenzisa kubafundi kanye nokwakha ulwazi olusha. Ukunika abafundi ithuba lokwakha amamodeli eSayensi kuthuthukisa ukuqonda kwabo amakhonsepthi eSayensi ngoba basuke bebona kumodeli abazakhele yona ukuthi isebenza kanjani empilweni yangempela.

Kanti uMursid benoSaragih noHartono (2022) ocwaningweni abalweza becwaninga ngokusebenzisa amaphrojekthi amamodeli okufundisa ukucabanga kubafundi bezifundo zobunjiniyela, baveza ukuthi ukufundisa ngokusebenzisa amamodeli kuthuthukisa imiphumela yabafundi. Ngale kwalokhu, kuphinde kuthuthukise izinga labafundi lokucabanga, ukucabanga ngokujulile, nokunye okuningi. Ukufundisa ngamamodeli kunika abafundi ukuqonda okubanzi kanye nothando lokufunda nokubambisana.

5.2.3.Ukusetshenziswa Kolimi Lwebele Nanxa Kufundiswa Ngolimi LwesiNgisi

Phakathi kokuvezwa ababambiqhaza ukuthi baye basebenzise ulimi lwebele (okuyisiZulu) kulezi zikole zombili kanyekanye nolimi lwesiNgisi lapho befundisa nakuba ulimi lokufunda nokufundisa kuyisiNgisi. Izicaphuno zabo othisha ziyaziveza izizathu ezenza basebenzise ulimi lwesiZulu kube kufundiswa ngolimi lwesiNgisi. Nazi izicaphuno zababambiqhaza:

Ngiye ngethule isifundo *either introduce it* ngesiNgisi noma ngesiZulu *depending* kuhlobo lwesingeniso engiluhlelile. Ngiyabafundisa nge-FAL [Ulimi lokuQala lokwEngeza] lapho ngibatshela *the definitions of laws and principles* ukuze bawabone nokuthi abhalwa kanjani kodwa ukubachazela kabanzi ngiyengisebenzise ulimi lwabo lwebele [isiZulu] ngoba kungenjalo ngeke bayiqonde nhlobo into engiyishoyo. Uma sengibabuza imibuzo *to test whether* bangizwile *or not*, bayangiphendula okukhombisa ukuthi ukufundisa ngolimi lwesiNgisi nesiZulu *simultaneously* kuyamlekelela umfundi *to grasp the lesson and get a deeper understanding* (Thisha D).

Kanti okuvezwa uThisha B (kucishe kufane nokuvezwa uThisha D) ukuthi:

Ngabe ngizimoshela isikhathi sami futhi ngabe ngibulala izingane uma ngingaqhuma [ukufundisa] ngesiNgisi nje wayawaya ngoba angeke bangizwe nhlobo futhi kwasifundo lesi ngeke basiqonde nakancane. *Because of this* ngiye ngifundise ngokusebenzisa ulimi lwesiZulu ukubachazela kahle ukuze baqonde. *We can not dispute* ukuthi kufundiswa ngesiNgisi *but* abami abafundi nje abaphasi uma ungabachazeli ngolimi lwesiZulu. *Definitions and statements of problems to be solved in activities abhalwe* ngesiNgisi futhi angiwabhali

ngesiZulu *but I explain them* ngesiZulu and
kuyasisebenzela nabo abafundi bami (Thisha B).

Kuyacaca okuvezwa othisha bakulezi zikole ukuthi bayakholelwa ekusebenziseni ulimi lwesiZulu ukufundisa abafundi nakuba ulimi lokufundisa kuyisiNgisi. Lokhu bakusebenzisa njengenywe yezindlela namasu okufundisa isifundo seSayensi ngokusebenzisa ubulimimbili. Baveza ukuthi isizathu sokuthi basebenzise ulimi lwesiZulu ukuthi abafundi bakhombisa ukungasiqondi isifundo seSayensi uma sethulwa ngolimi lwesiNgisi kuphela. Ukufundisa ngesiZulu kuthuthukisa ukuqonda kwabafundi isifundo seSayensi ngolimi lwabo lwebele okuyisiZulu kulezi zikole kanti nolwesiNgisi kuyathuthuka ukuluqonda kubafundi. Lokhu kudalwa ukuthi ngesikhathi uthisha echaza ngesiZulu usuke eqale wakhuluma ngesiNgisi, ngenxa yalokho abafundi bagcina beqonda ikhonsephthi ngezilimi ezimbili.

UMcDermott (2023) wayecwaninga ngokufundisa iSayensi lapho abafundi ababekhombisa khona ukuphumelela kahle uma befundiswa ngezilimi zabo zebele. Kulolu cwaningo uveza ukuthi ukusebenzisa kothisha nabafundi ulimi lwabo lwasekhaya ngesikhathi sokufunda iSayensi kubagqugquzela ukuzitholela amagama okuchaza iSayensi anembayo ngalo ulimi lwebele. Lokhu kubalekelela ukuthi bakhule ekuwaqondeni la magama. Abafundi baveza ukuthi ngokusebenzisa ulimi lwabo lwebele nolwesiNgisi ekufundeni isifundo seSayensi bathola ukuqonda okubanzi ngeSayensi baphinda bakhula ekuqondeni ulimi lwesiNgisi.

UCharamba (2019) ocwaningweni ayelwenza ngokucwaninga ukufunda ukusebenzelana kolimi nesifundo seSayensi emaklasini eSayensi anabafundi abakhuluma izilimi ezahlukene uveza ukuthi inkinga yolimi esifundweni seSayensi eNingizimu-Afrika yenyuswa ukuthi othisha abanengi beSayensi banolimi lwebele olungelona ulimi lokufunda nokufundisa ezikoleni abasebenza kuzo. UCharamba uthi okungalekelela ukuqeda le nkinga, ukusebenzisa ulimi lwesiNgisi kanye nolimi lwebele lapho kufundiswa ukuze othisha nabafundi bezwane olimini abalusebenzisayo. Ukusebenzisa ulimi lwebele kanye nesiNgisi ekufundiseni iSayensi kulekelela abafundi ngokudlondlobala ekufundeni nasekuqondeni isifundo seSayensi nokuphinde kubadlondlobalise ekuqondeni ulimi lwesiNgisi.

5.2.4. Ukusetshenziswa Kwama-Eksperimenti

Ngaphansi kwalesi sihlokwana ngizoveza okushiwo ababambiqhaza ngokusebenzisa ama-eksperimenti njengeny ezezindlela namasu okufundisa isifundo seSayensi kusetshenziswa ubulimimbili. Abakuvezayo ababambiqhaza ukuthi kuyabasebenzela bona nabafundi ukusebenzisa ama-eksperimenti angama-*demonstration* ezethulweni zezifundo okuba yizingeniso ngenhloso yokufaka ikhonsephtsi okufundwa ngayo igxile emqondweni womfundi.

Nazi izicaphuno zabakushoyo othisha ngezansi:

Uma ngifundisa ngijwayele ukuwenza ama-*experiment which are informal* ukuze baqonde amakhonsephtsi eSayensi nakuba singenayo i-*lab* [ilabhorethri]. *For esterification ku-organic chemistry* ngiye ngiwenze *as demonstration before* ngiqale ukuyifundisa. *For 3 or 4 esters produced in an experiment*, yibona abangitshelayo ukuthi njengoba ikhipha iphunga nje lizwakala sengathi elani. *Usually* kuba amaphunga o-*nail polish remover, pear, paint, lavender* nokunye. *That helps* them ukuthi baqonde ukuthi *esterification is used to produce scents* afakwa *mostly in toileteries like* insipho nokunye (Thisha B).

Okuvezwa uThisha B akwehlukile kokuvezwa uThisha A:

Kwa-Grade 10 uma ngifundisa nge-*evaporation, crystallisation no-dissolving* kanje ngiye ngibenzise *an experiment of a salt-water solution. I come with salt, water and a bowl* eklasini. *I let one learner pour water in a bowl*, omunye afake usawoti, omunye agoqoze *to make a solution. When it dissolves* ngiyibeka *at the corner of a class and tell them to observe every day* okwenzeka kuloya bheseni ngoba sizowubeka *for few days. As days go by*

kubonakale amanzi encipha *kwi-bowl and I explain* ukuthi *that is evaporation. As days go by* kuyaqala kubonakale inzika kasawoti ngaphansi kwamanzi. Uma esephelile amanzi usawoti usala unamathele *ku-bowl and* ngiye ngibachazele ukuthi *that is crystallisation* (Thisha A).

Kuyacaca ezicaphunweni zothisha ukuthi bakholelwa ekusebenziseni ama-eksperimenti njengendlela nesu lokusebenzisa ubulimimbili ukufundisa isifundo seSayensi. Othisha bawasebenzisa ukwenza izethulo zokuqala isihloko esisha sesifundo ukuze baqubule uthando, ukuqaphela nokuqondisisa isifundo seSayensi. Kokunye ama-eksperimenti bawenza ngemuva kokufundisa isihloko esithile ukuze bagcizelele ikhonsephthi elisha kubafundi. Lokhu kuyefana nokushiwo uBhute nabanye (2021) ocwaningweni lapho ababecwaninga khona ngokuthuthukiswa kokufundisa emalabhorethri ngenhloso yokuthuthukisa ukufundwa kweSayensi lapho abaveza khona ukuthi ukufunda iSayensi ngokwenza ama-eksperimenti nabafundi kuthuthukisa ukuqonda kwabo isifundo seSayensi. Lokhu kungenxa yokuthi ngesikhathi abafundi benza ama-eksperimenti basuke besebenzisa ulwazi abalufundile esifundweni seSayensi.

Ukubona kuma-eksperimenti sekwenzeka ngempela lokhu abakufundile abafundi, ulwazi abanalo luyazinja ezingqondweni zabo futhi luyathuthuka. Ngenxa yokuthi ama-eksperimenti adinga ukuthi kube khona ilabhorethri nezinsizakusebenza ezihambisana nesifundo esethulwayo, ezinye izikole aziwenzisi. Lokho kwenza ukuthi abafundi babe nolwazi olufushane ngesifundo seSayensi ngoba kunzima ukukholwa ukwenzeka kwezinye izinto zeSayensi uma ungakaze uziqinisekise ngokuzibona emalabhorethri.

U-Otchie nabanye (2020) baveza ukuthi ama-eksperimenti alekelela abafundi ukuthi basebenzise amathuluzi eSayensi ukuze bakhule ekuqondeni iSayensi namakhonsephthi ayo. Ukufundisa izifundo zeSayensi kuholwa amakhonsephthi namathiyori. La makhonsephthi ukuze akhele agxile ezingqondweni zabafundi, kudingeka ukuthi othisha bathasisele ngokwenzisa abafundi ama-eksperimenti ukuze bahlole ithiyori abayifundile ubuqiniso bayo abafundi.

5.2.5.Ukusebenzisa Amavidiyo eSayensi

Ngaphansi kwalesi sihlokwana kuyavela ezitatimendeni zothisha abangabambiqhaza kulolu cwaningo ukuthi abanye babo basebenzisa amavidiyo ukuchazela abafundi amakhonsepthe eSayensi njengenye yezindlela namasu okusebenzisa ubulimimbili ukufundisa isifundo seSayensi. Nazi izicaphuno zababambiqhaza eziyizibonelo zabakushoyo ngalesi sihlokwana:

Sinawo ama-video lessons where by esezo-conduct(wa) umuntu wakwenye i-language, like an Indian or white guy ukuze bekwazi ukubona ukuthi ngempela when you're teaching i-Physics [iSayensi] kungesiyena umuntu owumZulu njengabo kuhamba kanjani. Baze ba-complain(e) ukuthi, "Hhayi lo muntu uyasezelisa" ngoba bebona ukuthi ukhuluma i-English throughout, akabachazeli amanye amagama. Yilapho engingenelela khona ngibachazele ngolimi lwebele [isiZulu] coz [ngoba] ngisuke sengibona ukuthi aba-understand(i) (Thisha A).

Okuvezwa uthisha A kuyefana nokuvezwa uThisha D:

....naku-youtube ngiyangena ngibuke ama-video a-related to Physics uku-equip(a) i-language yami ukuze ngingabi limited ku-language. Ngiye ngikhethe leyo ehambisana nesikufundayo bese ngidedela uthisha okuvidiyo ukuthi abafundise kodwa ngenxa yokuthi ufundisa ngolimi lwesiNgisi ngiye ngilokhu ngiyimisa i-video ukuze ngi-emphasis(e) ngesiZulu so that bezozwa kahle. Kuyasiza kakhulu ngoba bayayi-understand(a) i-lesson ngaleyo ndlela (Thisha D).

Ngaphansi kwalesi sihlokwana othisha baveza ukuthi bakholelwa ekusebenziseni amavidiyo eSayensi abawathola ku-Youtube njengendlela nesu lofundisa isifundo

seSayensi ngokusebenzisa ubulimimbili. Kuyathuthuka ukuqonda kwabafundi besifundo seSayensi kulezi zikole ngoba kuthi ngesikhathi abafundi bebukela amavidiyo uthisha abuye ababuze imibuzo noma futhi agcizelele ngolimi lwesiZulu lokhu okufundiswa kwividiyo ukuze abafundi bacacelwe kahle. Othisha baveza ukuthi la mavidiyo abuye alekelele ekuthuthukiseni ulimi lwesiNgisi nolweSayensi ngoba izifundo zisuke zethulwa ngolimi lwesiNgisi bese uthisha ecacisa ngolimi lwesiZulu lapho ebona sengathi abafundi bazoba nokudideka khona.

U-Ibe beno-Abamucho (2019) ocwaningweni ababecwaninga khona ngokusetshenziswa kobuchwepheshe bamavidiyo ngenhloso yokwakha ugqozi lokuthanda isifundo seSayensi nokusiphasa kubafundi basezikoleni zaseNigeria, bathola ukuthi abafundi abafundiswa kusetshenziswa amavidiyo basiphasa kahle kakhulu isifundo seSayensi uma beqhathaniswa nababengawasebenzisi. U-Ibe beno-Abamucho (2019) bagcizelela ukuthi kuyakulekelela kakhulu ukufunda komfundi uma uthisha ezolokhu emisa ividiyo ebuze imibuzo ngokufundwayo kubafundi, futhi nokugcizelela okufundwayo kwenza abafundi baqonde kangcono okufundwayo. Ukufunda kusetshenziswa amavidiyo kuqubula uthando ngesifundo seSayensi kubafundi.

UPecay (2017) ocwaningweni lapho ayecwaninga khona ngokubandakanya amavidiyo ka-*Youtube* ekufundiseni isifundo seSayensi uveza ukuthi inhloso yocwaningo lwakhe kwakungukuthola ukuqonda ngezimpande nezindlela zokusebenzisa u-*Youtube* ekufundiseni isifundo seSayensi. NgokukaPecay (2017) othisha beSayensi basebenzisa amavidiyo ka-*Youtube* ngenhloso yokuthuthukisa indlela abafundisa ngayo isifundo seSayensi bese bewabukisa abafundi amavidiyo njengenywe yezindlela zabo zokuchaza isifundo seSayensi kubafundi.

5.2.6. Ukusebenzisa Amamodeli eSayensi

Ngaphansi kwalesi sihlokwana, kuyavela ezitatemendeni zababambiqhaza ukuthi abanye basebenzisa amamodeli eSayensi ukucacisela abafundi kabanzi ngamakhonsephtsi alesi sifundo ukuze baqiniseke ukuthi abafundi bayasiqonda. Nazi izichaphuno zokushiwo ababambiqhaza balolu cwanningo ngalesi sihlokwana:

What I do ukuthi ngisebenzise ama-model but
angifiki nawo kodwa ngiye ngiyalele bona ukuthi

bayowakha bese befika nawo eklasini ukuze sibone ukuthi ayasebenza yini. Bayasizakala ngoba basuke beyakha ngaphambi kokuzofunda ngaleyo khonsephtsi. Ngiye ngibatshela izinto abazozidinga ukuyakha leyo *model* bese ngithi abayobuka ku-*Youtube* ukuthi isebenza kanjani *and modelise it. Usually* ngikwenza uma ngifundisa ngama-*generator*. Anginayo nje inkinga yabafundi *who lose marks* kuleyo ngxenye coz bayazi njengoba bezazi *and I'm still trying out other models* engizowasebenzisa ukuze bayiqondisise iSayensi abafundi (Thisha B).

Lokhu kuyahambisana nokushiwo uThisha D lapho ethi:

With my grade 10 siye sakhe a circuit board as a model esizoyisebenzisa *to understand the concept of electricity and the flow of charges in a circuit*. Ngiye ngibacele ukuthi baphathe amakhalibhothi esizowasika *to build a model. The rest* iphathwa yimi. Ngibahlalisa *in groups and instruct them to build it in a class* futhi ngisuke ngilindele ukuthi ikhanye leyo *circuit*. Bayasizana-ke *to connect it in parallel and in series while we continue. The following days* ngifundisa ngayo beyibona iphambi kwabo. Leyo naleyo *component of the circuit* engikhuluma ngayo ngiye ngithi abayithinte *and operate the circuit so that* bezoyibona ukusebenza kwayo. *From* ukusebenzisa imodel bahleze bephumelela kahle coz *they understand* iSayensi ngokuyibona (Thisha D).

Ezicaphunweni ezingenhla kuyacaca ababambiqhaza bakhetha ukusebenzisa amamodeli eSayensi njengendlela nesu lokusebenzisa ubulimimbili ukufundisa isifundo seSayensi. Othisha baveza ukuthi amamodeli athuthukisa ukuqonda

kwabafundi isifundo seSayensi ngoba ikhonsephthi ngayinye abasuke beyakhele imodeli, abafundi bayayiqonda ngokuzibonela bona ngokwabo uma sebebacacisele abafundi ukuthi isebenza kanjani. Abafundi bathola umdlandla wokuzisungulela awabo amamodeli begqugquzelwa yilawa abawanikwa uthisha njengephrojekthi ukuthi bawakhe. Lokhu akwehlukile kokuvezwa uGogolin benoKrüger (2018) ocwaningweni lapho ababebheka khona ukuqonda kwabafundi ngomsuka nenhloso yamamodeli esifundweni seSayensi. Laba bacwaningi baveza ukuthi amamodeli asekelwe kumakhonsephthi ahlukene angaba wusizo ngoba ukuqonda imodeli eyodwa kumfundi kungamenza afise ukufunda nangamanye amamodeli ukuze ngelinye ilanga azisungulele awakhe. Othisha kufanele baqikelele ukuthi yimaphi amamodeli abafisa ukuwadidiyela ekufundiseni isifundo seSayensi kuqala.

UClement (2000) lapho ayecwaninga khona ngokufundisa iSayensi ngokusebenzisa amamodeli baveza ukuthi inhloso yokusebenzisa amamodeli eSayensi evezwa abacwaningi abaningi ukuthuthukisa ukuqondwa kwethiyori efundiswayo esifundweni seSayensi. Lokhu kwelekelela ukuthuthukisa ukuqondwa kwamakhonsephthi eSayensi kodwa akuzona zonke izingxenye zethiyori ezicaciswa yimodeli ngoba uma kwakhiwa imodeli kwakhiwa eliqondene naleyo khonsephthi elifundiswa ngaleso sikhathi.

5.2.7. Ukusebenzisa Amasimuleshini

Okuvela ezitatimendni zababambiqhaza ukuthi bayawasebenzisa amasimuleshini ukucacisela abafundi amakhonsephthi eSayensi futhi bathi kuyabalekelela abafundi. Ngezansi kuvela izicaphuno zokushiwo ababambiqhaza ngaphansi kwalesi sihlokwana:

Kulesi sikole asinayo ilabhorethri, so ngiye ngisebenzise ama-*simulations* ukubenza babone amakhonsephthi nama-ekspariment akhona ukuthi enziwa kanjani coz *I only have a lab kit. PhET simulations helps a lot because* bayakwazi ukuwasebenzisa noma bebodwa coz *they just search in their phones*. Okuhle ngawo ukuthi *they don't need internet* ukuthi asebenze *if you've downloaded them* (Thisha C).

Okuvezwa uThisha C akwehlukile kokushiwo uThisha C ngezansi:

Kukhona ama-*simulations* engiwasebenzisa esikhundleni se*lab* [labhorethri] ngoba asinayo kule sikole. Uma kunama-*practical investigations* okufanele siwenze *formal and informal* ngiye ngisebenzise ama-*sims* [simulations] kakhulu. Okuhle ukuthi *learners do have phones, we downloaded them* emafonini abo *and they use them* noma besemakhaya. *They benefit a lot coz* [Ngoba] bayawaqondisisa ama-scientific concepts kanjalo (Thisha A).

Othisha balezi zikole zombili bayacacisa ukuthi bayakholelwa ekusebenziseni amasimuleshini njengenye yezindlela zokufunda nokufundisa isifundo seSayensi ngokusebenzisa ubulimimbili. Amasimuleshini athuthukisa ukuqonda kwabafundi ngoba ngesikhathi uthisha ewasebenzisa ukubafundisa uye abacacisele ngolimi lwabo lwebele, okuyisiZulu, futhi abafundi bathola ithuba lokuwasebenzisa ngabodwana emakhaya ngoba asemafonini abo. Ngenxa yalokho bayathuthuka abafundi ekuqondeni amakhonsephti eSayensi. Othisha babuye bawasebenzise esikhundleni samalabhorethri ngoba izikole zabo azinawo, kanti bathi kubelekelela ukuqhuba ama-eksperimenti ayingxenye yokufunda kwabafundi nalawa angekho ohlwini.

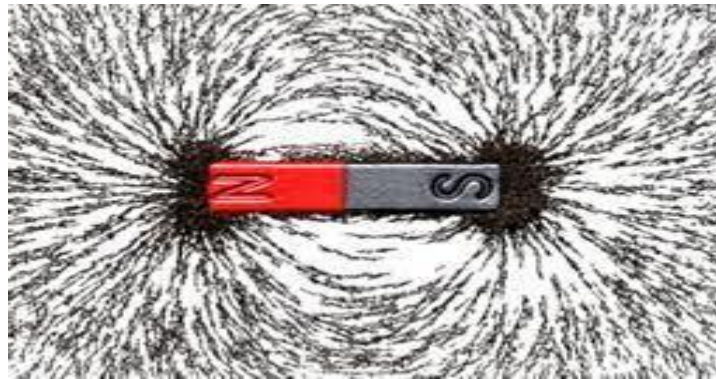
URayan nabanye (2023) lapho ababecwaninga khona ngokudidiyela ukufundwa kweSayensi nokusetshenziswa kwamasimuleshini baveza ukuthi kufanele kukhuthazwe kakhulu ukusetshenziswa kobuchwepheshe besimanje ekufundiseni isifundo seSayensi. Inzuzo yokusebenzisa ilabhorethri yamasimuleshini zimbandakanya ukuthi abafundi bathola amathuba okuzifundela ngabodwana ngoba bayakwazi ukuwasebenzisa nangabodwana emakhaya. Abafundi abasuke bengenzi kahle kumakhonsephti eSayensi bakhombisa ukuthuthuka ekuwaqondeni uma besebenzisa amasimuleshini okufundwayo ngaleso sikhathi.

URamnarain benoMoosa (2017) ocwaningweni lapho ababecwaninga khona ngokulungisa amaphutha ekufundweni kwe-*Electricity and Magnetism* ebangeni leshumi ngokusebenzisa amasimuleshini kubafundi besifundo seSayensi

eNingizimu-Afrika baveza ukuthi othisha basezikoleni zasemakhaya sebeyaqaqala manje ukusebenzisa kancane ubuchwepheshe besimanje ekufundiseni iSayensi. Kuyabalekelela kakhulu ngoba bayakwazi ukulwa nokushoda kwezinsiza ezifana namalabhorethri kanti amasimuleshini ayilabhorethri yobuchwepheshe besimanje.

5.2.8. Ukusetshenziswa Kwamaphrakthikhali

Phakathi kokuvezwa ababambiqhaza ngalesi sihlokwana ukuthi bayaye basebenzise amaphrakthikhali njengenye yezindlela abazisebenzisayo lapho besebenzisa ubulimimbili ukufundisa isifundo seSayensi. Ngezansi ngizoveza okwakwenziwa uThisha D ngesikhathi ngimbukele efundisa:



Isithombe 3

Lesi sithombe esingenhla yisithombe uThisha D afike asinamathisela ebhodini ngesikhathi ezoqala isifundo, ngenhloso yokuphetha isifundo sangayizolo ngoba wayesezoqala isihloko esisha. UThisha D wafika ephethe iphepha elimhlophe elingabhalwe lutho, amazibuthe (Magnet) kanye nama-iron fillings (izingcucwana zensimbi ezigaywe zalingana nezomanyazini). UThisha D waba nengxoxo nabafundi kanje:

Thisha D: *Namuhla ngifisa si-demonstrat(e) the magnetic field partten by this practical demonstration. I've got these (ebakhombisa akuphetha, amazibuthe nama-iron fillings). Manje ngizoqala ngokuthi nginenzele bese nina nizoza and observe ngokwehlukana.*

Abafundi: *(Bekhombisa ukujabula) Yes!*

Thisha D: *Wo, manini, lindani. Ningayitatazeleli ngoba inhloso yami lana ukuthi nibone the magnetic field pattern practical ngenkathi yakheka ukuze*

nisusele kuyo uma senidweba le okufanele nikwazi ukuyidweba.

UTHisha D waqala wabeka iphepha elinama-iron fillings etafuleni, wacela iqoqwana labafundi ukuthi lisondele lizobuka okwakuzokwenzeka. Wabe esefaka isandla sakhe esinomazibuthe ngaphansi kwetafula, wawuthintisa etafuleni umazibuthe maqondana nephepha elinama-iron fillings. Wayelokhu esihambisa isandla esiphethe umazibuthe etafuleni, ahleleka ama-iron fillings kanjengoba kuvela esithombeni esingenhla. Wabashintshanisa abafundi ukuthi bazobuka le phrakthikhali baze baphela eklasini. Ngemuva kwalapho waqhuba ingxoxo nabo abafundi:

Thisha D: *Now that we've seen this demonstration, yini ongayiphawula ngokubonayo?*

Mfudi P: *Ngibona lezi zinto ezimnyama zinqwabelene ndawonye eduze nomagnet but ziqhelelene as ziba kude no-magnet.*

Thisha D: *Ok, next.*

Mfundi Q: *Ngibona ama-fillings akha the smooth curves phakathi nendawo.*

Mfundi R: *(Engenelela) Mina ngib....(wamumisa uthisha)*

Thisha D: *Mana kancane, asingangenani emlonyeni. Mfundi Q, ubusuqedile?*

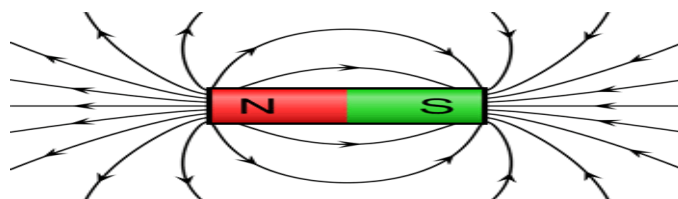
Mfundi Q: *Yebo besengiqedile.*

Thisha D: *Usungaqhubeka Mfundi R.*

Mfundi R: *Ngiyabonga and I'm sorry. Ngibona ama-lines ama-iron fillings akheke Njengama-lines ezinhlangothini zombili zomazibuthe.*

Thisha D: *Ok, great. Nibona lokhu engikubonayo nami. Lena-ke eniyibonayo futhi Eniyichazayo yi-magnetic field pattern. Manje-ke ngizonidwebela ebhodini Ngisusela kule eniyibona ephepheni.*

UTHisha D wanamathisela lo mfanekiso ongezansi ebhodini:



Umfanekiso 3

Thisha D: *Lokhu enikuchazayo enithi niyakubona kuchaza that magnetic field is the strongest*

closer to the poles, yingakho nibona ama-fillings embondelene ndawonye eduze namapoles of magnet. Nakhu nalana kumdwebo kuvela kanjalo (esho ethinta, ebakhombisa emdwebeni owawusebhodini).

Waqhubeka uThisha D wabachazela konke okufanayo kulo mdwebo nokukuphrakthikhali. Kanti uThisha A waveza ukuthi:

Uma ngifundisa nge-*electroplating*, ngiye ngifike ne-*glass beaker, wires, a cell, copper electrode and any other electrode* engisuke ngiqoke ukusebenza ngayo ngalelo langa kanye ne-*copper sulphate solution*. Ngisuke ngifuna ukubenza babone ukuthi yenzeka kanjani i-*electroplating where a cheap metal is coated with an expensive metal so that it may look expensive and be sold to people*. Ngiye ngibatshela ukuthi *that is how* ombombayi bobucwebe ngisho nabezipuni *are created*, nokuye kuthi ngemuva kwesikhathi kuphucuke bese kuvela ubunjalo bawo lowo mbombayi owuthengile (Thisha A).

Okuvezwa othisha ngaphansi kwalesi sihlokwana kuveza ukuthi bayawenza amaphrakthikhali njengendlela yokufundisa isifundo seSayensi besebenzisa ubulimimbili besiNgisi nesiZulu. Othisha bayabavumela abafundi ukuthi babe nezingxoxo zeSayensi ngolimi lwesiZulu njengolimi lwabo lwebele ngesikhathi bebukela uthisha enza, ekhombisa ukwenzeka kokuthile afundisa ngakho. Othisha baveza ukuthi ayabasiza amaphrakthikhali ukwenyusa izinga lokuthanda isifundo seSayensi kubafundi. Lokhu kwenza ukuthi abafundi basiqonde bese besiphumelela ngendlela ehabeka emathubeni okwamukelwa kalula ezikhungweni zemfundo ephakeme isifundo seSayensi.

UKibirige noRebecca kanye noMavhunga (2014) lapho ababecwaninga khona ngomthelela womsebenzi wamaphrakthikhali ekuphumeleleni kwabafundi besifundo seSayensi ebangeni leshumi eNingizimu-Afrika, baveza ukuthi ukusebenzisa amaphrakthikhali ukufundisa isifundo seSayensi ngenye yezindlela ezithuthukisa

ukuphumelela kwabafundi. Ngenxa yalokho kubalulekile ukuthi othisha beSayensi bawasebenzise amaphrakthikhali ukuthuthukisa ukuqondwa kwesifundo. Abafundi abafundiswa kubandakanywa amaphrakthikhali baphumelela kangcono kunabafundi abafundiswa ithiyori engahlolwa ngamaphrakthikhali (Kibirige, Rebecca & Mavhunga, 2014). Kuyaqapheleka kodwa ukuthi ezinye izikole azinawo amalabhorethri okwenza amaphrakthikhali, ezinye zinawo kodwa ashoda ngezinsizakusebenza nokwenza ukuthi ingalandelwa imigomo yezokuphepha yaselabhorethri. OKibirige noRebecca kanye noMavhunga (2014) baveza ukuthi othisha abanengi abagqugquzelekile ukwenza amaphrakthikhali, lokho kwenza ukuthi bangawenzisi nhlobo kanti abanye bakhetha ukwenza lawa abalelwa emamakini abafundi kuphela.

UKoirala nabanye (2019) sebeke bacwaninga ngomthelela wokusebenzisa amaphrakthikhali ekuphumeleleni isifundo seSayensi ezikoleni ezazikhethiwe ezweni laseNepal, eNingizimu ye-Asia. Bathola ukuthi ukusebenzisa amaphrakthikhali kuyayenyusa imiphumela yabafundi ezivivinyweni zesifundo seSayensi.

5.3. Iqoqa Lesahluko

Lesi sahluko sethule izindlela namasu okusetshenziswa othisha ekufundiseni isifundo seSayensi ngokusebenzisa ubulimimbili besiNgisi nesiZulu ngaphansi kwalezi zihlokwana: ukuqhathanisa amakhonsephti abhalwe ngokufana kodwa equkethe imiqondo ehlukeni; ukusetshenziswa kwezibonisi; ukusetshenziswa kolimi lwebele nanxa kufundiswa ngolimi lwesiNgisi; ukusetshenziswa kwama-eksperimenti; ukusebenzisa amavidiyo esifundo seSayensi; ukusebenzisa amamodeli eSayensi; ukusebenzisa amasimuleshini; ukusetshenziswa kwamaphrakthikhali. Esahlukweni esilandelayo kuzohlaziywa imininingo yalolu cwanningo etholakele.

ISAHLUKO SESITHUPHA

Izizathu Zokwenza Kothisha Uma Befundisa Isifundo Sesayensi

6.1. Isingeniso

Esahlukweni esedlule ngethule ngahumusha okwenziwa othisha ababeyingxenye yocwaningo ukufundisa isifundo seSayensi besebenzisa ubulimimbili. Kulesi sahluko ngizohlaziya imininingo yalolu cwaningo engiyethule ngaphinde ngayihumusha esahlukweni sesine nesesihlanu. Lokhu ngizokwenza ngokuphendula umbuzongqangi wocwaningo wesithathu othi: “Kungani othisha besifundo seSayensi besebenzisa ulimi ngendlela abenza ngayo lapho bethula izifundo zeSayensi emaklasini ebanga leshumi neleshumi nanye?” Lo mbuzo ngizowuphendula ngaphansi kwalesi sihlokwana esithi: “Izizathu ezenza ukuthi othisha bebanga leshumi neleshumi nanye benze ngendlela abenza ngayo lapho befundisa isifundo seSayensi”.

6.2. Izizathu ezenza ukuthi othisha bebanga le-10 nele-11 benze ngendlela abenza ngayo lapho befundisa isifundo seSayensi

Ngaphansi kwalesi sihlokwana ngizoveza izizathu ezenza ukuthi othisha bebanga le-10 nele-11 benze ngendlela abenza ngayo lapho befundisa isifundo seSayensi ngaphansi kwalezi zihlokwana:

- (i) Ubumqoka bolimi olusabalele nekharikhulamu.
- (ii) Ulwazi lukathisha lwesifundo nolwazi lwakhe lokufundisa.
- (iii) Ulimi lwasekhaya neqhaza lwalo ekufundiseni isifundo seSayensi.
- (iv) Izinsizakufundisa ezibulimimbili esifundweni seSayensi.
- (v) Izichazamazwi eziqondene namatemu esifundo seSayensi ezibulimimbili
- (vi) Uthando lolimi lwasekhaya nomthelela wakho kuthisha nakumfundi.

6.2.1. Ubumqoka bolimi olusabalele nekharikhulamu

Ngokwemininingo yocwaningo ekhiqiziwe kuvela ukuthi othisha balezi zikole eziyingxenye yalolu cwaningo bakubona kubaluleke kakhulu ukufundisa ngokulandela ulimi olusabalele nekharikhulamu ukuze bathuthukise ukuqonda kwabafundi esifundweni seSayensi. Izitatimende zababambiqhaza ezivela

emininingweni ekhiqizwe yilolu cwaningo ukuthi lab'othisha abafundisa kulezi zikole basabalalisa ulimi nekharikhulamu ngokuthi uma befundisa amakhonsephti eSayensi abhalwa futhi abizwe ngokufanayo nasolimini lwesiNgisi bawachaze kusukela endleleni abafundi abawaqonda ngayo. Lokhu bakwenza ngokuthi baqale ngokuchazela abafundi ikhonsephti ngendlela abaliqonda ngayo olimini abafunda ngalo, bese kuthi uma sebegculisekile othisha ukuthi bonke abafundi bayayiqondisisa incazelo yesiNgisi, bese bebachazela ngokwenzazelo yolimi lwesifundo seSayensi. Othisha lokhu bakwenza ngenhloso yokulekelela ukuthi abafundi basiqondisise isifundo seSayensi futhi bathuthuke nasolimini lwayo nakolwesiNgisi. Isibonelo, ngesikhathi uThisha D efundisa lapho aqala khona ngokuhlola ulwazi ngokufundisa abafundi nge-*number line*. Ngemuva kokuxoxa nabafundi ekufundiseni ngamagama *o-increase no-decrease ku-number line* wadlulela phambili ngokuthi athi: “Asisukeni egameni *increase no-decrease* siye ku-*loss no-gain of electrons*, sizelokhu siphuma esiNgisini siya kuSayensi ngoba iSayensi ayisona isiNgisi”. Kulapho ayesengena khona ekubafundiseni la magama esiNgisi esenencazelo ehlukile kweyeNgisi uma esesetshenziswa esifundweni seSayensi.

Indlela uThisha D afundisa ngayo amakhonsephti eSayensi ngokubafundisa ngencazelo yolimi abalukhulumayo, okululimi lwesiNgisi (okululimi lwesibili kubo abafundi nothisha) kuqinisekisa ukuthi ukholelwa ukuthi ukufundisa ngokulandela ulimi olusabalele nekharikhulamu kubalulekile futhi kuyabasiza abafundi ukuqondisisa isifundo seSayensi. Lokhu kuveza ukuthi uThisha D uyalibamba iqhaza ekufundiseni nasekuthuthukiseni ulimi kubafundi esifundweni seSayensi okungesona isifundo solimi. Ngalokhu akwenzayo ulandela iminxa nezisekelo zolimi olusabalele nekharikhulamu eziveza ukuthi bonke othisha kufanele babambe iqhaza ekuthuthukiseni ulimi lomfundi, kungabi umsebenzi wothisha bolimi kuphela (Fillion, 1979).

USingh benoGeetah (2021) baveza ukuthi limi olusabalele nekharikhulamu lwakhele phezu kwesisekelo nenkolelo yokuthi akufanele kube khona umgoqo noma umgcele phakathi kolimi nokufunda kodwa zozimbili lezi zinto kufanele zihlanganiswe, zisebenzisane. Ikhonsephti lolimi olusabalele nekharikhulamu ligcizelela ukubaluleka kokubandakanywa kokufundiswa kolimi ezifundweni ekungezona ezolimi. Laba bacwaningi bagcizelela ukuthi ulimi olusabalele nekharikhulamu

luhlose ukukhulisa ulwazi lwezifundo okungezona ezolimi ngamakhono olimi (ukukhuluma, ukufunda, ukubhala nokulalela). Ulimi olusabalele nekharikhulamu lulekelela ngokuhlomisa abafundi ngamakhono okusebenzisa ulimi ngale ndlela ukuze bakwazi ukubhekana nezinsalelo nezingqinamba zokufunda izifundo okungezona ezolimi.

Ukwenza kothisha kungokulandela ukufundisa ngolimi olusabalele nekharikhulamu ngoba lona lunika abafundi ithuba lokusebenzisa amakhono olimi (ukufunda, ukubhala, ukulalela nokukhuluma) ezifundweni ekungezona ezolimi (Vollmer, 2009). Kanti uVygotsky (1978) uveza ukuthi ulimi lubamba iqhaza elibalulekile ekukhuleni komqondo wengane ngokuyilekelela ukuthi ikwazi ukuxhumana nabanye abantu nokucabanga. Kukhonsephtsi ye-*scaffolding* uVygotsky uveza ukuthi ukulekelela abafundi ukuthuthuka ekufundeni ezingeni labo lokukhula kuyabalekelela abafundi ukuthi bathole ukuqondisa okufundwayo. UMcNair benoGarrison-Fletcher (2022) baveza ukuthi uma uthisha ekhombisa ukukhathalela ukufundisa ngokulusabalalisa ulimi nekharikhulamu kuba nomthelela omuhle kubafundi ngoba nabo bashintsha indlela ababuka nabacabanga ngayo ngolimi, bayahlanganyela nabo ekuthuthukeni kolimi ezifundweni abazifundayo okungezona ezolimi. Lokhu kugcwalisa ukuthi ukufundwa kolimi nezifundo ezahlukahlukene kuyathuthukisana kanyekanye (Singh & Geeta, 2021).

6.2.2. Ulwazi lukathisha lwesifundo nolwazi lwakhe lokufundisa

Ngaphansi kwale ndikimba, kuyavela ukuthi ulwazi lukathisha lwesifundo kanye nolwazi lokufundisa, okuhlanganisa namakhono akhe uthisha, kubalulekile kakhulu ngoba kulekelela ekutheni uthisha akwazi ukuhlonza nokusombulula izingqinamba abafundi abadibana nazo ekufundeni isifundo asifundisayo. Ababambiqhaza balolu cwaningo bakhombisa ukuba nolwazi lokufundisa isifundo seSayensi. Kuyavela eminingweni ekhiqizwe yilolu cwaningo ukuthi othisha balezi zikole bayakwazi ukuhlonza izinto ezingaba yizingqinamba ekufundiseni kwabo bese besungula okungaba yizixazululo. Umthelelela omkhulu walezi zingqinamba ukuthi lezi zikole zakhiwe endaweni yasemakhaya lapho ukuthuthukiswa kwengqalasizinda kuhamba kancane. Lapho othisha bebhekana nengqinamba yokuthi abafundi bangaqondi kahle amakhonsephtsi esifundo seSayensi baqoka ukubachazela ngolimi lwesiZulu, okululimi lwasekhaya lwabafundi. Othisha batshengisa ukuba nolwazi lwesifundo

olwanele ngoba lapho bechaza, bachaza kucace kubafundi. Lokhu kubonakala lapho bebabuza imibuzo maphakathi nasekugcineni kwesifundo, lapho sebebahlola ulwazi abaluzuzile abafundi ekwethulweni kwaleso sifundo. Nangale kwalokho, amakhono othisha okufundisa kubukeka sengathi aphezulu ngoba akukho okwabonakala okwashiya kudide abafundi emva kwaleso naleso sifundo. Lokhu kuwubufakazi bokuthi othisha banolwazi olwanele ngesifundo, baphinde babe namakhono okufundisa amahle. Okunye okwabonakala ukuthi othisha bayazisombulula izinkinga zabafundi ezimayelana nesifundo, ababahiyo bedidekile. Kwaqapheleka nokuthi othisha baze babe nesikhathi esengeziwe, lapho abazama khona ukulekelela abafundi abasuke benemibuzo. Bonke othisha bangenisa kahle isifundo, ngokuthi bahlobanise ulwazi olusha nolwazi oludala, babakhumbuze nokuthi bekwenziwani esifundweni esedlule.

UHotaman (2010) Ugcizelela ukuthi uthisha weSayensi kufanele abe nolwazi olumbandakanya amakhono okuba yiciko ngesikhathi elungisa iklasi lakhe ukuthi lihlobe ngezithombe zeSayensi eziveza ubuhle beSayensi ukuze abafundi baheheke futhi bagqugquzeleke ekusithandeni lesi sifundo, bazuze nemiphumela emihle kuso. NgokukaTanak (2018) kumqoka ukuthi uthisha abe nolwazi olunzulu ngesifundo asifundisayo. Ulwazi uthisha okufanele abe nalo lumbandakanya ukuhlela izinjongo zesifundo, ukuhlela ukulandelana kwezihloko ezethulwa esifundweni, ukwethula isifundo, nokuhlela isikhathi esanele ukucolisisa wonke amakhonsepheleli amqoka esifundo seSayensi. Kufanele othisha bakwazi ukwethula ulwazi olusha kubafundi, ukubekezelelana nokukhathalelana. Othisha kufanele babe nolwazi lokuqonda amaklasi abo, okungabafundi (Tanak, 2018; König et al., 2020). Yilo lolu lwazi olukhonjiswe ababambiqhaza balolu cwaningo futhi yilona olubalekelelayo ukuhlonza izindlela abazozisebenzisa ukubhekana nezingqinamba abafundi abadibana nazo ekufundeni isifundo seSayensi.

U-Akbarovna (2024) ekucwaningeni kwakhe ngamakhono amqoka ekufundiseni isifundo seSayensi uveza ukuthi amakhono okufundisa kukathisha wesifundo seSayensi maningi kakhulu kodwa wonke alekelelana nolwazi uthisha analo ngesifundo seSayensi. Lo mcwaningi uveza ukuthi uthisha weSayensi kufanele abe ngumeluleki nomqondisi omuhle kubafundi bakhe ngalesi sifundo nochwepheshe wesifundo seSayensi, aphinde abe nekhono lokuxhumana nabafundi bakhe. Ngokwalo mcwaningi, uthisha kufanele akwazi ukumelana nezimo zesikole

asebenza kuso bese eba nobuhlakani bokukwazi ukulawula imizwa yakhe nokukwazi ukubhekana nokuqonda izinkinga zabafundi bakhe. La makhono alekelelana nolwazi lukathisha ngesifundo sakhe ukuze akwazi ukuqinisekisa ukuthi isifundo sakhe usethula ngendlela ezolekelela abafundi ukuthi basiqonde. Kufanele uthisha awasebenzise wonke la makhono ekufundiseni kwakhe (Hotaman, 2010; Akbarovna, 2024). Lolu lwazi lukathisha luyalekelela kakhulu futhi nasekutheni akwazi ukuhlonza izibonelo ezithinta izimpilo zabafundi angazisebenzisa ekuthuthukiseni ukuqonda kwabafundi isifundo seSayensi.

Imininingo ekhiqizwe yilolu cwaningo iyaveza ukuthi ulwazi lothisha lwesifundo seSayensi luyabalekelela ukukwazi ukuhlonza ulwazi olusondelene namasiko nezinkolelo zesiNtu abangalusebenzisa ekuchazeni okuqukethwe yisifundo seSayensi ngempumelelo. Njengoba kuke kwavela esahlukweni sesihlanu, uThisha lapho efundisa khona ngekhonsepthe *le-electrostatics* nombani wezulu uveza ukuthi usebenzisa le nkolelo yokuthi akufanele uphathe into eyinsimbi ecwebezelayo noma uhlale eduze kwayo uma kuduma izulu ngoba lokhu kungaholela ekutheni ulinyazwe yizulu. Lokhu ukwenza uma efundisa nge-*transfer of electrons*. UThisha D uye abone kumsiza kakhulu ukuthi abafundi baliqonde leli khonsepthe ngoba usuke uthisha elixhumanise nento okuhlale kukhulunywa ngayo nasekhaya. Kanti uThisha B yena uveza ukuthi uye asebenzise ukwenyuka intaba kwamatshitshi uma eya entabeni ukuyocela imvula kuNomkhubulwane uma efundisa ngomthelela we-*force of gravity*. Uye asebenzise isivinini samantombazane uma enyuka noma ehla intaba. Ukuqonda kwabo abafundi ngokwehla kwesivinini uma beqwala intaba nokwenyuka kwaso uma sebhla, kwenza baqonde ukuthi ukwehla nokwenyuka kwesivinini se-*projectile* ngenxa ye-*force of gravity* esihlokweni se-*Vertical projectile motion* ukuthi kwenzeka kanjani empilweni yangempela yabantu. UVygotsky (1978) uyakugcizelela ukuthi uthisha kumele abe ngumuntu onolwazi oluthuthukile kumfundi amfundisayo, ukuze umfundi ezozuza ulwazi ngesifundo esethulwayo.

6.2.3 Ulimi lwasekhaya neqhaza lwalo ekufundiseni isifundo seSayensi

Ulimi lokufunda nokufundisa ezikoleni zaseNingizimu-Afrika eziningi ulimi lwesiNgisi (Probyn, 2006). Lolu limi lululimi lwesibili kubafundi abaningi kuleli lizwe. njengoba kuke kwachazwa ngaphambilini, abafundi baba nengqinamba ekuqondeni izifundo ezethulwa ngolimi lwesiNgisi ngoba kufanele baqale baqonde kahle ulimi lwesiNgisi

kuqala ngaphambi kokuthi baqonde amakhonsepthi aleso sifundo esifundwayo (Oyoo & Nkompodu, 2019). Kuvelile eminingweni ekhiqizwe yilolu cwaningo ukuthi ulimi lwasekhaya luneqhaza olulubambile ekufundisweni kwesifundo seSayensi. Le mininingo iveza ukuthi othisha ababeyingxenywe yalolu cwaningo basebenzisa ulimi lwasekhaya lwabafundi ukubachazela amakhonsepthi esifundo seSayensi. Othisha laba basebenzisa ulimi lwesiZulu ukuchazela abafundi isifundo seSayensi ukuthuthukisa ukuqonda kwabafundi isifundo seSayensi kanye nemiphumela yabo. Ulimi lwasekhaya balusebenzisa ngoba bafuna ukuthuthukisa ukuqonda kwabafundi ngoba uma bebefundisa ngolimi lwesiNgisi kuphela abasiqondi isifundo seSayensi.

Kuke kwavezwa esahlukweni sesihlanu ukuthi uThisha D, kusukela ebangeni leshumi, uchazela abafundi ngolimi lwesiZulu amakhonsepthi eSayensi. Lokhu kwenza kuthi uma sebefike ebangeni le-11 abafundi babe sebejwayele ukuthi bafundiswa ngazo zombili izilimi (olwesiZulu nolwesiNgisi) esifundweni seSayensi. Abafundi bakhombisa ukukuthakasela ukuchazelwa ngolimi lwabo ngesikhathi ngibukele okwenziwa uthisha ngesikhathi efundisa. UThisha D waveza ukuthi ulimi lwesiZulu okululimi lwasekhaya lwakhe nabafundi lubamba elikhulu iqhaza ekuthuthukiseni imiphumela yabafundi bakamatikuletsheni ngoba nawo uyawufundisa. Lo thisha waveza ukuthi ngesikhathi esanda kuqala ukufundisa wayefundisa ngolimi lwesiNgisi ngoba yilona ulimi olusetshenziswayo ngokusemthethweni. Kanti uThisha D kanye noThisha A ngokufanayo baqaphela ukungaphumeleli kahle kwabafundi, kwathi esezinike isikhathi sokuhlola inkinga eyayenza bangaphumeleli kahle abafundi wahlonza ulimi lokufunda nokufundisa njengoluyiyona ngqinamba ekufundiseni. Lokhu kungenxa yokuthi abafundi bahlala endaweni yasemakhaya lapho ulimi lwesiNgisi lungakhulunywa khona nokwenza ukuthi bangathuthuki kulo ngoba balugcina esikoleni. Ngemuva kokuhlonza ingqinamba njengabo abanye othisha uThisha C waqala wafundisa ngolimi lwesiZulu lapho echazela khona abafundi isifundo seSayensi nokulapho aqaphela ukuthuthuka okukhulu kwemiphumela yabafundi kamatikuletsheni.

Ukusebenzisa ulimi lwasekhaya lwabafundi othisha laba akusho ukuthi olwesiNgisi abasalusebenzisi kodwa bazisebenzisa zombili kanyekanye ukufundisa. Othisha laba baveza ukuthi isifundo seSayensi basifundisa ngokusebenzisa ubulimimbili ukuze abafundi bazuze ukuqonda okufanele nokuzobasiza ekuphumeleleni isifundo. Esahlukweni sesibili ngaphansi kokubuyekezwa kwemibhalo ngike ngaveza ukuthi

ukufundisa ngobulimimbili kubalekelela kanjani abafundi ukuthi baqonde futhi baphase isifundo seSayensi. Isibonelo, uChiramba (2020) uveza ukuthi ukusebenzisa ulimi lwasekhaya lwabafundi kanye nolimi lwesibili ekufundiseni isifundo seSayensi kulekelela abafundi ukuthi bakwazi ukwenza izethulo zesifundo seSayensi ngolimi lwesiNgisi ngoba izingxoxo basuke beqale bazenza ngolimi lwabo lwebele ngaphambi kokubhala noma ukwethula. Lokhu kuyabasiza abafundi ukuthi bakhule ekuziqondeni zombili lezi zilimi kanye nolimi lwesifundo seSayensi.

U-Archila noMolina kanye noDe Mejía (2018) baveza ukuthi ukusebenzisa ulimi lokufunda nokufundisa kanyekanye nolwasekhaya lwabafundi kuthi kuthuthukisa ukubhala amathekisthi eSayensi kubafundi ababulimimbili kuphinde futhi kuthuthukise ukuzethemba ekusebenziseni ulimi lokufunda nokufundisa ekubhaleni amathekisthi esifundo seSayensi. Lapha umfundi ugcina esethuthukile ekubhaleni ngolimi lwesibili kuze kufike ekutheni akwazi ukuzibhalela ngokusebenzisa ulimi lwesiNgisi ngaphandle kosizo lukathisha ngoba usenokuqonda okwanele. Lokhu kuyahambisana nokushiwo uVygotsky (1978) lapho eveza khona ukuthi i-*scaffolding* sibalekelela okwesikhashana abafundi ngokubasiza ukuthi bafinyelele ku-*Zone of Proximal Development*, kanti futhi ngosizo lukathisha bagcina sebekwazi ukuzenzela umsebenzi nokuqonda kahle isifundo ngokuzimela.

6.2.4 Izinsizakufundisa ezibulimimbili esifundweni seSayensi

Ngaphansi kwalesi sihlokwana, kuyavela ukuthi othisha besifundo seSayensi balezi zikole ezimbili bayazisebenzisa izinsizakufundisa ezibulimimbili ekufundiseni isifundo seSayensi. Izinsizakufundisa abazisebenzisayo amasimuleshini, amavidiyo ka-*Youtube*, izinsizakufundisa ezisetshenziswa ekwenzeni amaphrakhikhali, ama-eksperimenti. Inhloso yothisha yokusebenzisa lezi zinsizakufundisa ezibulimimbili esifundweni seSayensi ukuthuthukisa ukuqonda kwabafundi isifundo seSayensi esethulwa ngolimi lwesibili, okululimi lwesiNgisi kanye nolimi lwesiZulu ukuze abafundi baqonde ngesiNgisi nangolimi lwabo. Othisha laba lezi zinsizakufundisa bazilungisela bona ukuthi zibe bulimimbili ngokuthi basebenzise ulimi lwesiZulu ekufundiseni ngazo uma kuwukuthi zitholakala ngolimi lwesiNgisi.

Kuvelile esahlukweni sesihlanu ukuthi uThisha A uveza ukuthi mavidiyo ka-*Youtube* uwasebenzisa njengenywe yezindlela zokufundisa isifundo seSayensi. Wathi usuke enzela ukuthi abafundi bezwe ukufundiswa umuntu ongeyena umZulu njengoba

asuke etholakala ngolimi lwesiNgisi. Ngokuqhubeka kwesifundo sosuku uye ayimise ividiyo, achazele abafundi ngolimi lwesiZulu lokho osuke kwethulwa uthisha okuvidiyo. Kuvelile futhi esahlukweni sesihlanu ukuthi uThisha D yena uthi usuke esebenzisa amavidiyo ka-*Youtube* ngenhloso yokuzithukisa yena olimini lwesiNgisi njengoba ewumZulu naye, nanxa kumsiza lokhu futhi ekuchazeleni abafundi ngolimi abaluzwa kangcono. Uveza ukuthi uye akhethe le ehambisana nesihlokwana noma nekhonsephti efundiswayo kulezo zinsuku. Indlela abasebenzisa ngayo amavidiyo lab' othisha iveza ukuthi ekufundiseni kwabo isifundo seSayensi basebenzisa amavidiyo njengenye yezinsizakufundisa ezibulimibili. Ubulimibili kumavidiyo busekutheni wona aqoshwe ngesiNgisi kanti bona othisha bawachaza ngolimi lwesiZulu kubafundi.

Lokho okuvezwa ababambiqhaza kuyahambisana nokuvezwa abacwaningi abangoPecay (2017), u-Ibe no-Abamuhe (2019), lapho beveza khona ukuthi othisha beSayensi basebenzisa amavidiyo ka-*Youtube* ngenhloso yokuthukisa indlela abafundisa ngayo isifundo seSayensi bese bewabukisa abafundi amavidiyo njengenye yezindlela zabo zokuchaza isifundo seSayensi kubafundi. Laba bacwaningi bagcizelela ukuthi bayalekeleleka kakhulu abafundi uma uthisha ezolokhu emisa ividiyo abuze imibuzo ngokufundwayo kubafundi, futhi nokuthi uthisha agcizelele okufundwayo, kwenza abafundi baqonde kangcono okufundwayo. Ukufunda ngokusebenzisa amavidiyo kwakha ugqozi lokuthanda isifundo seSayensi kubafundi futhi basiphumelela kangcono uma beqhathaniswa nabafundi abangafundiswa ngamavidiyo.

Okuvela eminingweni yalolu cwaningo ukuthi othisha abafundisa isifundo seSayensi kulezi zikole bakholelwa ukusebenzisa amasimuleshini njengenye yezinsizakufundisa ezibulimibili. Okuvezwa uThisha C noThisha A kuyefana ngoba bobabili bathi izikole abasebenza kuzo azinawo amalabhorethri, ngakho-ke baye basebenzise amasimuleshini ukwenza amaphrakhthikhali *investigations* nama-eksperimenti ahluahlukene. Lab' othisha baveze ukuthi baye bawasebenzise ukugcizelela amakhonsephti esifundo seSayensi ngokuthi abafundi bazibonele ukuthi asebenza kanjani elabhorethri yakumasimuleshini ngoba abanayo le eyisakhiwo sendlu. Abafundi bayawasebenzisa nangabodwana amasimuleshini ngoba banawo emafonini futhi kuyabasiza kakhulu ukuthi bazitholele ngokwabo ulwazi ngamakhonsephti esifundo seSayensi.

URamnarain benoMoosa (2017) baveza ukuthi othisha basezikoleni zasemakhaya sebeyaqaala manje ukusebenzisa ubuchwepheshe besimanje ekufundiseni iSayensi. Kuyabalekelela kakhulu ngoba bayakwazi ukuvala isikhala sokushoda kwezinsizakufundisa ezifana namalabhorethri, kanti amasimuleshini agcina esesebetshenziswa esikhundleni samalabhorethri. Kanti uRosenberg benoLawson (2019) ekucwaningeni kwabo bathola ukuthi abafundi abakuzuzayo ngokufundiswa ngokusebenzisa amasimuleshini ukuthi abahlaziyela izimo ezijiyile, ezilukhuni azenze zibe lula futhi ziqondakale kalula. Ngike ngachaza esahlukweni sesihlanu ukuthi uChumba, Omwenga kanye no-Atemi (2020) bagcizelela ukuthi umthelela wokusebenzisa amasimuleshini njengenywe yezinsizakufundisa, kulekelela ngokuthi kwenze ukufundisa kube ngokubandakanya ukuthi bazenzele abakufundayo kumakhompyutha ngokuyalelwa uthisha. Ngenxa yalokho abafundi bayagquzeleka ukuthi bazibandakanye nokuzithuthukisa ekuqondeni isifundo seSayensi. Liyathuthuka izinga lokuqondwa kwamakhonsepthi eSayensi abafundi uma kuqhathaniswa nezindlela ezindala nezejwayelekile zokufundisa.

UGericke, uHögström kanye noWallin (2022) baveza ukuthi ukuholwa nokulekelelwa uthisha kubaluleke kakhulu ekwenzeni kwabafundi amaphrakthikhali ngoba kunzima kubona ukuzakhela ukuqonda amakhonsepthi eSayensi ngokuwayamanisa nomsebenzi wamaphrakthikhali ngaphandle kosizo lukathisha. Izimpendulo zikathisha uma bebuza abafundi zibaluleke kakhulu ngesikhathi benza amaphrakthikhali ngoba uma uthisha ehlola umsebenzi wabafundi ngesikhathi bewenza amaphrakthikhali, futhi uthisha eveza nokuthi abakubona kwenzeka elabhorethri kuyenzeka kube namaphushana, kube imiphumela enobuthaka obuthile. Uthisha usuke ebagquguzela ukuthi bangethuswa imiphumela engafani ngqo abayitholayo abafundi. Leyo ncazelo iyabakhulula futhi ibanike ukuzethemba abafundi bese begqugquzeleka ukuthanda ingxenye yamaphrakthikhali nama-eksperimenti. Abafundi balezi zikole engenze kuzo ucwaningo balahlekelwa yithuba lokuqonda umsebenzi waselabhorethri ngokuzenzela ngoba izikole zabo azinawo amalabhorethri. Nakuba bewenza amasimuleshini kodwa kubenza kuthi uma befika ezikhungweni zemfundo ephakeme bebe bengenalokuzenzela ngezandla zabo.

Imininingo yalolu cwaningo iyaveza ukuthi ezinye zezinsizakufundisa ezibulumimbili abazisebenzisayo ukufundisa isifundo seSayensi zibandakanya amamodeli.

Ababambiqhaza baveza ukuthi bayaye basebenzise amamodeli emaklasini abo. Baveza ukuthi bayaye bathathe izinto ezingasasebenzi ezifana namakhalibhothi ukwakha amamodeli. Amamodeli bawakha kanye nabafundi ngokuthi babahlukanise amaqoqo azokwakha imodeli.

6.2.5 Izichazamazwi eziqondene namatemu esifundo seSayensi ezibulimimbili

Imininingo yocwaningo iveze ukuthi othisha besifundo seSayensi kulolu cwaningo basebenzisa izichazamazwi ezibulimimbili zesiNgisi nesiZulu ukuchazela abafundi. Lokhu bakwenza ngenhloso yokuchazela abafundi amakhonsepthe eSayensi angamagama abhalwe futhi abizwa ngokufanayo nasolimini lwesiNgisi. La magama esiNgisi asuke esenencazelo entsha uma esengamakhonsepthe eSayensi futhi esedinga ukucaciswa ukuze umfundi awaqonde. Lab' othisha inhloso yabo enkulu yokusebenzisa izichazamazwi ekufundiseni isifundo seSayensi ukukhulisa ulwazimagama kubafundi ukuze kukhule ukuqonda kwabo isifundo seSayensi, futhi bakwazi nokuzibandakanya ezingxoxweni zeSayensi, njengoba kuke kwachazwa esahlukweni sesine nesesihlanu. UVygotsky uveza ukuthi kunomehluko phakathi kwamakhonsepthe ansuku zonke (asolimini olukhulunywa nangaphandle kwesikole) namakhonsepthe eSayensi anqala. Lokhu kusho ukuthi ukwenza kwalab' othisha kuyinto efanele nelusizo kubafundi.

UVygotsky (1978) wayekholelwa ukuthi ukuqonda kwabantu abadala amakhonsepthe kufinyeleleka kukho ngenxa yemfundo abayithola esikoleni ebuncaneni babo. Amakhonsepthe anqala ezinto ezisezingeni lengane uVygotsky uwabiza ngamakhonsepthe ansuku zonke, kanti awabantu abasha abasakhula abawafunda esikoleni uwabiza ngamakhonsepthe eSayensi. Ngokombono wakhe uVygotsky, amakhonsepthe eSayensi anqala futhi amqoka kakhulu ngenxa yokuthi ayingxenywe yochungechunge lwamakhonsepthe. Le ngcithabuchopho enguVygotsky (1978) ithi othisha kufanele bawuqonde lo mehluko kumakhonsepthe bese belekelele abafundi ukuqonda la makhonsepthe ansuku zonke bese befundiswa aweSayensi ukuze baphumelele ukuwaqonda nawo.

UNiyazova (2023) uveza ukuthi ngenxa yokwanda ngesivinini kwamagama amasha (alukhuni isikhathi esiningi) ngenxa yezimo zokuthuthuka kwezeSayensi emhlabeni wonke kubalulekile ukunothisa ulwazimagama lwabafundi ukuze la magama bawaqonde kahle bese bekhula nolwazi olubanzi. Lokhu kungeminye yemisebenzi

nezinhlolo ezinkulu zokufundisa ngolimi lwesibili nolimi lwasekhaya lwabafundi. Ngakho-ke kubalulekile ukusebenzisa izinhlobo ezahlukene zezichazamazwi ngoba zilekelela nasekuthuthukeni kwendlela abafundi abahlela ngayo izingxoxo abazethulayo emaklasini noma nasemathekisthini ahlukene. Kanti U-Ünsal nabanye (2018) bavumelana nalokhu ngokuthi baveze ukuthi ukunikwa kwabafundi amathuba amaningi okusebenzisa izichazamazwi ngesikhathi kuqhubeka isifundo sosuku kuvala igebe lokungaqondi kwabafundi isifundo seSayensi.

6.2.6.Uthando lolimi lwasekhaya nomthelela wakho kuthisha nakumfundi

Ngaphansi kwalesi sihlokwana ngizoveza umthelela wothando lolimi lwasekhaya kubafundi nakothisha besifundo seSayensi. Imininingo ekhiqizwe yilolu cwaningo iveza ukuthi othisha bayaluthanda ulimi lwasekhaya, okuyisiZulu. Lokho ngikubone ngokuthi basebenzise ulimi lwesiZulu ukuchazela abafundi amakhonsephtsi esifundo seSayensi. Kuye kuthi noma besebenzisa izinsizakufundisa ezahlukene kodwa bazinike isikhathi sokuthi bazichaze ngolimi lwesiZulu ngoba zisuke zifika zilulimi lwesiNgisi. Ulimi lwasekhaya balusebenzisa ngoba bayabona ukuthi abafundi abaqondi ngokwanele isifundo seSayensi uma sifundiswa ngolimi lwesiNgisi. Ngikusho ngoba balusebenzisa lolu limi ngokungazenyenzi, futhi bagqugquzele nabafundi ukuthi balusebenzise ngokulingana nesiNgisi, ukuze baziqonde zombili lezi zilimi. Ngakolunye uhlangothi, abafundi nabo bakhombisa izimpawu zokuthanda isiZulu ngoba babukeka bekhululekile ekulusebenziseni lolu limi eklasini, futhi ababukeki bengabantu abazenyenzi ngalo lolu limi.

Ucwaningo oluningi oseluke lwenziwa luveza ukuthi abanye abafundi baye bazenyenzi ngezilimi zabo zendabuko, bazibukele phansi, kanjalo nothisha. UMagwa (2015) uveza ukuthi othisha abaningi, abafundi kanye nabazali abahambisani nokusetshenziswa kwezilimi zomDabu wase-Afrika ekufundiseni. Lokhu kuyiyona ngqinamba enkulu ekufundiseni ngolimi lwasekhaya ezweni iZimbabwe. Lo mcwaningo uveza ukuthi othisha abafunda ezikoleni zabaqoneli (kulolu lwakhe ucwaningo) baveza ulimi lwesiNgisi njengalona limi olukwazi ukuchaza kahle imibono ebukhuni yezifundo zeSayensi. Lab' othisha bagcizelela ngokuthi ulimi lwesiNgisi abafundi bazoludinga emanyuvesi uma sebeqhubeka nokufunda, ngakho-ke imfundo kufanele yenzeke ngesiNgisi. Kanti uKhanyile no-Awung (2023) baveza ukuthi othisha basoThungulu district abahambisani nokusetshenziswa kolimi

IwesiZulu ukufundisa ngoba bona abalungiselelwanga ekuqeqeshelweni kwabo ukufundisa ukuthi bafundise ngolimi lwasekhaya, isiZulu. Othisha baphinda bakhala ngokuthi abanazo izinsizakufundisa ezanele ezilungele ukufundisa ngesiZulu, izincwadi ikakhulukazi. UNaom benoSarah (2014) ocwaningweni ababelwenza baveza ukuthi ulimi lwesiNgisi ngokomlando luphethe ukukhanya ngoba luyanyaniswa nokuthola imisebenzi esezingeni eliphezulu, ngakho-ke kufanele kuqhubeke kufundiswe ngalo.

UNishanthi (2020) uveza ukuthi uVygotsky wagcizelela umthelela wendawo umfundi akhulela kuyo ekukhuleni kokuqonda akufundayo. I-*sociocultural theory* yakhe yaveza ukubaluleka kolimi ekulolongeni ukuqonda okufundwayo njengokunye kokunomthelela omkhulu ekuqondeni umhlaba. Ukuthanda kothisha ulimi lwasekhaya lwabafundi kulekelela ukukhula kolimi kubona ngoba bayazihlupha ngokufuna izincazelo zamagama abhalwe ngolimi lwesiNgisi ukuthi zithini izincazelo zawo ngesiZulu.

UWang (2016) uveza ukuthi ukukhathalela nokuthanda kothisha nabafundi ukusebenzisa ulimi lwasekhaya ekufundeni kugqugquzela futhi kuqubule izindlela zokuxhumana kubafundi nothisha ekufundeni nasekufundiseni. Lokhu kulekelela ekuthuthukeni kokuxoxa kwabafundi nothisha ngendlela elula ukuthola izincazelo ukuze abafundi baqonde isifundo abasifundayo. Kanti uNishanthi (2020) ugcizelela ukubaluleka kokufunda kusetshenziswa ulimi lwasekhaya ngokuthi aveze ukuthi ukusebenzisa lolu limi kunyusa intshisekelo yokuzimbandakanya kwabafundi ezingxoxweni zesifundo ngoba baxhumana ngolimi abalusebenzisayo nasekhaya. Lokhu kukhulisa ukuzethemba ekusebenziseni ulimi lwebele nakwezinye izilimi ezikhulunywayo.

6.3 Isiphetho socwaningo lonke

Lolu cwaningo belucwaninga mayelana nokufundiswa kwesifundo seSayensi kusetshenziswa ubulimimbili emabangeni aphezulu ezikoleni. Lwenziwe ezikoleni ezimbili endaweni yaseMsinga, ngaphansi kobukhosi baseMabomvini nobaseMachunwini ezikoleni iNgonyameni Sekhondari naseGabangaye Sekhondari okungamagama okungewona awangempela.

Lolu cwaningo luphendule le mibuzongqangi:

- (i) Othisha abafundisa isifundo seSayensi bakuqonda kanjani ukusebenzisa ubulimimbili ekufundiseni isifundo seSayensi kubafundi bebanga leshumi neleshumi nanye?
- (ii) Othisha bebanga leshumi neleshumi nanye babusebenzisa kanjani ubulimimbili ekufundiseni isifundo seSayensi?
- (iii) Kungani othisha besifundo seSayensi besebenzisa ulimi ngendlela abenza ngayo lapho bethula izifundo zeSayensi emakilasini ebanga leshumi neleshumi nanye?

Lolu cwaningo luphetha ngokuthi:

- Othisha bezikole ezaziyingxenye yocwaningo basebenzisa ulimi lwesiZulu nesiNgisi ngempumelelo emakilasini abo, ukulekelela abafundi ukuba baqonde isifundo seSayensi. Ukusetshenziswa kwesiZulu nesiNgisi othisha bakusebenzisa ngendlela yokuthi nanxa besuke behlose ukuthi abafundi baqonde isifundo ngolimi lwabo, baphinde futhi baqonde okwethulwa ngolimi lwesiNgisi. Lokhu kubasiza ekutheni nanxa sekubhalwa izivivinyo, bangabi nenkinga ngoba imibuzo okwamanje emaphepheni okuhlola isabuzwa ngolimi lwesiNgisi. Yisona sizathu esenza ukuba othisha bathi noma bebachazela abafundi ngolimi lwabo, kodwa bangayeki ukusebenzisa nesiNgisi.
- Izindlela zokufundisa ezisetshenziswa othisha kanye namasu, kuyabasiza abafundi ekuqondeni isifundo seSayensi, futhi ubulimimbili besiNgisi nesiZulu babusebenzisa nalapho kwenziwa ama-eksperimenti, amamodeli kanye namaphrakthikhalo. Abakushoyo othisha ezingxoxweni kuyahambisana nabakwenzayo.
- Izinsizakufundisa zesifundo seSayensi azanele, kuhlanganisa nelabhorethri. Sikhona isidingo sokuba kube nezinsiza ezanele nezihambisana nesifundo esisuke sethulwa. Nokho-ke othisha bayayizama imizamo yokusebenzisa lezo zinsiza ezikhona, ukulekelela abafundi ukuze baqonde isifundo, bebe futhi besebenzisa zombili izilimi, isiZulu nesiNgisi, ukuqinisekisa ukuthi abafundi abasaleli emuva nesifundo.
- Othisha ababengababambiqhaza bayazama ukusebenzisa ezobuchwepheshe emakilasini, njengamavidiyo, nanxa esuke engawesiNgisi, kodwa bayabalekelela abafundi ukuthi okuqukethwe kumavidiyo babachazele ngolimi lwesiZulu.

- Othisha bayabalekelela abafundi ukuchaza amatemu, besebenzisa ulimi olusabalele nekharikhulamu, ukuze abafundi baqonde ukuthi itemu elithile lisebenziseka kanjani esifundweni esithile kumbe olimini ngokwejwayelekile, kanjalo babachazele nokuthi uma selisesifundweni seSayensi lisuke lichaza ukuthini. Lokhu kuyalithuthukisa izinga lokuqonda kwabafundi isifundo seSayensi.
- Othisha ababeyingxenye yocwaningo banolwazi olwanele lwesifundo, futhi lolo lwazi lubasiza ekucaciseni okuqukethwe yisifundo. Bayakwazi ukuphendula imibuzo esuke ibuzwa abafundi, futhi ukuphendula kwabo kube ngokucacile kubafundi.
- Othisha ababengababambiqhaza banakho ukulangazelela ukuthi uMnyango weMfundo ubalekelele kangcono kulesi sifundo seSayensi, ngoba bakholwa ukuthi bangenza kangcono uma uMnyango uqinisa izindlela zokubalekelela njengothisha balesi sifundo.

6.4 Izincomo

- a. Kungancomeka ukuthi uMnyango wezeMfundo eyiSisekelo uhlelele othisha ama-*workshop* amayelana nolimi olusabalele nekharikhulamu, ukuze nalabo abangenakho ukuqonda ngalokhu, bazuze.
- b. Kungaba kuhle ukuthi uMnyango wezeMfundo eyiSisekelo ulekelele othisha ngokubaqeqesha, ubahlomise ngokufundisa imfundo ebulimimbili nakwezinye izikole ezingeyona ingxenye yalolu cwano kodwa ezinengqinamba efanayo neyalezi eziyingxenye yalolu cwano. Lokhu kunconywa ngenxa yokuthi kuyavela kulolu cwano ukuthi imiphumela yabafundi iyathuthuka unyaka nonyaka ngenxa yokusebenzisa ulimi lwesiNgisi kanye nolwesiZulu ukufundisa isifundo seSayensi.
- c. Kungancomeka ukuthi uMnyango wezeMfundo eyiSisekelo ugqugquzele othisha besifundo seSayensi abasebenza ezikoleni ezingeyona ingxenye yocwaningo, futhi abangenayo imiphumela emihle esifundweni seSayensi ukuthi bazithuthukise olwazini lokufundisa isifundo seSayensi. Othisha kumele bahlonyiswe ngezindlela zokuhlonda okungaba yizingqinamba ekufundiseni kwabo isifundo seSayensi ukuze bathole izindlela zokuzigwema lezo zingqinamba ukuze ukufunda nokufundisa kuhambe kahle futhi kulekelele abafundi ukuphumelela kahle isifundo seSayensi.

- d. Kungancomeka uma uMnyango wezeMfundo eyiSisekelo uma ungalekelela othisha ukuthi bathole izinsizakufundisa ezibulimimbili ezingabasiza uma belungiselela isifundo sosuku nosuku. Lokhu kuhlenganisa izincwadi ezifakwe iphimbo, ezikwikhompyutha, kanye namavidiyo atholakala ngolimi lwesiNgisi, aphinde atholakale ngolimi lwesiZulu.
- e. Kungancomeka ukuthi uMnyango wezeMfundo eyiSisekelo wakhele izikole amalabhorethri amakhompyutha kulezi zikole engicwaninge kuzo nakwezinye ezinenkinga yokungabi nawo. La malabhorethri amakhompyutha azosiza ukuthi ezikoleni othisha bakwazi ukufundisa ngamasimuleshini ekumakhompyutha ngoba akubona bonke abafundi abaphatha amafoni esimanjemanje.
- f. Kuyanconywa ukuthi uMnyango wezeMfundo eyiSisekelo ulekelele izikole ngokuzakhela amalabhorethri esifundo seSayensi ukuze othisha bangasebenzisi amasimuleshini namavidiyo ka-*Youtube* ngoba bevala isikhala samalabhorethri kodwa bawasebenzise njengezinye zezinsizakufundisa ezilekelela ukuthuthukisa ukuqonda kwabafundi isifundo seSayensi.
- g. Kungancomeka ukuthi uMnyango wezeMfundo eyiSisekelo ugqugquzele futhi ulekelele othisha ngamamodeli esifundo seSayensi akhandwe osoSayensi. Lokhu kunconywa ngoba kubonakele ukuthi othisha bayafisa ukufundisa ngawo kodwa abanawo kulezi zikole, baze baphoqeke ukuwakha nabafundi, nokugcina kuthathe nasesikhathini sabo sokufundisa.
- h. Kungaba wusizo ukuthi uthisha ofundisa isifundo seSayensi kube ngonolwazi lwesiZulu nesiNgisi, ukuze kube lula ukuthi achazele abafundi ngolimi lwesiZulu uma kuwukuthi badinga ukucaciseleka ngolimi lwabo, uma kuwukuthi kukhona okubadidayo ngolimi lwesiNgisi.
- i. Kungaba kuhle uma ababhali bezichazamazwi bengakhiqiza izichazamazwi eziqondene nesifundo seSayensi ngqo, zibhalwe ngolimi lwesiNgisi nesiZulu, ezizokwazi ukusetshenziswa abafundi bamabanga aphantsi, ezinye zikwazi kusetshenziswa abafundi asebekhulile, abasemabangeni aphezulu. Lokhu kungasiza ekutheni abafundi kusukela emabangeni aphantsi babe bejwayela amatemu eSayensi ngazo zombili lezi zilimi, ukuze kuthi uma sebesemabangeni aphezulu, babe sebewajwayele.

6.5 Iqoqa

Leli yiqoqa lokugcina kulolu cwaningo. Kulesi sahluko kuhlaziywe imininingo yocwaningo, kwethulwa nesiphetho socwaningo okuyisona esisivezela okutholakele emva kokwethulwa nokuhlaziywa kwemininingo yocwaningo. Kuso lesi sahluko kuphinde kwethulwa nezincomo ngalokho okungaba wusizo nakwezinye izikole ezifundisa lesi sifundo seSayensi emabangeni afanayo, nalapho kufundiswa abafundi abangamaZulu, labo isiNgisi kuwulimi lwabo lwesibili.

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IZELEKO

1. UHLELO LWEMIBUZO YENHLOLOLWAZI ESAKUHLELEKA

1. Ake uchaze mayelana nokusetshenziswa kolimi uma ufundisa isifundo seSayensi. Ufundisa ngaluphi ulimi, kanjani?

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2. Uma ubahlola abafundi, ubahlola usebenzisa luphi ulimi? Kanjani?

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3. Ithini inqubomgomo yolimi kulesi sikole mayelana nokufundisa izifundo okungezona ezolimi?

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4. Ngokwakho ukuqonda njengothisha, ulimi olusetshenziswa uthisha ekwethuleni isifundo kumele kube yiluphi? Kungani usho kanjalo?

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5. Kungabe kukhona ukuqeqeshwa noma ukuthuthukiswa kolwazi ngama-workshop oke ukuthole njengothisha eMnyangweni Wezemfundo mayelana nolimi lokufundisa? Uma kukhona, kukulekelela kangakanani njengothisha wesifundo seSayensi?

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6. Yikuphi ongafisa kwenziwe njengothisha weSayensi ukuthuthukisa ulwazi ekufundiseni isifundo seSayensi?

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7. Yiziphi izindlela namasu okufundisa owasebenzisayo njengothisha weSayensi emabangeni aphezulu?

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8. Yiziphi izingqinamba obhekana nazo ekufundiseni isifundo seSayensi kula mabanga owafundisayo?

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9. Uma zikhona izingqinamba, uzisombulula kanjani?

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10. Yiziphi izinsizakufundisa ozisebenzisayo ukuthuthukisa ulimi esifundweni seSayensi? Kungabe lezo zinsizakufundisa zitholakala ngaluphi ulimi? Chaza.

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11. Kungabe uzisebenzisa kanjani lezi zinsiza ukufezekisa inhloso yokuzisebenzisa esifundweni seSayensi?

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12. Njengothisha weSayensi, ngabe unazo izinsizakufundisa ezilekelelela ukuthi ufundise isifundo seSayensi ngokuchaza nangolimi lwesiZulu?

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2. ISHEDULI LOKUBUKELA OTHISHA EMAKLASINI

Uthisha:..... Usuku:.....

Umcwaningi:.....Isikhathi:.....Ubude Besifunjwana:

Isikole:..... Ibanga:.....Inani Labafundi:.....

Injongo Yokubukela / Isihloko Socwaningo:

.....

Incazelo kafishane ngomumo / ngesimo kweklasi:

.....

Isihloko sesifunjwana:

.....

UKUTHUTHUKA KWESIFUNJWANA:

Isinyathelo Sesifunjwana	Okwenziwa Uthisha	Okwenziwa Abafundi
Isingeniso		
Isinyathelo-1		
Isinyathelo-2		
Isinyathelo-3		
Isinyathelo-4		
Isinyathelo-5		
Ukuma kweklasi		
Okuphakathi eklasini		
Izinsizakufundisa		
Ulimi olusetshenziswayo		

3. INCWADI YEMVUME YOMNYANGO WEMFUNDO EYISISEKELO



KWAZULU-NATAL PROVINCE

EDUCATION
REPUBLIC OF SOUTH AFRICA

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OFFICE OF THE HEAD OF DEPARTMENT

Enquiries: Phindile Duma

Ref.:2/4/8/41129

Miss PS Mchunu PO Box 1152 **GREYTOWN** 3250

Dear Miss Mchunu

PERMISSION TO CONDUCT RESEARCH IN THE KZN DoE INSTITUTIONS

Your application to conduct research entitled: **“UKUFUNDISA ULIMI OLUSABALELE NEKHARIKHULAMU ESIFUNDAZWENI SESAYENSI EMABANGENI APHEZULU EZIKOLENI ZASEMZINYATHI, EMSINGA”**, in the

KwaZulu-Natal Department of Education Institutions has been approved. The conditions of the approval are as follows:

1. The researcher will make all the arrangements concerning the research and interviews.
2. The researcher must ensure that Educator and learning programmes are not interrupted.
3. Interviews are not conducted during the time of writing examinations in schools.
4. Learners, Educators, Schools and Institutions are not identifiable in any way from the results of the research.

5. A copy of this letter is submitted to District Managers, Principals and Heads of Institutions where the Intended research and interviews are to be conducted.
6. The period of investigation is limited to the period from 19 September 2022 to 31 August 2025.
7. Your research and interviews will be limited to the schools you have proposed and approved by the Head of Department. Please note that Principals, Educators, Departmental Officials and Learners are under no obligation to participate or assist you in your investigation.
8. Should you wish to extend the period of your survey at the school(s), please contact Miss Phindile Duma at the contact numbers above.
9. Upon completion of the research, a brief summary of the findings, recommendations or a full report/dissertation/thesis must be submitted to the research office of the Department. Please address it to The Office of the HOD, Private Bag X9137, Pietermaritzburg, 3200.
10. Please note that your research and interviews will be limited to schools and institutions in KwaZulu-Natal Department of Education.

UMZINYATHI DISTRICT

Mr GN Ngcobo

Head of Department: Education Date: 22 September 2022

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GROWING KWAZULU-NATAL TOGETHER

4. INCWADI YOMZALI (ngesiZulu)

College of Humanities, School of Education

University of KwaZulu-Natal,

Edgewood Campus

6 kuNhlangulana 2023

Mzali

Igama lami nginguPhindisiwe Sthandiwe Mchunu. Ngingumfundi owenza iziqu ze-*Masters* kwimfundo the eNyuvesi yaKwaZulu-Natali, Edgewood Campus, eNingizimu-Afrika.

Nginogqozi lokufunda ngokuthi lufundiswa kanjani ulimi olusabalele nekharikhulamu esifundweni sesayensi ezikoleni zamabanga aphakeme. Lesi sikole okufunda kuso umntwana wakho singesinye sezikole engizoqokelela kuzo ulwazi. Ukuqokelela ulwazi, nginesifiso sokubuza othisha besayensi imibuzo ethile bese futhi ngiphinde ngingene nabo emakilasini ukubabukela ngenhloso yokuqokelela ulwazi lapho bebefundisa. Lolu cwaningo alugxilile kubo njengabafundi kodwa lugxile kothisha, ngenxa yokuthi kuzoba nesidingo sokuthi ngingene ekilasini ngesikhathi befunda, yingakho ngizokucela imvume yokuba kanye naye ekilasini kodwa ngibe ngibukela uthisha wakhe emfundisa.

Ngicela ukuqinisekisa ukuthi:

- Ubuqobo lwakhe umntwana wakho buzovikeleka ngoba azikho iziqophazithombe ezizosebenza ukuthatha izithombe ngenkathi ngiqokelela ulwazi ngokubukela emakilasini, konke engiyokubukela ngiyokubhala phansi.
- Izinhlobo-lwazi ezisakuhleleka zizoba phakathi kwami nothisha.
- Lonke ulwazi oluyiqokelelwa ekilasini alusoze lwasetshenziswa kabi, futhi lolo lwazi engiyoluqokelela ngiyolusebenzisela ucwaningo kuphela.
- Ulwazi oluyiqokelelwa luyogcinwa endaweni ephephile bese lushatshalaliswa ngemuva kweminyaka emi-5 lwenziwe ucwaningo.
- Unelungelo lokumvumela umntwana wakho ukubamba iqhaza, ukungamvumeli ukubamba iqhaza nokumhoxisa ekubambeni iqhaza kulolu cwaningo. Akukho la eyojeziswa khona ngokungabambi iqhaza kulolu cwaningo. Kepha-ke, ngingakugqugquzela ukuthi umvumele ukuthi alibambe iqhaza kulolu cwaningo ngoba luzobamba iqhaza ekuthuthukiseni ukufunda nokufundisa konkana.
- Ukubamba kwakhe iqhaza kumayelana nokufunda kuphela, awukho umhlomulo wezimali azowuthola ngakho.

Ngingatholakala kule mininingwane elandelayo:

Ikheli lombikonyazi: [S \[REDACTED\]](#)

Inombolo kamakhalekhukhwini: [REDACTED]

Umeluleki wami uDokotela Z.P Nkosi, otholakala emkhakheni wemfundo, ophikweni lwase-Edgewood enyuvesi yaKwaZulu-Natali.

Imininingwane yakhe yilena elandelayo:

Ikheli lombikonyazi: Nkosiz@ukzn.ac.za

Inombolo kamakhalekhukhwini: [REDACTED]

Omunye umeluleki wami udokotela R.G Cele, otholakala emkhakheni wemfundo, ophikweni lwase-Edgewood enyuvesi yaKwaZulu-Natali.

Imininingwane yakhe yilena elandelayo:

Ikheli lombikonyazi: CeleR2@ukzn.ac.za

Phone number: [REDACTED]

Ungaphinda futhi uxhumane neHhovisi loCwaningo ngale mininingwano elandelayo:

HUMANITIES & SOCIAL SCIENCES RESEARCH ETHICS ADMINISTRATION

Research Office, Westville Campus

Govan Mbeki Building

Private Bag X 54001

Durban

4000

KwaZulu-Natal, SOUTH AFRICA

Tel: 27 31 2604557- Fax: 27 31 2604609

Email: HSSREC@ukzn.ac.za

Ngiyabonga kakhulu ngokubamba kwakho iqhaza kulolu cwaningo.

UKUQINISEKISA

Mina.....(amagama aphelele omzali) ngiyaqinisekisa ukuthi ngiyakuqonda okuqukethwe ile ncwadi kanye nohlobo lwalo ucwaningo, ngiyavuma ukuba umntwana wami abe yingxenye yalolu cwaningo. Ngियाqonda ukuthi nginelungelo lokuhoxisa ingane yami noma nini kulolu cwaningo uma ngibona isidingo.

ISAYINA YOMZALI

USUKU

.....

.....

5. INCWADI YOMZALI (ngesiNgisi)

College of Humanities, School of Education

University of KwaZulu-Natal,

Edgewood Campus

6 June 2023

Dear Parent

My name is Phindisiwe Sthandiwe Mchunu. I am a Language Education Master of Education candidate studying at the University of KwaZulu-Natal, Edgewood Campus.

I am interested in learning about how language across the curriculum is taught in physical sciences in secondary schools. Your child's school is one of my fields of studies. To gather the information, I am interested in asking physical sciences educators some questions and observe some of their lessons. The focus of this study is on teachers not learners but because I would require getting inside the classroom, I am asking your permission to allow me to observe your child's teacher while teaching him/her.

Please note that:

- Your child's confidentiality is guaranteed as your inputs will not be attributed to you in person, but reported only as a population member opinion.
- The interview sessions will be between me and educators.
- Any information gathered from their classroom cannot be used against them, and the collected data will be used for purposes of this research only.
- Data will be stored in secure storage and destroyed after 5 years the study was completed.
- You have a choice to allow your child to participate, not participate or withdraw him/her from participating in the research. He/she will not be penalised for taking such an action. However, I encourage you to allow your child to participate as this study will contribute to the overall quality of education.
- His/her involvement is purely for academic purposes only, and there are no financial benefits involved.

I can be contacted at:

Email: [REDACTED]

Cell: [REDACTED]

My supervisor is Doctor Z.P Nkosi, who is located in the School of Education, Edgewood Campus of the University of KwaZulu-Natal.

Her contact details are the following:

Email: Nkosiz@ukzn.ac.za

Phone number: 0 [REDACTED]

My co-supervisor is Doctor R.G Cele, who is located in the School of Education, Edgewood Campus of the University of KwaZulu-Natal.

Her contact details are the following:

Email: CeleR2@ukzn.ac.za

Phone number: [REDACTED]

You may also contact the Research Office through the following address:

HUMANITIES & SOCIAL SCIENCES RESEARCH ETHICS ADMINISTRATION

Research Office, Westville Campus

Govan Mbeki Building

Private Bag X 54001
Durban
4000

KwaZulu-Natal, SOUTH AFRICA

Tel: 27 31 2604557- Fax: 27 31 2604609

Email: HSSREC@ukzn.ac.za

Thank you for your contribution to this research.

DECLARATION

I..... (full names of parent)
hereby confirm that I understand the contents of this document and the nature of the
research project, and I consent to my child participating in the research project.
I understand that I am at liberty to withdraw my child from the project at any time,
should I so desire.

SIGNATURE OF PARENT

DATE

.....

.....

6. INCWADI KATHISHA OWUMBAMBIQHAZA (ngesiZulu)

College of Humanities, School of Education

University of KwaZulu-Natal,

Edgewood Campus

6 kuNhlangulana 2023

Mbambiqhaza

Igama lami nginguPhindisiwe Sthandiwe Mchunu. Ngingumfundi owenza iziqu ze-*Masters* kwimfundo the eNyuvesi yaKwaZulu-Natali, Edgewood Campus, eNingizimu-Afrika.

Nginogqozi lokufunda ngokuthi lufundiswa kanjani ulimi olusabalele nekharikhulamu esifundweni sesayensi ezikoleni zamabanga aphakeme. Lesi sikole osebenza kuso singezinye zezikole engizoqokelela kuzo ulwazi. Ukuqokelela ulwazi, nginesifiso sokukubuzisa imibuzo ethile njengothisha wesayensi bese futhi ngiphinde ngingene nawe ekilasini ukukubukela ngenhloso yokuqokelela ulwazi lapho ufundisa.

Ngicela ukuqinisekisa ukuthi:

- Ubuqobo lwakho buzovikeleka ngoba azikho iziqophazithombe ezizosebenza ukuthatha izithombe ngenkathi ngiqokelela ulwazi ngokubukela emakilasini, konke engiyokubukela ngiyokubhala phansi.
- Lzinhlololwazi ziyothatha imizuzu elinganiselwa kwengama-45 kuya ehoreni eli-1, ingahlukaniswa izigatshana ezimbili kuye ngokukhetha kwakho.
- Lonke ulwazi oluyoqokelelwa ekilasini nakwinhlololwazi alusoze lwasetshenziswa kabi, futhi lolo lwazi engiyoluqokelela ngiyolusebenzisela ucwaningo kuphela.
- Ulwazi oluyoqokelelwa luyogcinwa endaweni ephephile eNyuvesi umeluleki wami bese lusatshalaliswa ngemuva kweminyaka emi-5 lwenziwe ucwaningo.
- Unelungelo lokukhetha ukubamba iqhaza, ukungabambi iqhaza nokuhoxa ekubambeni iqhaza kulolu cwaningo. Akukho la uyojeziswa khona ngokungabambi iqhaza kulolu cwaningo. Kepha-ke, ngingakugqugqezela ukuthi ulibambe iqhaza kulolu cwaningo ngoba luzobamba iqhaza ekuthuthukiseni ukufunda nokufundisa konkana.
- Ukubamba kwakho iqhaza kumayelana nokufunda kuphela, awukho umhlomulo wezimali ozowuthola ngakho. Uma uvuma ukwenza inhlololwazi, ngicela ucacise ngokukhetha ukuthi uyavuma ukuthi inhlololwazi yenziwe ngala mathuluzi abhalwe ngezansi:

	Ngiyavuma	Angivumi
Ukwenziswa inhlololwazi		
Iwekhishophu		
Ukuqoshwa ngesiqophamazwi		

Ngingatholakala kule mininingwane elandelayo:

Ikheli lombikonyazi: XXXXXXXXXX

Inombolo kamakhalekhukhwini: 0 [REDACTED]

Umeluleki wami uDokotela Z.P Nkosi, otholakala emkhakheni wemfundo, ophikweni lwase-Edgewood enyuvesi yaKwaZulu-Natali.

Imininingwane yakhe yilena elandelayo:

Ikheli lombikonyazi: Nkosiz@ukzn.ac.za

Inombolo kamakhalekhukhwini: [REDACTED]

Omunye umeluleki wami udokotela R.G Cele, otholakala emkhakheni wemfundo, ophikweni lwase-Edgewood enyuvesi yaKwaZulu-Natali.

Imininingwane yakhe yilena elandelayo:

Ikheli lombikonyazi: CeleR2@ukzn.ac.za

Phone number: [REDACTED]

Ungaphinda futhi uxhumane neHhovisi loCwaningo ngale mininingwano elandelayo:

HUMANITIES & SOCIAL SCIENCES RESEARCH ETHICS ADMINISTRATION

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Durban

4000

KwaZulu-Natal, SOUTH AFRICA

Tel: 27 31 2604557- Fax: 27 31 2604609

Email: HSSREC@ukzn.ac.za

Ngiyabonga kakhulu ngokubamba kwakho iqhaza kulolu cwaningo.

UKUQINISEKISA

Mina.....(amagama aphelele ombambiqhaza) ngiyaqinisekisa ukuthi ngiyakuqonda okuqukethwe ile ncwadi kanye nohlobo lwalo ucwaningo, ngiyavuma ukuba yingxenye yalolu cwaningo. Ngियाqonda ukuthi nginelungelo lokuhoxa noma nini kulolu cwaningo uma ngibona isidingo.

ISAYINA YOMBAMBIQHAZA

USUKU

.....

.....

7. INCWADI KATHISHA (ngesiNgisi)

College of Humanities, School of Education

University of KwaZulu-Natal,

Edgewood Campus

6 June 2023

Dear Participant

My name is Phindisiwe Sthandiwe Mchunu. I am a Language Education Master of Education candidate studying at the University of KwaZulu-Natal, Edgewood Campus.

I am interested in learning about how language across the curriculum is taught in physical sciences in secondary schools. Your school is one of my fields of studies. To gather the information, I am interested in asking physical sciences educators some questions and observe some of their lessons. The focus of this study is on teachers not learners. Please note that:

- Your confidentiality is guaranteed as there will be no picture or video capturing during the course of data generation. All data generated through observations will be written down.
- The interview will be about 45 minutes to 1 hour. You may choose for the interview to be divided into two sessions if you feel like it.
- Any information gathered from the classroom cannot be used against you, and the collected data will be used for purposes of this research only.
- Data will be stored in secure storage and destroyed after 5 years the study was completed.
- You have a choice to participate, not participate or withdraw from participating in the research. You will not be penalised for taking such an action. However, I encourage you to participate as this study will contribute to the overall quality of education.
- Your involvement is purely for academic purposes only, and there are no financial benefits involved.

I can be contacted at:

Email: [REDACTED]

Cell: [REDACTED]

My supervisor is Doctor Z.P Nkosi, who is located in the School of Education, Edgewood Campus of the University of KwaZulu-Natal.

Her contact details are the following:

Email: Nkosiz@ukzn.ac.za

Phone number: [REDACTED]

My co-supervisor is Doctor R.G Cele, who is located in the School of Education, Edgewood Campus of the University of KwaZulu-Natal.

Her contact details are the following:

Email: CeleR2@ukzn.ac.za

Phone number: [REDACTED]

You may also contact the Research Office through the following address:

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Private Bag X 54001

Durban

4000

KwaZulu-Natal, SOUTH AFRICA

Tel: 27 31 2604557- Fax: 27 31 2604609

Email: HSSREC@ukzn.ac.za

Thank you for your contribution to this research.

DECLARATION

I..... (full names of parent)
hereby confirm that I understand the contents of this document and the nature of the
research project, and I consent to my child participating in the research project.

I understand that I am at liberty to withdraw from the project at any time, should I so
desire.

SIGNATURE OF PARTICIPANT

DATE

.....

.....

8. INCWADI YOMFUNDI (ngesiZulu)

College of Humanities, School of Education
University of KwaZulu-Natal,
Edgewood Campus
6 kuNhlangulana 2023

Mfundi

Igama lami nginguPhindisiwe Sthandiwe Mchunu. Ngingumfundi owenza iziqu ze-Masters kwimfundo the eNyuvesi yaKwaZulu-Natali, Edgewood Campus, eNingizimu-Afrika

Ngingogqozi lokufunda ngokuthi lufundiswa kanjani ulimi olusabalele nekharihulamu esifundweni sesayensi kulesi sikole ofunda ukuso. Lesi sikole ofunda kuso singezinye zezikole engizoqokelela kuzo ulwazi. Ukuqokelela ulwazi, ngingesifiso sokubuzisa othisha besayensi imibuzo ethile bese futhi ngiphinde ngingene nabo emakilasini ukubabukela ngenhloso yokuqokelela ulwazi lapho bekufundisa. Lolu cwaningo alugxilile kuwe njengomfundi kodwa lugxile kothisha, ngenxa yokuthi kodwa kuzoba nesidingo sokuthi ngingene ekilasini ngenkathi ufunda, yingakho ngizokucela imvume yokuba kanye nawe ekilasini kodwa ngibe ngibukela uthisha wakho ekufundisa.

Ngicela ukuqinisekisa ukuthi:

- Ubuqobo lwakho buzovikeleka ngoba azikho iziqophazithombe ezizosebenza ukuthatha izithombe ngenkathi ngiqokelela ulwazi ngokubukela emakilasini, konke engiyokubukela ngiyokubhala phansi.
- Izinhlobo-lwazi ezisakuhleleka zizoba phakathi kwami nothisha.
- Lonke ulwazi oluyiqokelelwa ekilasini alusoze lwasetshenziswa kabi, futhi lolo lwazi engiyoluqokelela ngiyolusebenzisela ucwaningo kuphela.
- Ulwazi luyogcinwa endaweni ephaphile bese lushatshalaliswa ngemuva kweminyaka emi-5 lwenziwe ucwaningo.
- Unelungelo lokukhetha ukubamba iqhaza, ukungabambi iqhaza nokuhoxa ekubambeni iqhaza kulolu cwaningo. Akukho la uyojeziswa khona ngokungabambi iqhaza kulolu cwaningo. Kepha-ke, ngingakugquzela ukuthi ulibambe iqhaza kulolu cwaningo ngoba luzobamba iqhaza ekuthuthukiseni ukufunda nokufundisa konkana.
- Ukubamba kwakho iqhaza kumayelana nokufunda kuphela, awukho umhlomulo wezimali ozowuthola ngakho.

Ngingatholakala kule mininingwane elandelayo:

Ikheli lombikonyazi: [REDACTED]

Inombolo kamakhalekhukhwini: [REDACTED]

Umeluleki wami uDokotela Z.P Nkosi, otholakala emkhakheni wemfundo, ophikweni lwase-Edgewood enyuvesi yaKwaZulu-Natali.

Imininingwane yakhe yilena elandelayo:

Ikheli lombikonyazi: Nkosiz@ukzn.ac.za

Inombolo kamakhalekhukhwini: [REDACTED]

Omunye umeluleki wami udokotela R.G Cele, otholakala emkhakheni wemfundo, ophikweni lwase Edgewood enyuvesi yaKwaZulu-Natali.

Imininingwane yakhe yilena elandelayo:

Ikheli lombikonyazi: CeleR2@ukzn.ac.za

Phone number: [REDACTED]

Ungaphinda futhi uxhumane neHhovisi loCwaningo ngale mininingwano elandelayo:

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KwaZulu-Natal, SOUTH AFRICA

Tel: 27 31 2604557- Fax: 27 31 2604609

Email: HSSREC@ukzn.ac.za

Ngiyabonga kakhulu ngokubamba kwakho iqhaza kulolu cwaningo.

UKUQINISEKISA

Mina.....(amagama aphelele

omfundi) ngiyaqinisekisa ukuthi ngiyakuqonda okuqukethwe ile ncwadi kanye

nohlobo lwalo ucwaningo, ngiyavuma ukuba yingxenye yalolu cwaningo.

Ngiyaqonda ukuthi nginelungelo lokuhoxa noma nini kulolu cwaningo uma ngibona isidingo.

ISAYINA YOMFUNDI

USUKU

.....

.....

9. INCWADI YOMFUNDI NGOLIMI LWESINGISI

College of Humanities, School of Education
University of KwaZulu-Natal,
Edgewood Campus,

Dear Learner

INFORMED CONSENT LETTER

My name is Phindisiwe Sthandiwe Mchunu. I am a Language Education Master of Education candidate studying at the University of KwaZulu-Natal, Edgewood Campus, South Africa.

I am interested in learning about how language across the curriculum is taught in physical sciences in your school. Your school is one of my fields of studies. To gather the information, I am interested in asking physical sciences educators some questions and observe some of your lessons. The focus of this study is on teachers not learners but because I would require getting inside the classroom, I am asking your permission to allow me to observe your teacher while teaching you.

Please note that:

- Your confidentiality is guaranteed as there will be no photographic equipment, meaning you won't be photographed in any way.
- The interview sessions will be between me and your educators.
- Any information gathered from your classroom cannot be used against you, and the collected data will be used for purposes of this research only.
- Data will be stored in secure storage and destroyed after 5 years the study was completed.
- You have a choice to participate, not participate or stop participating in the research. You will not be penalised for taking such an action. However, I encourage you to participate as this study will contribute to the overall quality of education.
- Your involvement is purely for academic purposes only, and there are no financial benefits involved.

I can be contacted at:

Email: [s\[REDACTED\]](mailto:s[REDACTED])

Cell: 0[REDACTED]

My supervisor is Doctor Z.P Nkosi, who is located in the School of Education, Edgewood Campus of the University of KwaZulu-Natal.

Her contact details are the following:

Email: Nkosiz@ukzn.ac.za

Phone number: [REDACTED]

My co-supervisor is Doctor R.G Cele, who is located in the School of Education, Edgewood Campus of the University of KwaZulu-Natal.

Her contact details are the following:

Email: CeleR2@ukzn.ac.za

Phone number: [REDACTED]

You may also contact the Research Office through the following address:

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Private Bag X 54001

Durban

4000

KwaZulu-Natal, SOUTH AFRICA

Tel: 27 31 2604557- Fax: 27 31 2604609

Email: HSSREC@ukzn.ac.za

Thank you for your contribution to this research.

DECLARATION

I..... (full names of participant) hereby confirm that I understand the contents of this document and the nature of the research project, and I consent to participating in the research project. I understand that I am at liberty to withdraw from the project at any time, should I so desire.

SIGNATURE OF LEARNER

DATE

.....

.....

10. UHLELO LWESIFUNDO – UTHISHA A (ISIBONELO)

LESSON PLAN

Subject: Physical Sciences

Date: 27 February 2024

Grade: 10

Duration: 1 hour

Lesson Topic: Electrostatic

Lesson Objectives:

- * Know how to differentiate between electrons & protons
- * Know which charge is able to move
- * Know what do we call object with equal number of electrons and protons
- * Know how to define electrostatic

Learner's Activity:

- * Copy notes from the board
- * Do an activity based on charges

Educator's Activity:

- * Give the summary of notes to learners
- * Give classwork based on charges
- * Monitor work given to learners

Feed Back:

- * Successful

11. INKAMBISO ELUNGILEYO YOCWANINGO



24 November 2023

Phindisiwe Sthandiwe Mchunu (208517617)
School Of Education
Edgewood Campus

Dear PS Mchunu,

Protocol reference number: HSSREC/00006229/2023

Project title: Ukufundisa ulimi olusabalele nekhrikhulamu esifundweni sesayensi ezikoleni zamabanga aphezulu
Degree: Masters

Approval Notification – Expedited Application

This letter serves to notify you that your application received on 28 September 2023 in connection with the above, was reviewed by the Humanities and Social Sciences Research Ethics Committee (HSSREC) and the protocol has been granted **FULL APPROVAL**.

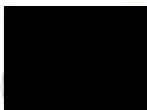
Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment/modification prior to its implementation. In case you have further queries, please quote the above reference number. **PLEASE NOTE:** Research data should be securely stored in the discipline/department for a period of 5 years.

This approval is valid until 24 November 2024.

To ensure uninterrupted approval of this study beyond the approval expiry date, a progress report must be submitted to the Research Office on the appropriate form 2 - 3 months before the expiry date. A close-out report to be submitted when study is finished.

HSSREC is registered with the South African National Health Research Ethics Council (REC-040414-040).

Yours sincerely,



Professor Dipane Hlalele (Chair)

/dd

Humanities and Social Sciences Research Ethics Committee

Postal Address: Private Bag X54001, Durban, 4000, South Africa

Telephone: +27 (0)31 260 8350/4557/3587 Email: hssrec@ukzn.ac.za Website: <http://research.ukzn.ac.za/Research-Ethics>

Founding Campuses: ■ Edgewood ■ Howard College ■ Medical School ■ Pietermaritzburg ■ Westville

INSPIRING GREATNESS

12. UMBIKO WE-TURNITIN

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Phindisiwe Mchunu

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[Gumbi, Patrick Phephani.. "Ukusetshenziswa kolimi lokufunda, ukufundisa nokuhlola ezikoleni zase-Harrismith, esifundazweni sase-Free State.", 2017](#)

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<https://mitchellkember.com/sch4u/galvanic-cells.html>

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[Nkosi, Zinhle Primrose.. "Ucwaningo lokuhlola ukufundiswa kokufunda okubhaliwe emabangeni aphantsi akhethiwe esizulu.", 2011](#)

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Class: Masters Class

Assignment: Isimomqondo sabafundi nothisha

Paper ID: [503262048](#)

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