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Classroom interaction in Rwandan secondary physics classrooms

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Key words

Classroom interaction; Rwanda; power relation; pedagogy; corporal punishment

Abstract

This study investigates the classroom environment and interactions in physics lessons in Rwandan lower secondary schools. The data obtained from 6 classroom observations, interviews with 6 teachers, and interviews with 17 students have been used to explore classroom discourse which has been generally regarded as 'teacher-centred', 'knowledge transmission' and 'highly ritualized'. The research findings revealed the teachers' use of an authoritative non-interactive approach, controlling students' participation by using highly ritualized questioning and feedback techniques. Students' behaviour was also controlled by the teachers by using punishment including corporal punishment and exclusion. However, dialogic interactive verbal exchanges between a teacher and students were also observed, where the teacher was discovering students' knowledge. This micro-level analysis provides insight into what goes on inside classrooms and highlighted asymmetrical power relations between the teachers and students that have a constraining influence on the range of potential approaches to teaching and learning.

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List of abbreviations

Abbreviation	
EFA	Education for All
FGD	Focus Group Discussion
GER	Gross Enrolment Rate
GoR	Government of Rwanda
I-R-E	Initiation-Response-Evaluation
I-R-F	Initiation-Response-Follow-up
KIE	Kigali Institute of Education
MINEDUC	Ministry of Education
MOI	Medium of Instruction
NER	Net Enrolment Rate
9YBE	Nine Years Basic Education
REB	Rwanda Education Board
SSA	Sub-Saharan Africa
ZPD	Zone of Proximal Development

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1. Introduction

EFA (Education for All) discourse has gradually shifted from exclusive persistence on access to quality. However policy makers have prioritized how quality can be measured rather than what quality entails. Therefore input and output for quality education which can be quantified and easily compared has been focused on rather than the process of quality education which is hard to measure (Alexander 2008). However, setting indicators for input such as number of resources might not improve the quality of education unless the process of how to use those inputs are not supported (O'Sullivan 2006). The indicators for output such as percentage of qualified teachers might not improve the quality of education because no link between students' academic achievement and teachers' qualifications was observed (UNESCO 2014; Westbrook et al. 2013). Quality education cannot be achieved without focusing on the process - how a teacher teaches and how students learn in a certain context. Alexander (2008) asserts the importance of the use of international research about teaching and learning in developing the indicators of the process of quality education. At the same time he claims the importance of taking account of the cultural context when developing the indicators, otherwise indicator might become a tool of cultural colonization. O'Sullivan (2006) defends the effectiveness of lesson observational research as a method of measuring the process of quality education. She claims that lesson observation enables the discovery of classroom reality within a micro-context, therefore an appropriate approach to quality education which best fits the context should be possible. However, according to her, classroom observation has gained limited attention and is rarely used to inform on policy formation for quality education despite the fact that it can provide understanding of different aspects of quality in a certain context. It should gain more attention because research of classroom observation has revealed a critical issue which cannot be overlooked when determining policy for quality education such as classroom interaction in sub-Saharan Africa (SSA) being far from developing students' cognitive skills (Chick 1996; Hardman, Abd-Kadir, and Smith 2008; Hardman and Abd-Kadir 2010; Moloi, Morobeb, and Urwick 2008; O-saki and Agu 2002; Pontefract and Hardman 2005; Prophet and Rowell 1993).

Therefore, this study uses lesson observation, alongside the interviews with teachers and students to investigate how teachers and students interact in class and to what extent the classroom environment encourages students' active participation. This micro-level analysis reveals what actually goes on at classroom level and provides policy implications for the quality education in the Rwandan context. Chapter 2 describes the context of Rwanda and its education system including a brief educational history and recent educational policy. Chapter 3 reviews literature related to classroom interaction in SSA. It begins with general classroom discourse in SSA and moves to consider the effect that medium of instruction (MOI) and corporal punishment have on classroom interaction. Then it

discusses the importance of classroom interaction from the viewpoint of social constructivism. Chapter 4 describes the methodology of this research and the research findings are shown in Chapter 5. Finally Chapter 6 draws the conclusion that students' participation and behaviour in the classroom is strongly controlled by teachers and this prevents dialogic interaction between students and the teachers.

2. Context

This chapter begins with the geographic and demographic context of Rwanda. The structure and history of education in Rwanda are then briefly described, and the successes and challenges of the current education system are highlighted. Finally history of the policy of MOI is described.

2.1. Geographic and demographic context of Rwanda

Rwanda is a landlocked country surrounded by Uganda to the north, Tanzania to the east, Burundi to the south and the Democratic Republic of Congo to the west. It has a population about 10.5 million, 47.7% of which are youth under 17 years old. 82.8% of the whole population lived in rural areas in 2012 and people living below the poverty line in 2010/2011 were 44.9%. Adult literacy was 69.7% and the youth literacy rate was 83.7% in 2010/2011 (NISR 2013). According to the national census in 2002, almost all of the residents, 99.7% of population, speak Kinyarwanda, which is the national language of Rwanda. The official languages are Kinyarwanda, French and English according to the constitution of Rwanda (MINECOFIN 2005). The percentage of English speakers in Rwanda is estimated to be from 1.9 to 5% and French speakers are estimated to be from 3 to 5%, although the exact number is ambiguous (Samuelson and Freedman 2010).

2.2. Education sector context of Rwanda

2.2.1. Structure of education

The education system in Rwanda consists of 4 main levels: pre-primary of 3 years; primary of 6 years (P1-P6); secondary of 6 years which consist of lower secondary 3 years (S1-S3) and upper secondary 3 years (S4-S6); and higher education. There are also technical and vocational institutions for secondary levels. There are national examinations at the end of primary school (P6), at the end of lower secondary school (S3), and at the end of upper secondary school (S6) which screen some students from going on to the next level of education (World Bank 2011).

2.2.2. Education history

Aftermath of genocide and lack of qualified teachers

Before the genocide in 1994, access to education was limited to a certain number of people based on regional and ethnic criteria rather than academic performance. Education had been used to distinguish between people and to build feelings of hatred and prejudice. Therefore, during the 1994 conflict, the education system was particularly targeted. Educated people including teachers became objects of massacre and schools were destroyed. About 800,000 people, 10% of the population, were

killed in the event, and 2000,000 people, about a third of the population, fled to neighboring countries. The Ministry of Education re-opened primary and secondary schools only a couple of months after the end of the genocide. The regional or ethnic identification which triggered genocide was abolished. Equity in access to all levels of education was ensured and criteria for the admission to education became purely based on academic performance. The problem was the lack of teachers. To overcome this situation, the ministry called for not only secondary school leavers but also secondary drop-outs to fill in the position of primary school teachers. Secondary school teachers were in even greater shortage. More than two-thirds of secondary school teachers did not have the necessary qualifications to teach secondary level (Obura 2003). To cope with this critical situation, the Teacher Training College, which offers pre-service primary school teacher training and the Kigali Institute of Education (KIE), which offer secondary school teacher training, were established in 1998. The KIE also started distance learning programmes for in-service teachers in 2001(World Bank 2011; Mukamusoni 2006) and gradually the number of qualified teacher has started to increase.

Fee-free education

The Government of Rwanda (GoR) introduced universal fee-free primary education in 2003. Following its success, the GoR launched the Nine Year Basic Education (9YBE) programme with fast tracking strategies which ensures 9 years of free compulsory education, 6 years of primary education (P1-P6) and 3 years of lower secondary education(S1-S3), for all Rwandese children from January 2009. This programme was characterized by its innovative strategies of cost effectiveness and rapidness. To reduce the cost, the strategies of specialization of teachers, reduction of core courses, and double shifting for primary school teachers were introduced. Moreover, implementation of the 9YBE programme was highly decentralized in order to achieve rapid and cost effective construction of classrooms and provision of resources. A wide range of stakeholders were involved in the construction of classrooms including existing local communities called Umuganda. The community was given ownership of financial management and decision making, which enabled their contribution of money, time, and workforce (Muvunyi 2013; MINEDUC 2008). In this paper, I call those schools which built additional classrooms for lower secondary school after 2008 beside primary classrooms ‘9YBE schools’. Thanks to those strategies, the number of students who pass primary school leaving national examination has increased dramatically. The statistics shows that while only 22.4% of those who sat the primary school leaving examination in 2007 could pass the national examination to transit to lower secondary school due to the limited number of places, by 2008 it had increased into 74.2%, and to 78.1% in 2013, thanks to the rapid construction of classrooms. The transition rate from P6 to S1 increased from 54.6% in 2007/2008 to 87.9% in 2008/2009 (MINEDUC 2012).

Challenges of current education

Access to secondary school has expanded significantly, yet it should be noted that even though 9YBE is compulsory and free according to policy, there are still national examinations to screen some students from access to secondary schools as the figures above indicate, and also not all existing primary schools have constructed classrooms up to lower secondary school (IPAR 2012). Furthermore, even though official school fees were abolished, households still need to pay for uniform, contribution to PTA (Parent-Teacher Association), and school supplies such as books (World Bank 2011). Therefore, access to secondary school is still limited to a certain number of children.

There is also an issue of over-age students which can be indicated by comparing the statistics of GER at lower secondary schools in 2013, which was 49.8 % (male 46.8% and female 52.6%) and NER which was 22.7 % (male 20.4% and female 25.0%). The dropout rate and repetition rate in lower secondary schools in 2012/2013 was also high, at 17.7% and 6.2% respectively (MINEDUC 2014). The quality of teachers at secondary school level is still problematic in terms of qualifications and years of experiences although it has been gradually improving. In 2013, 30.7% of secondary school teachers were not qualified (MINEDUC 2014). There is a significant difference in the qualification levels of teachers between urban and rural areas; for example, less than 20% of secondary school teachers at public and government subsidized school are under-qualified in Kichukiro district in urban Kigali, while more than 80% in Kirehe district in the rural Eastern province were under-qualified in 2008. More than 40% of teachers at secondary school had less than 5 years of experience in 2008 (World Bank 2011).

In 2012, 9YBE was expanded into 12 years so that all pupils who end 9 years of education are able to access a further three years of education, although these extended three years are not compulsory (IPAR 2012).

2.2.3. Language of instruction

The policy of MOI in Rwanda has kept changing, affected by politics and donor agencies. After independence from Belgium in 1962, the colonial language, French, continued to be used as MOI after upper primary school. After the 1994 genocide when the Rwandan Patriotic Front took power in Rwanda, the GoR for the first time introduced English as MOI in order to accommodate the returnees from exile in Anglophone neighboring countries. In 1996 the language of instruction became French and English after P4 with the continuation of use of Kinyarwanda from P1 to P3 (Pearson 2013). In 2008, the GoR abruptly introduced a new MOI policy to use English from P1 and abolished French in all levels of education from 2009 in spite of the fact that above 95% of teachers

at secondary schools in Rwanda still taught mainly in French in 2008 (Dyer 2008). The official reasons for this change were due to the membership of the East African Community and the Commonwealth. However, in 2011 pressure from donors which supported mother-tongue based education finally made Rwanda revert to the policy that the first 3 years of primary school should be taught in Kinyarwanda and from P4 in English (Pearson 2013; MINEDUC 2010). Since a large number of teachers were educated in French, they are struggling to teach subjects in English. According to the baseline survey of Rwandan teachers' English skills in 2009, 85% of primary school teachers and 66% of secondary teachers were categorized as having beginner to pre-intermediate levels of English (MINEDUC 2010). To cope with this situation intensive English training courses were provided for all primary and secondary school teachers during holidays. A radio programme which teaches English to the teachers was also introduced. In 2012, school based mentoring programmes also started with one mentor who helps to improve teachers' English language skills and learner-centred pedagogy skills being allocated to two neighboring schools (Muvunyi 2013; RwSA 2012).

3. Literature review

This chapter first reviews general classroom discourse in SSA including Rwanda which lacks a dialogic interactive teaching approach. Then it discusses how MOI influences students' learning and participation. Next, it considers the prevalence of corporal punishment in SSA which negatively influences classroom environment and interaction. Finally, it discusses why dialogic classroom interaction is important for learning from the viewpoint of social psychology.

3.1. General classroom discourse in SSA and Rwanda

Past research has found that classroom discourse in sub-Sahara Africa (SSA) is highly ritualized and has similar classroom organization. The lesson usually opens with a teachers' explanation, which encourages rote-learning and questioning-and-answering being followed, with students copying the chalkboard, before time for finally doing written exercises is given (Hardman and Abd-Kadir 2010). Questioning-and-answering is strongly controlled by teachers with the purpose of reaching one 'correct answer', due to which most of the initiation made by teachers is through asking closed questions or teacher-led, cued recitation followed by students' choral response with minimum feedback (Chick 1996; Hardman, Abd-Kadir, and Smith 2008; Hardman and Abd-Kadir 2010; Moloi, Morobeb, and Urwick 2008; O-saki and Agu 2002; Pontefract and Hardman 2005; Prophet and Rowell 1993). According to Prophet and Rowell (1993), this ritualized teacher-centred way of teaching is derived from strong African tradition which emphasizes age hierarchy, giving authority to elder people. On the contrary, Arthur (1996) argues that the institutionalized recitation routine is not based on African traditional culture but, rather, it originates in formal schooling practice imposed by colonial leaders.

In the case of Rwanda, according to Mathisen (2012), indigenous education taught by tribal elders and family members in an interactive way was common before colonization. However, during colonization, teacher-led education was introduced in order to serve the colonial master and it continued to be used even after independence until emergency education promoting healing and learning was introduced after the genocide in 1994. Since 2001, the GoR has emphasized the importance of learner-centred education through teacher training (Rutaisire 2012). Despite the GoR's strong emphasis on learner-centred education in its policy and curriculum (MINEDUC 2010; NCDC 2006, 2010, 2011), Rwanda also seems to follow the same classroom discourse as other SSA countries, so-called 'recitation of transcript', as several researchers have reported teachers' use of one-way knowledge transmission in a ritualized way. For instance, Uworwabayeho (2009) states that typical teachers in Rwanda explain a concept and write notes on the chalk board while learners copy

them into their notebooks, then 5 to 10 minutes is given for exercises for learners to practice taught techniques at the end of the class. Uworwabayeho (2009) also mentions that learners speak in the classroom only to answer teachers' questions or ask for clarification of an explanation. The classroom observation of 8 classes including primary and secondary school in Rwanda conducted by Walker-Keleher (2006) found that all observed classes were teacher-centred and didactic. She states that teachers' ways of checking students' comprehension was characterized by asking '*Are you with me?*' and the intended and received answer was always *'Yes!*' in choral (p.47). Exactly the same way of pseudo-checking is reported also in Kenya (Pontefract and Hardman 2005). Walker-Keleher (2006) further states that there were no structured student interactions and students' opinions were not present at all in the 8 classes she observed. The absence of students' voices in the classrooms is also reported by classroom observation conducted by Earnest and Treagust (2002). They observed how in the classes students never questioned their teacher's knowledge, the teaching methods, and the content knowledge because they were culturally supposed to respect the ability of teachers. Their argument is supported by Schweisfurth (2011) who states that implementing learner-centred pedagogy in some developing countries is difficult due to stratification in societies in which the appropriate, respectable distance between authorities and teachers, and between teachers and learners, is determined. A lack in teachers' skills in questioning techniques and feedback are also reported in an observation study of science classrooms taught by teachers who graduated from distance learning teacher training programs (Rutaisire 2012). Rutaisire (2012) states that the teachers used questioning techniques which only focused on low-order, short answer questions and they did not give any guidance or feedback on students' answers.

The above short literature review explicitly indicates that student voice is lacking in school culture in Rwanda and teachers never seem to attempt to discover students' ideas. The one-way knowledge transmission style of teaching has been embedded and a dialogic climate of learning through talking does not appear to exist. However, this has perhaps been exacerbated by the language of instruction because, as I mentioned in section 2.2.3, the GoR abruptly changed the policy of MOI into solely English from P4 and abolished French instruction regardless of the fact that most teachers were educated in the French system and therefore lack sufficient English proficiency, as do the students who have been taught by those teachers. Arthur (2001) claims that whole class teaching which does not allow student initiation protects teachers from revealing their proficiency in English. In the next section, how the language of instruction influences on teaching and learning in SSA is discussed.

3.2. Language of instruction

Introducing a foreign language as MOI influences the quality in the learning of students. According to Rassool and Edwards (2010), past research over 3 decades revealed that educating students in their first language facilitates children's cognitive development because children can grasp concepts easily. For example, Nigerian primary school students educated in their vernacular showed better results across the subjects including English than students who were educated in English (Bamgbose 1984). The higher achievement of those taught in their mother tongue is also reported in many other countries in SSA such as Cameroon, Ethiopia, Mali and Burkina Faso (UNESCO 2014).

Introducing a foreign language as the official language or as a MOI in SSA can also contribute to disparities within society because the provision of the language is not implemented equally, often favoring urban locations and middle class households who can go to schools which have good English speaking teachers (Harlech-Jones 1998; Rassool 2013). Students in rural areas also have fewer chances to be exposed to English outside of class (Arthur 1996; Humphreys 2013; MINEDUC 2010)

Teaching in a foreign language also reinforces the asymmetrical power knowledge relations between teachers with superior knowledge of the language and students with lower levels of language, and also among students who already have better knowledge of it and those who don't (Humphreys 2013). In Botswana, while the internalized classroom discourse allowed teachers free access to participant-related code switching from English to the local language, students were not free to switch the languages (Arthur 1996). This asymmetrical role between teacher and students in the class reinforces the power relation between them and deprive students the opportunities to speak freely in class. The use of a foreign language as the MOI excludes students who are not confident in the language by rescinding their voice from official classroom discourse. They are often unable to participate comfortably in the class especially where the use of indigenous languages is prohibited. These students tend to stay docile, fearing being ridiculed by their classmates for their lack of language proficiency (Humphreys 2013). Therefore those who have weaker knowledge of the medium of instruction are not only disadvantaged in their understanding of the contents taught but also disadvantaged in terms of their participation in class. Thus, introducing a non-mother tongue as the MOI brings about a less child-friendly classroom climate, depriving students the opportunities to freely interact in class.

In addition to MOI, there is another constraint preventing the introduction of a child-friendly, interactive and dialogic classroom climate which is reported in SSA, namely, heavy punishment, which reinforces the power relation between the teacher and students. In the next section the

prevalent use of corporal punishment and verbal abuse in schools in SSA is discussed.

3.3. Corporal punishment

The endemic use of corporal punishment such as canning, beating with fists or with other materials, slapping, pinching, heads hit against walls and so on in SSA has been continuously reported (Dunne et al. 2005; Dunne 2007; Morrell 2001; Mweru 2010; Soneson 2005). A strong belief that corporal punishment is the most effective punishment to correct children's behaviour has been embedded in African tradition for a long time and therefore it is not easy to change people's belief even if it is officially banned. Parents also agree to have their children thrashed at school because they themselves beat their children at home (Morrell 2001; Mweru 2010). According to Mweru (2010), Kenyan teachers' rational for the continuing uses of corporal punishment although banned is that after corporal punishment was banned students started to break school regulations and misbehave. The teachers also tried to justify corporal punishment by saying that in a classroom situation where the teacher pupil ratio is very high, there is no better method than corporal punishment. They also compared corporal punishment with other punishments like detention and concluded that corporal punishment is more time-saving because teachers don't have to spend extra time on students and compliance can be immediately enforced.

Prevalent use of verbal abuse during the class by teachers towards students is reported in Botswana and South Africa (Dunne et al. 2005; Soneson 2005). Since verbal abuse is so damaging to students, leaving the feelings of embarrassment and anxiety for a long time in their mind and influencing their performance in the class, some students even stated the preference to corporal punishment (Dunne et al. 2005).

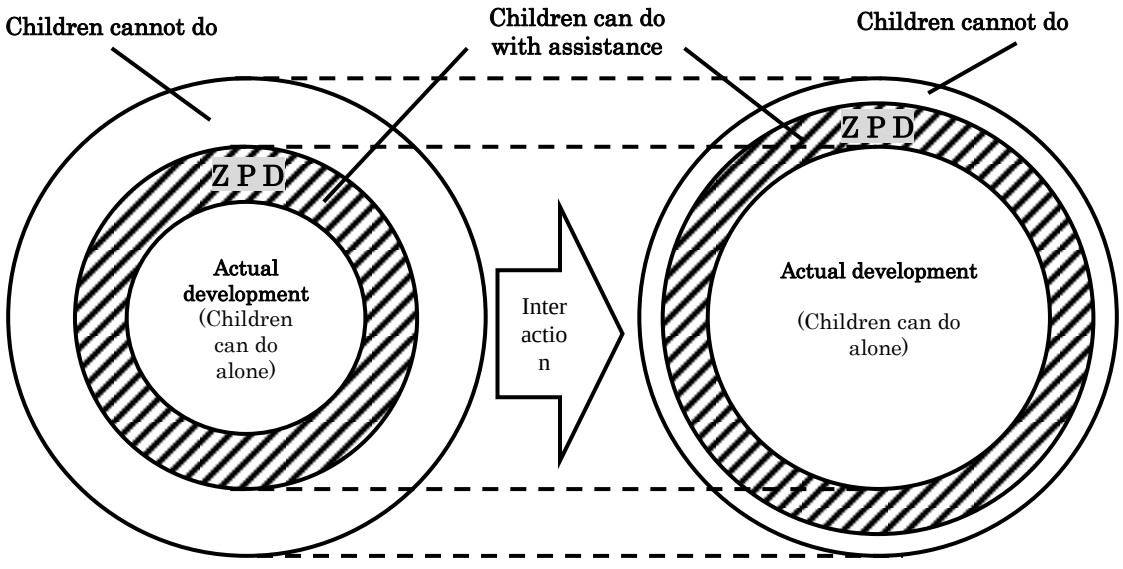
The use of humiliating and degrading punishments reinforces a teacher's authoritative power against students and discourages students from initiating classroom talk, reducing them to speaking only when asked to by a teacher. In the next section, why dialogic classroom interaction is important for meaningful learning is discussed.

3.4. Dialogic teaching and constructivism

According to Alexander (2006), the form and context of language which children have been exposed to play a key role in their cognitive development and verbal interaction with others assists children to construct meaning. This view is based on the social psychology developed by Vygotsky. Vygotsky (1978) explains the importance of classroom interaction and teachers' support for students'

meaning-making process using the concept of the zone of proximal development (ZPD). According to him, there are two different levels of development; the actual development level and the ZPD. The former only measures the functions that have already matured in children's mental development processes. When children reach actual development level, children can do alone without assistance from others. On the other hand, the ZPD measures the functions which have not yet matured but are in the process of maturation. The ZPD is the level of potential development which can be reached under adults' guidance or in collaboration with more able peers. Thus, what is in the ZPD today may be in the actual developmental level tomorrow (Vygotsky 1978) (see Figure 1). To facilitate this, dialogic and interactive approaches between the teacher and students and among students are important. Thus the central role of teachers should first be to monitor the level of students' understandings (actual development level) and then give appropriate intervention (ZPD) to support individual students to be able to do what they cannot do alone but can do with assistance. Whether the task at the ZPD level will be able to be reduced to the actual development level depends on teachers' skills in how they interact with students and scaffold them by elaborating and probing students' answers, giving opportunities to discuss with peers to reflect their own thinking to help internalize the idea of a task.

Figure 1 The levels of development



Accordingly verbal interaction in the classroom is critical in the process of the cognitive development of students because it facilitates the meaning-making process. In other words, learning is a dialogic process and through talking students can reflect their own thinking and internalize ideas (Mortimer and Scott 2003).

Dialogic teaching expands students' thinking and promotes learning and understanding through the power of talk. While a traditional model of teaching, which is prevalent in SSA, considers knowledge as fixed and propositional, merely being transmitted from the teacher to the students, dialogic teaching regards knowledge as open and processual. In dialogic teaching, the questioning skills of teachers are important and paying attention to students' words might be even more important. The critical factor to promote students' learning is a teacher's follow-up to their answers, and questioning and discussion themselves do not necessarily harness the process of learning. Giving feedback to what students say provides them with the opportunity to reflect on their own thinking, which enhances their cognitive development. (Alexander 2006).

Dialogic interaction in a classroom is especially important when learning science because '*every day social language*', the language used in day-to-day communication within a given social system and a given time, is often different from '*school science social language*', the language determined by the science education community. Moreover, children's conceptions of scientific phenomena derived from *every day social language* are sometimes misconceptions. For example, we routinely talk about the sun as 'rising and setting' in *every day social language* which implies that the sun is spinning around the earth, yet this is a misconception in *school science social language* because in fact the earth is revolving around the sun while rotating itself. Therefore, where the gap between those two languages is big, learning, in other words, assimilating new *school science language*, becomes demanding for students. Thus a dialogic approach should be taken so that teachers are able to discover the students' existing and developing understanding of scientific concepts and phenomena by paying attention to what students are saying in class. Then teachers should assist them in making sense of and internalizing new *school science* ideas by using analogies or setting up conceptual cognitive conflict situations which give them opportunities to reflect on their own thought and understandings (Mortimer and Scott 2003).

As such, dialogic teaching requires high-level talking and listening techniques for teachers to elicit students' talking. Alexander (2006) classifies classroom teaching talk into five categories based on comparative studies of teaching in different countries – rote, recitation, instruction, discussion and dialogue – and states that only the last two are parts of dialogic teaching whereas the first three are parts of traditional transmissive pedagogy (Table.1).

Table 1 Five categories of teaching talk

	Categories	Explanation
Traditional transmissive pedagogy	rote	The drilling of factual knowledge through repetition
	recitation	Knowledge accumulation by questioning students recalling or cued questions
	instruction	Telling the students what to do or giving them information or procedures
Dialogic teaching	discussion	The exchange and the sharing of ideas
	dialogue	Achieving common understanding through questioning, follow-up and discussion

Source: Alexander (2006, p.30)

While rote, recitation, and instruction are unlikely to give cognitive challenges to students, discussion and dialogue give greater opportunities to face cognitive conflict and reflect on one's own ideas. Yet, dialogic teaching challenges not only students' understanding but also teachers' understanding of subject matters because in dialogic classrooms students are free to explore the territory of teachers' knowledge. Teachers who are less confident in their subject knowledge might continue to use traditional transmission pedagogy because it leaves power in teachers' hands to control the classroom, reducing the risk of exposing the limitation of their subject knowledge. In Rwanda only 36% of secondary school teachers had a degree in education, 21% of them a diploma, and 40% a certificate in 2008 and there was a significant gap in the past academic performance among teachers between those with different qualification levels. Given the academic background of secondary school teachers in Rwanda, it might take considerable time for dialogic teaching to be mainstreamed.

Apart from lack of teachers' subject knowledge, there are also other factors which might affect implementation of dialogic teaching, such as the speaking and listening skills of children and teachers, classroom organization, and classroom climate (Alexander 2006). Classroom climate plays a key role since dialogic teaching might be intimidating for students who have experienced the classroom climate where traditional transmissive pedagogy is prevalent. Traditional transmissive pedagogy protects not only teachers but also students. By using rote or recitation which requires choral response, students are also protected from making wrong responses and being shamed by peers. Therefore Chick (1996) called classroom talk using traditional transmissive pedagogy which he observed in classrooms in South Africa '*safe-talk*' because it protects both teacher and students from showing their vulnerability in class. Alexander (2006) suggests that setting guiding principles

for classroom talk, such as 'showing respect to each other's ideas' and 'listening carefully to others and not interrupting' might be the first step to nurturing dialogic climates in the classroom.

Drawing on Vygotsky's perspective of social constructivism and Alexander's dialogic teaching, Mortimer and Scott (2003) identified four classes of communicative approach in the classroom focusing on talk between teachers and students along each of two dimensions: dialogic - authoritative and interactive - non-interactive (see Table 2). The difference between dialogic and authoritative is whether the teacher listens to more than one point of view or accepts only one viewpoint in relation to school science and the difference between interactive and non-interactive is whether the teacher allows the participation of other people or not.

Table 2 Four classes of communicative approach

	Interactive	**Non-interactive**
Dialogic	**A. Interactive and dialogic** ➢ Teacher and students explore ideas, generate new meaning together. ➢ Teacher takes into account of each student's view through verbal exchange even it is different from the scientific view.	**B. Non-interactive and dialogic** ➢ Teacher considers the various points of view but excludes the participation of other people.
Authoritative	**C. Interactive and authoritative** ➢ Teacher leads students with instructional questions through verbal exchange to reach the required school science answer	**D. Non-interactive and authoritative** ➢ Teacher presents one specific point of view.

Source: Mortimer and Scott (2003, p.35-39)

Interactive approaches usually follow the pattern of interaction discourse; the I-R-F (-R-F-) pattern (initiation-response-follow-up) and the I-R-E pattern (initiation-response-evaluation) (Mortimer and Scott 2003). In the interactive authoritative approach, the I-R-E pattern is generally observed because the purpose of this approach is to reach the one required 'correct' answer thus students' responses apart from this answer are excluded through the process of evaluation. On the other hand, the I-R-F(-R-F-) pattern, which was first introduced by Sinclair and Coulthard (1975), is commonly used in interactive and dialogic approaches to sustain the chain of dialogue to support students talking and take account of their point of views by using effective questioning and feedback.

Through the feedback, a student can elaborate on his or her thinking which helps teachers to understand students' ideas and helps students to reflect on his or her own idea.

Research which analyzed verbal interaction using I-R-F structures (From here 'F' includes also 'E') in SSA is available (Hardman, Abd-Kadir and Smith 2008; Pontefract and Hardman 2005). Not surprisingly, most of the observed classrooms used authoritative approaches and neglected dialogic meaning-making approaches by limited use of effective questioning and feedback techniques. The observation of primary science classrooms in Kenya and Nigeria revealed that less than half of teacher input in initiation moves could be categorized as questions, with the remaining as ritualized activities such as cued elicitation (repetition or completion of a word or phrase), or pseudo-checking (tag questions with only one possible affirmative response) only to keep students involved in the class. The questions asked by teachers were mostly short answer, closed questions and open questions which expected thought or reasoning response were extremely rare. Furthermore, a prevalence of choral answers was also observed. Most of the follow-up was evaluation, such as affirming responses, repeating students' responses, praising, and commenting on students' responses. Teachers rarely probed students' responses or asked for further explanation to develop their ideas even when they asked open questions (Hardman, Abd-Kadir and Smith 2008; Pontefract and Hardman 2005). This literature clearly indicates that students in Kenya and Nigeria rarely have opportunities to contribute in class because the classroom is tightly controlled by teachers' initiation, talking, and evaluation techniques which maintain power in their hands. This teaching method does not allow students' ideas to be discovered or to gauge students' understanding level of newly introduced concepts. Therefore students are merely obliged to remember *school science language* as the sole 'correct' answer even if their own ideas were different from it. Classroom observation in Botswana found that teachers used pedagogy which completely ignored students' 'incorrect' responses and acknowledged only 'correct' answers. This classroom discourse led students to use trial and error approaches to continue responding until they could satisfy the teacher by saying the 'correct answer' (Prophet and Rowell 1993). This method does not help students' cognitive development because if the 'correct answer' is not reasonable for students, it is unlikely to be accommodated into the students' existing schemata, possibly rejected by them. In Rwanda, judging from the existing literature review mentioned earlier, teachers seem to use only non-interactive authoritative approaches and interactive authoritative approaches characterized by the I-R-E pattern. However, there is currently no available literature which analyzes verbal interaction in the classroom in a structured way in Rwanda.

3.5. Summary

The effectiveness of dialogic classroom interaction in learning is evidenced by social psychology (Vygotsky 1978). Dialogic teaching enables students to reflect on their own thinking and assists them in the process of meaning-making and the internalization of ideas through scaffolding. However, in SSA including Rwanda teaching still tends to be dominated by behaviouristic knowledge transmission models and to be highly ritualized. Teachers and students merely play a scripted role instead of constructing knowledge together. Teachers rarely use effective questioning techniques such as asking reasoning/open questions or feedback techniques such as probing/elaborating. This authoritative approach prohibits students' own ideas from being discovered in the classroom in SSA. Possible reasons for this 'recitation of script' classroom discourse might be due to traditional stratification, adult-child hierarchy and teacher-student hierarchy which have rationalized the authoritative power of the teacher. In addition, the lack of teachers' subject and/or MOI knowledge might support this knowledge transmission pedagogy because this pedagogy protects them from disclosing their vulnerability in these areas. The prevalent use of corporal punishment and verbal abuse in SSA also characterizes the teacher's authoritative stance and this would further militate against active interaction between the teachers and students.

4. Methodology

This chapter explains the methodology of this research project: the aim and rationale, research design, pilot research, samples and data collection methods, data analysis methods, the ethical consideration, and reflection and limitation.

4.1. Overall aim and research questions

Overall aim

To investigate how teachers and students interact in lower secondary physics classrooms in Rwanda

Research questions

(1)What teaching approach is taken and how does it affect students' learning and participation?

(2)How does the classroom environment influence the interaction of the teacher and students?

4.2. Rationale

While there is plenty of literature discussing the prevalence of traditional knowledge transmission teaching in SSA, this study focuses on classroom interaction in secondary schools in a structured way. Despite the numbers of studies, this approach has rarely been used. In Rwanda, studies have revealed the typical classroom organization and teaching style which lacks verbal interaction (Rutaisire 2012;Uworwabayeho 2009; Walker-Keleher 2006); however, there are no available studies of classroom discourse focusing on classroom interaction in secondary schools. In summary, this research investigates secondary school physics teachers' pedagogical approaches and classroom environment by observing teacher-student interactions and dialogue in the classrooms, and by interviewing teachers and students.

4.3. Research design

In this research, I used mixed methods, collecting qualitative and quantitative data throughout classroom observation of physics lessons at lower secondary level, semi-structured interviews with the teachers who taught the observed class, and interview with students who were taught by the teachers. In the observation, I focused on teacher-students verbal interaction and dialogue in classrooms. Both of classroom observation and interviews were audio recorded. Observation was also written down on semi-structured observation sheets in order to record non-verbal aspects. Later it was transcribed and analysed by an I-R-F structure and discourse analysis. This helped to elucidate

classroom discourse, including teachers' questioning techniques and verbal feedback. The interviews were semi-structured but I placed importance on making the interview communicative by asking follow-up questions to probe what the interviewee was trying to say. At the same time I tried to follow my pre-formulated interview protocol as much as possible. I also checked whether my understanding of what the interviewee said was correct by paraphrasing the interviewee's statement. The interview data was coded and analyzed using discourse analysis. Finally, all of the collected data was analyzed together.

4.4. Pilot research

I carried out a pilot study in 2 schools, in one 9YBE school and in one 'school of excellence' boarding school in Kigali. As explained earlier, 9YBE schools are schools which opened lower secondary education (S1-S3) after GoR launched 9YBE programme in 2008. 'Schools of excellence' are science-based boarding secondary schools (S1-S6) located in every district which are furnished with high-quality equipment and human resources. (Kwizera 2011). Those who passed primary leaving national examinations with high results besides having the capacity to pay far more expensive tuition fees than that of 9YBE schools could be enrolled in a 'school of excellence' boarding school. During the pilot research, I faced with some constraints to my original research plan. Therefore, I decided to modify my original research methods and instruments after the pilot research and informal discussion with some secondary school graduates.

My original plan of research with students was to conduct a student focus group discussion (FGD). I chose a FGD with students instead of individual interviews with them because I expected a synergistic effect of FGD and also I thought it might be less intimidating than individual interviews given the fact that I am a complete outsider. As an advantage of FGD, Cohen, Manion and Morrison (2011) mention that it can help to develop the views of participants through interaction within group, by reducing the researcher to a kind of moderator. Langford and McDonagh (2003) also state that participants often speak openly and honestly when they are not alone due to the feeling of security. Therefore I implemented FGD with students at the pilot schools. However through my pilot research, I found it difficult to develop the discussion and to elicit individual student's views by using FGD because the students tended to perform particular identities which were gender-related or knowledge-related within the group as mentioned in Humphrey (2013). I discovered that girls tended to keep quiet with the presence of boys and the students who spoke English fluently tended to dominate the discussion. Power relations among students due to gender and knowledge hierarchy were prominent in the discussion because their expected role in the discussion had already been shaped and agreed tacitly through daily school life. This drawback of

FGD is already mentioned by Langford and McDonagh (2003) saying that one dominant member of the group may hijack the discussion and influence other participants' points of view in FGD. Cohen, Manion, and Morrison (2011) also claim there is a risk of participants' withholding their own ideas and being overly sensitive to other people.

An informal discussion with some secondary school graduates also influenced me to change my method. They informed me that Rwandan students culturally often don't say their honest opinions in front of others. I reflected on the purpose of my research and concluded that it might be better to use individual interviews with students because my research purpose included investigating the classroom environment, which is subjective and dependent on individual student's points of view, rather than collective views of students' groups. Therefore I changed the research method towards students from FGD to individual student interviews.

Through pilot research I also found that using a translator was problematic for eliciting the students' views. At a pilot boarding school, I did not need to use a translator because the students there could speak English well, while at the 9YBE school I needed to in order to communicate with students. There, I asked a teacher of English working at the same school to assist in the translation from Kinyarwanda to English and vice versa during FGD. This prevented me from eliciting the students' own views because the translating teacher sometimes mixed his own view with what the students said. Students also seemed under pressure with one of their teacher's presence. I could see the power relations between the translating teacher and students in the speaking tone of the teacher and the students' way of speaking, not seeing my eyes when answering the questions during the discussion. Therefore, I decided that if I needed to use a translator, I should choose one of the students who spoke English well from the same school as the interviewee to reduce power relations derived from age and status hierarchy and make him or her understand not to put his or her own view in the translation before the interview.

Regarding the instruments for the interviews I changed some of the pre-determined questions to make them more open and easy to respond to after the pilot research reflected the reaction of the pilot participants. I also decided to add some spontaneous questions to pre-determined questions because during the pilot research, responses I did not anticipate came out from the participants. I realized that probing deeply into what participants want to say, even though the interview went outside the track I had planned, was important in order to investigate the participants' real views. Kvale and Brinkmann (2009) state that this might make the process of interview analysis complicated but the possibility of being able to obtain participant-initiated, unexpected answers would be beneficial.

4.5. Samples and data collection methods

The sample comprised of 4 schools, one ‘school of excellence’ boarding school and one 9YBE school in urban areas in Kigali, and one ‘school of excellence’ boarding school and one 9YBE school in rural areas in Eastern province. These schools were selected based on recommendation by the Rwanda Education Board (REB) and by the head teacher of the school which I worked for before.

At the urban boarding school and the rural 9YBE school, there were 2 teachers of physics who were teaching lower secondary level, while there was only one teacher at the urban 9YBE school and rural boarding school. Therefore, I decided to have these 6 teachers as samples of my research, observing their lessons and having semi-structured interviews with them after the lessons. Both the observations and interviews were audio recorded, and observations were also written down on semi-structured observation sheets in order to record non-verbal aspects. I did not announce to the teachers when and whose lesson I was planning to observe, when I first visited each school to inform them about my research, in order to avoid the effect of preparation of special lessons for me.

Sampled students were selected from each class taught by the sampled teachers after classroom observation. The number of sampled students from each class was not fixed but I basically chose at least one active student and one passive student from each school. I also included some students who were punished by the teachers in my samples in case I found evidence of the exercise of punishment. The sampled students were interviewed individually by me after the class. In 9YBE schools, a translating student also sat together during the interview. The interviews were audio-recorded.

The following Table 3 shows the number of the participants involved in my research and observed classes. From now on, the pseudonyms for teachers shown in Table 3 are used to describe them.

Table 3 Number of samples (schools, teachers, and students)

	Urban boarding school		Urban 9YBE school	Rural boarding school	Rural 9YBE school		Total
Number of sampled teachers	2		1	1	2		6
Sampled teachers' pseudonyms	Teacher A (Male)	Teacher B (Male)	Teacher C (Male)	Teacher D (Male)	Teacher E (Male)	Teacher F (Male)	6
Classroom observed	S2 (single period)	S3 (single period)	S1 (double period)	S2 (single period)	S2 (double periods)	S3 (double periods)	6
Number of sampled students	4	2	5	2	2	2	17
Sampled students	-1 active girl -1 non-active boy -1 punished girl -1 punished boy	-1 active girl -1 non-active boy	-2 active girls -1 active boy -1 non-active girl -1 punished boy	-1 active girl -1 non-active girl	-1 active girl -1 non-active boy	-2 active boys	17

Context of sampled schools

The context of the sampled schools was completely different depending on the school type (boarding/9YBE) and the location (urban/rural) as seen in Table 4. Boarding schools had better school facility and classroom conditions than 9 YBE schools, and urban schools had teachers with higher qualifications than rural schools.

First of all, there was a huge gap in the amount of school fees between boarding schools and 9YBE schools. The annual school tuition fees for S1 in boarding schools were as much as 6-7 times greater than at 9YBE schools. This difference was reflected in school facilities. While boarding schools had science laboratories, 9YBE schools did not have them. At both of the 9YBE schools, the walls between classrooms were very thin and the sounds of neighboring classrooms could be heard very easily. Moreover, since 9YBE schools had primary school classrooms in the compound with different time schedules, the noise from outside forced teachers to shout in the classroom in order to

make themselves heard. Moreover, the number of students in one class at 9YBE schools was also much bigger than boarding schools.

The rural 9YBE school was further disadvantaged in terms of school infrastructure and the qualifications of the teachers compared to the other 3 schools. The school did not have electricity, and the size of chalk board in each classroom was relatively small often with a lot of damage on the surface. Teachers' average qualifications at the rural 9YBE school were relatively low with only 27.3% of them qualified among whom no one had a degree in education, all of them holding a diploma in education. This disadvantage is quite significant when compared to the urban boarding school which has 100% qualified teachers with 95.7% having a degree in education.

Table 4 Sampled school context

School / Context		Urban boarding school	Urban 9YBE school	Rural boarding school	Rural 9YBE school
Annual school fees for S1		**196,300 RWF**	**26,200 RWF**	**177,700 RWF**	**27,500 RWF**
School facility and infrastructure	**Library**	**Yes**	**Yes**	**Yes**	**Yes**
	Science laboratory	**Yes**	**No**	**Yes**	**No**
	Electricity	**Yes**	**Yes**	**Yes**	**No**
Teachers' qualification and experiences in lower secondary section	**% of qualified teachers[1]**	**100%**	**100%**	**70.6%**	**27.3%**
	% of Education degree holders	**95.7%**	**80.0%**	**41.2%**	**0%**
	% of teachers with less than 5 years of experience	**50.0%**	**80.0%**	**81.3%**	**72.7%**
Average number of students in a class in lower secondary section		**44.6**	**51.8**	**43.3**	**59.5**

[1] Teachers who have either diploma or degree in education

Context of sampled teachers

All of the 6 physics teachers involved in my research were male. This is not very surprising when the fact that 71.5% of the teaching staff at secondary level were male in Rwanda in 2013 is considered (MINEDUC 2014). While teachers A and B in the urban boarding school and C in the urban 9YBE schools were qualified with an education degree, teacher D in the rural boarding school was qualified but with a diploma, and teacher E and F in the rural 9YBE school were unqualified, as seen in Table 5.

Table 5 Sampled teachers' qualifications and experience

Name of school	**Urban boarding school**		**Urban 9YBE school**	**Rural boarding school**	**Rural 9YBE school**	
Sampled teachers	Teacher A	Teacher B	Teacher C	Teacher D	Teacher E	Teacher F
Gender	Male	Male	Male	Male	Male	Male
Qualification	Qualified (Education degree)	Qualified (Education degree)	Qualified (Education degree)	Qualified (Education diploma)	Unqualified (Non-education degree)	Unqualified (Education certificate)
Years of experience	5-6	5-6	4-5	3-4	0-1	3-4
MOI of school hood	Francophone	Francophone	Francophone	Anglophone	Francophone	Anglophone

Context of sampled students

Despite the fact that I basically chose students based on their activeness (both active and non-active), all of the students in the boarding schools, both in the urban and rural settings stated they were educated in private primary schools, while all of the students in 9YBE stated they were educated in public primary schools. This implies the difference of financial background between the students who study in 9YBE schools and those in boarding schools. This difference in students' primary school background was reflected to students' proficiency of English, causing me to use a translator in 9YBE schools in order to communicate with students, while I did not need to in boarding schools.

The next section explains how I analyzed the data collected through classroom observation and interviews.

4.6. Data analysis method

All observations and interviews were audio recorded, and later transcribed and coded thematically.

Classroom observation

The verbal interactions in the classes were analyzed basically using Sinclair and Coulthard's I-R-F pattern (1975). I at first classified every single utterance by the teacher and students into initiation, response or follow-up moves and then classified the utterances in each move into different categories which I determined. To develop the categories, I used a mixture of deductive and inductive methods. First of all, I classified observed verbal interactions using the categories developed by Hardman, Ad-Kadir, and Smith (2008); ultimately, I developed the categories which best fit Rwandan secondary school classroom contexts. As a limitation to this method, the verbal interaction during peer exercises (which was observed in 2 lessons) could not be analyzed because the recorder could not catch the sound of the interactions clearly during that time. Therefore verbal interaction was only analyzed during whole-class teaching periods.

Interviews with teachers and students

The transcribed data was coded mostly by deductive methods based on the semi-structured questions of the interviews; however some new categories were developed after examining and comparing the data. When analyzing each category, I tried to look for general themes which were common to most of the interviewees but at the same time, I tried not to miss minority views which could be supported by classroom observation.

Triangulation

I decided to triangulate the data collected by classroom observation, interviews with teachers, and interviews with students for analysis because the use of only one research method risks misinterpretation. Taking an example of an interview, what people say is sometimes different from what they do either consciously or unconsciously (Altrichter, Feldman, Posch, and Somekh 2008). Using only observation is also risky because the processes of transcribing the data and coding and analyzing it are subjective and also one-off observations are not sufficient for generalizations to be made about classroom discourse. Triangulation helped me to identify contradictions and discrepancies among the data collected using different methods. It provided a balanced picture of the situation and the interpretation became more reliable (Kvale and Brinkmann 2009).

4.7. Ethical consideration

All of the participants, both teachers and students, in this research were informed about the research by information sheets and verbal explanation before conducting the research. They were also given time to think whether they would like to participate in the research or not, and also time to ask questions about the research. The opportunity to withdraw from the research just in case they changed their mind after the observation or interview was also given.

For students, since all of them were under 18 years old, I received informed consent from both the head teacher of the school and individual students. Since interviewee students in 9YBE schools were not fluent in English, I asked the translator students to sit with us and assist with the explanation and questioning-and-answering about my research.

4.8. Reflection and Limitations

Reflexivity

It is impossible to eliminate the effect of the researcher during research because they become a part of the researched people's social world. As such, researchers' identities definitely bias the data collected by the researcher (Cohen, Manion and Morrison 2011). 3 teachers (teacher B, D, and E) mentioned that my identity in the classroom influenced the behaviour of the students. They stated that students were more '*motivated*' than usual asking many questions, and more '*disciplined*' without going in and out the classroom every time. Moreover some students were standing outside the classroom just to see me. Furthermore many students in the class also often looked back at me during the class.

Method of analysis

Lesson observation strongly depended on the audio recorder when I analyzed the observed data using I-R-F analysis. Since the recorder was left near the teacher on the first row of student seating in the classroom, it might have failed to catch the voice of the students sitting behind.

Reporting the interview data was also selective and biased probably influenced by the researchers' prior-knowledge about the context (Cohen, Manion and Morrison 2011).

Time period of observed lesson

The time period of the classroom observations might have affected the level of students' participation. The time period I observed in teacher D' lesson in the rural boarding school was immediately after lunch; this might have caused lower participation of students as I found many of

them sleeping in the class. On the contrary, students might have lost concentration due to hunger in teacher C's class in the urban 9YBE school because the class I observed there was the last period and students at the school did not have a lunch break, which meant they had not eaten since the early morning.

5. Research findings and analysis

This chapter answers the 2 research questions given in section 4.1. Section 5.1 answers the first research question (Q.1 What teaching approach is taken and how does it affect students' learning and participation?). Section 5.2 answers the second research question (Q.2 How does the classroom environment influence the interaction of the teacher and students?).

5.1. Teaching approach taken and its effect on students' learning and participation

This section first explains how the teachers structured lessons. Then it analyzes verbal interactions focusing on how teachers elicit students' responses, who responds to the teachers' initiations, and how the teachers give feedback to those responses. Finally the influence of MOI on learning is discussed.

5.1.1. Lesson structure

All of the six classes observed started with revision. This revision was based on questioning-and-answering, with the teacher asking closed questions such as definitions of terms or factual knowledge recall. In answering, students often referred to the page of notebook in the previous lessons. Then the teacher's explanation of new concept with initiation by the teacher and response by students was followed. Apart from teacher B who finished the lesson here, the rest of the 5 teachers then moved on to written exercises sessions. In these sessions, 3 teachers (teachers A, D, F) did all of their exercises together with students, sometimes calling a student to work on the board, but no lesson time was provided to work individually or in groups. Therefore, in these 3 lessons, peer interaction was not observed at all. The other 2 teachers (teachers C and E) provided time to do exercises with peer students which was called 'group work' by the 2 teachers. Observation of the 'group work' revealed that the teachers merely gave numerical problems to students, allowing them to solve the problems with their colleagues sitting next to them, in front, or behind. However, they were not allowed to move their desks or speak loudly to discuss the problems. When class was getting noisy due to discussion, the teachers always said 'Shiiii' to make the class quiet. No materials to develop talking were provided. In this sense, 'group work' simply referred to allowing the students to talk to each other rather than produce a joint result or piece of work. While students were doing the exercises, the teachers walked around the class and waited for students to say '*Finished!*' in order to mark their work. They assisted only the students who had finished the exercise by marking and giving some explanations, yet no assistance was observed for those who were not doing exercises or those who looked like struggling. Moreover, those who finished exercises were not given extra work thus they did not have anything to do further. After the exercises session, they were

corrected and if the correction could not be finished, the exercises were given as homework.

To some extent the timetable slot, whether single or double periods might have influenced the lesson structure, as 2 (teachers C and E) of 3 teachers (teachers C, E and F) who had double period lesson introduced peer exercises, while the other 3 teachers who had single period used only whole-class teaching method. The following Table 6 shows actual time for whole-class teaching in each class. In general, teachers came a bit late to the class because there was no break between each period apart from a small morning break and lunch break. Therefore, on average 15% of teaching periods was missed due to teacher lateness.

Table 6 Actual time for whole class teaching and group work

Name of school	**Urban Boarding school**		**Urban 9YBE school**	**Rural boarding school**	**Rural 9YBE school**	
Classroom observed	S2	S3	S1	S2	S1	S3
Teacher	Teacher A	Teacher B	Teacher C	Teacher D	Teacher E	Teacher F
Observed period	Single	Single	Double	Single	Double	Double
Official lesson time (minutes)	50	50	100	50	100	100
Actual lesson time for whole class teaching (minutes)	38	48	58	43	47	106
Actual lesson time for peer exercise (minutes)	0	0	9	0	33	0
Actual lesson time in total (minutes)	38	48	67	43	80	106

No teachers distributed textbooks to students during the lesson although all schools had libraries with plenty of books by appearance and the student physics text book ratio for lower secondary level is 2:1 according to MINEDUC (2014). When the teachers were writing notes or questions of

exercises on the board, they tended to show their back to students without looking back at them and writing quietly. In teacher F's class in the rural 9YBE school, the teacher did not speak anything for a continuous 19 minutes during the writing of the first notes and for 21minutes during the writing of the second notes, which was in total 40% of the class. During that time, students were passing pens, whispering to each other, and going out and coming back to the class without it being realized by the teacher.

The next section analyzes classroom verbal interaction between the teacher and students and investigates to what extent the verbal exchanges contribute to the learning of students.

5.1.2. I-R-F analysis

The verbal interaction between teachers and students was analyzed by classifying the verbal exchanges into initiation, response, follow-up moves and then categorizing each utterance in each move into smaller categories. Then the number of utterances in each category in each observation was counted. Finally the total number of utterances in each category was converted from actual time of whole-class teaching to 50 minute units, in order to aggregate the data of all the observed lessons and obtain the mean, since the observed lessons contained both single and double period lessons. When calculating actual time for whole-class teaching, I deducted the time for peer exercises (which was observed in teacher C and E's lessons) (see Table 6) from actual lesson time because the verbal interaction during that time was not caught on the recorder clearly, thus analysis was not possible.

In first section 5.1.2.1, the utterances in initiation moves are analyzed, then the utterances in response moves are analyzed in 5.1.2.2, and finally the utterances in follow-up moves are analyzed in section 5.1.2.3.

5.1.2.1. Initiation moves

I analyzed the initiation moves which required verbal response or physical action[2] (e.g. working at the chalk board or reading sentences aloud). That is to say, I focused on initiation moves which were mostly elicitations and directive but not on informative ones. I also eliminated some elicitations or directives which were not related to the learning of students (e.g. Teacher: '*Can you rub the board?*' Student: '*Yes*'). I also eliminated students' 'bidding', calling the teacher to get their attention in order to answer the question set by the teacher, and the teacher's 'nomination' which gives permission to students to speak (e.g. Students '*Teacher me!*' Teacher: '*Yes?*').The study found that across all observed lessons as much as 97.1 % of utterances in initiation moves which required response were

[2] Physical gestures such as nodding or moving eyebrows and also showing agreement are omitted since it was too hard to record.

made by the teacher, while only 2.9 % were made by students.

Initiation moves by the teachers

The initiations by the teachers were categorized into authentic questions (closed/open/repeating or rephrasing question), checking understanding, cued elicitation, and teacher direction. The following table, Table 7, indicates the mean number and percentages of initiations in each category gained by aggregating the number of initiations of observed 6 lessons which were converted to 50 minute units.

Table 7 Mean and percentage of initiation moves by the teacher

Types			Code	Mean Number	%	%	%
Authentic question	Closed	Yes・No/ Multiple choice	IT1	6.1	4.4%	36.5%	48.4%
		A single word/number/phrase	IT2	32.2	23.3%		
		Sentence/ solving numerical problems	IT3	12.1	8.8%		
	Open	Opinion/ Reasoning	IT4	2.4	1.8%	1.8%	
	Rephrasing/repeating questions		IT5	13.9	10.0%	10.0%	
Checking understanding			IT6	50.5	36.6%	36.6%	36.6%
Cued elicitation			IT7	17.8	12.9%	12.9%	12.9%
Teacher direction			IT8	3.0	2.2%	2.2%	2.2%
Total initiation by the teacher				138.0	100.0%	100.0%	100.0%[3]

The findings displayed in Table 7 show that among initiation moves by the teachers, the most frequent method of elicitation was ‘Asking authentic questions’, at 48.4 %. Here, only teachers’ elicitations that cannot be answered automatically without recalling or thinking are classified as authentic questions. Among these questions, as much as 95.4% were closed questions which only required single fixed answers. Furthermore, 63.9% of the closed questions were asking for single word, number or phrase response. Open questions, which demand more than a single fixed answer,

[3] The sum of percentage in each category does not become 100% because of rounding up.

were extremely rare, at only 1.8%, and observed only in teacher A and B's classes in the urban boarding school. The reliance on closed short-answer questions in teachers' initiations is also reported in other research (Hardman, Abd-Kadir and Smith 2008; Pontefract and Hardman 2005)

'Checking understanding' (e.g. 'Are we together?', 'Do you understand?', 'OK?') was the second most frequent method in initiation moves with 36.6% followed by cued elicitation, 12.9%.'Checking understanding' is often used not for genuine check of students' understanding but rather as a ritual because even when there is no response from students, the teacher oftencontinues the lessons. This 'checking' is often considered pseudo-checking which often only expects an affirmative response (Hardman, Abd-Kadir,Smith 2008; Walker-Keleher 2006). Most of the time students either answered to these initiations by saying '*Yes!*' chorally or kept quiet which implied they did not understand well. However, I also observed students saying '*No!*' to these checking questions in 5 lessons, all but teacher E's class, on the contrary to classroom observation in Kenya (Pontefract and Hardman 2005) and in South Africa (Chick 1996) which stated that these checking questions only ever elicited an affirmative response. Moreover, 2 teachers (teacher D and F) responded to the 'No' and explained again; however, 3 teachers (teacher A, B and C) ignored them.

'Cued elicitation' was frequently observed especially in 9YBE schools[4]. In cued elicitation, students were required to repeat directly what the teacher said or complete the phrase or word, very often omitting the final word as reported in Hardman, Abd-Kadir, and Smith (2008) and Pontefract and Hardman (2005). Students seemed to know whether they were required to complete the phrase chorally from the teacher's intonation, with a rising tone on accented syllables (Chick 1996;Hardman, Abd-Kadir, and Smith 2008). Teachers tended to increase cued elicitation when students' choral responses became smaller or participation of students became lower. Chick (1996) speculates that the reason for a teacher's frequent use of cued elicitation is because it gives rhythm in verbal exchange between the teacher and students, therefore producing the perception that meaningful learning is taking place in the class. However, cued elicitation does not require students to think or recall because the students can speculate on the required response from the teacher's initiation. Therefore, Chick (1996) claims that cued elicitation has a social rather than academic purpose. The following table, Table 8, is an extract from teacher E's class in the rural 9YBE school which highlights the frequent use of cued elicitation.

[4] Cued elicitation was observed 3.7% in the class of teacher A, 3.6% in the class of teacher B, and 7.4% in the class of teacher D, while 14.6% in the class of teacher C, 24.2% the class of teacher E, and 17.5% in the class of teacher F.

Table 8 Transcript of verbal interaction (Frequent use of cued elicitation)

	Verbal interaction	Move[5]	Code[6]
Teacher E	If I jump, I can return back. Always they come down to the earth, they can't go up, because of what? Because of gravitational (↗)?	I	IT7
Students(choral)	Force.	R	RS1
Teacher E	(no follow-up)	F	FT1
Teacher E	It is the force pulling it down to the earth called gravitational (↗)?	I	IT7
Students(choral)	Force.	R	RS1
Teacher E	(no follow-up)	F	FT1
Teacher E	The force which pulling the chalk down, called what? Gravitational (↗)?	I	IT7
Students(choral)	Force.	R	RS1
Teacher E	(no follow-up)	F	FT1
Teacher E	OK?	I	IT6
Students(choral)	Yes.	R	RS2
Teacher E	(no follow-up)	F	FT1

'Teacher direction', is when a teacher instructs the whole class or individual students to do something which requires some action such as writing the answer on the board or reading a question aloud. However, it was rare, at 2.2%, although it was observed at least once in all 6 observed lessons.

Initiation moves by the students

The initiations by the student were categorized into 'asking for clarification of teacher's explanation', 'asking student's point of view', or 'repetition of student's initiated question'[7] (Table 9).

[5] In 'Move', 'I' stands for initiation, 'R' stands for response, and 'F' stands for follow-up moves.
[6] Codes for initiation moves by the teacher are shown in Table 7, and by the students are in table 9. Codes for response moves to teacher's initiation are in Table 10, and to students' initiation are in Table 11. Codes for follow-up moves are in Table 12.
[7] Students repeated their questions because they were not heard by the teacher clearly or because they were ignored by the teacher

Table 9 Mean and percentage of initiation moves by the students

Types	Code	Mean Number	%
Asking for clarification of explanation	IS1	2.4	57.4%
Asking student's point of view/ Correcting teachers' mistake	IS2	0.7	17.0%
Repetition of students' initiated question	IS3	1.1	25.6%
Total initiation by students		4.1[8]	100%

The findings displayed in Table 9 show that student initiation was extremely rare and most instances involved asking for clarification of what the teacher had explained, such as asking the meaning of a word, or asking for repetition of the explanation. Asking a student's point of view was seen only 4 times in 3 lessons (Teachers B, D and F). 3 of them were questions relating school science knowledge to their daily lives (1 male in teacher B's class: *'Why we do need light?'*/1 female in teacher B's class: *'Are clothes transparent body?'*/1 male in teacher F's class: *'How does cash power work?'*), and 1 of them was about correcting a teacher's mistake (choral initiation in teacher D's class). Interviews with teachers support this observation. Teachers mentioned clarification of explanations (spellings or meanings of words), questions about daily life, nature, and teaching aids as questions often asked by students.

5.1.2.2. Response moves

The study counted the number of responses to initiation moves both by the teacher and by students.

Responses to teachers' initiations

Responses to teachers' initiations were categorized according to whether there was a response, who responded to a teacher's initiation, and whether the initiation was responded chorally or individually.

[8] Total initiation by students does not match the sum of mean number in each category because of rounding up.

Table 10 Mean and percentage of response moves to teachers' initiation

	Types		Code	Mean Number	%	%
Student	**Choral**	**Class choral**	RS1	20.9	12.7%	53.1%
		Class few choral (Less than a quarter of the class)	RS2	66.3	40.3%	
		Demonstration in unison	RS3	0.2	0.1%	
	Individual	**A girl**	RS4	21.2	12.9%	21.3%
		A boy	RS5	10.9	6.6%	
		Demonstration	RS6	3.1	1.9%	
	No response		RS7	25.0	15.2%	15.2%
Teacher			RT1	6.5	3.9%	3.9%
Students and teacher in unison			RST1	10.6	6.4%	6.4 %
Total response				164.5[9]	100.0%	100.0%[10]

The findings displayed in Table 10 show that more than half of the responses to the teacher's initiation by students were choral, and most of these choral responses were responded to by few students. Regarding individual responses, on average, girls were twice as likely to be asked to answer questions by the teacher than boys. In teacher B's class, girls were about 4 times more likely to answer the teacher's questions. Only in teacher C's class did boys answer more than girls. This result is opposite to the finding in Nigerian primary schools in Hardman, Abd-Kadir and Smith (2008) which stated that boys were twice as likely to be asked to answer questions. This is partly due to the fact that the enrolled number of girls was more than boys in observed schools, which was not due to the uniqueness of the observed schools but because in general in Rwanda the ratio of enrolled number of girls to boys in lower secondary schools in 2013 was 1.16 to 1 (MINEDUC 2014).

In general, teachers did not tend to give time for students to prepare the answer, which was also reported in Botswana (Prophet and Rowell 1993). When teachers asked an individual question, whoever raised their hand promptly tended to be picked up by them. Even when there were very few students raising their hands, teachers tended not to add further explanation and simply picked one of them. Moreover, when students were answering a question, teachers sometimes hastened them

[9] Total response does not match the sum of mean number in each category because of rounding up.
[10] The sum of percentage in each category does not become 100% because of rounding up.

saying '*Quickly*' or cut in on the answer while they were still speaking. This also happened when a student was writing an answer on the board. When students working on the board were doing so wrongly, teachers sometimes interrupted their writing although they had not finished writing their answers yet and then controlled their answers. Teacher E in the rural 9YBE school explained the reason for this interruption as in order to manage time and he described the student who was doing the wrong answer on the board as '*wasting time*'. The discovery of students' own ideas or why and where they were going wrong was not attempted by the teachers.

'Demonstration' was observed either of students' writing the answer on the chalkboard or reading the question of an exercise aloud. It was observed in all observed classes at least once. However, the process of demonstration was disregarded. For example, in teacher E's class, the teacher asked students who were solving the exercises on the board to say the process aloud while writing. The students did as they were told but the teacher and other students did not pay attention to them at all because the teacher was busy marking other students' work and other students were busy calling the teachers to have their work marked.

'No response' was mostly seen to the initiations of 'checking understanding', yet when questions by teachers were not clear, there was also no response. In case a teacher asked a question and reinitiated the question without a pause to elicit students' response, I did not regard that case as 'No response'. I regarded as there was 'no response' only when a teacher's initiation is not responded more than 3 seconds or a teacher changed his initiation without being responded.

Overall, teachers responded 10% of their own initiations, often together with students.

Responses to student's initiation by teachers

Responses to student initiation by teachers were categorized according to whether the teachers attempted to answer student's question or not (Table.11).

Table 11 Mean and percentage of response moves to students' initiation

	Types	Code	Mean number	%
Teacher	**Answer student's question**	RT2	2.5	60.1%
	Ignore student's question	RT3	1.1	27.3%
	Ask clarification of the question	RT4	0.5	12.7%
Total response			4.1	100.0%[11]

[11] The sum of percentage in each category does not become 100% because of rounding up.

The findings displayed in Table 11 show that some of the students' initiated questions were completely ignored by the teachers (teachers A, C, D, and E). This is supported by the students' comment that '*There are some students who ask questions; he (the teacher) doesn't answer but others answer*' (by a non-active girl in teacher C's class) or '*Teacher has told me it (the question the student asked) is not my level*' (by an active student in teacher C's class).

5.1.2.3. Follow-up moves

Only teachers' utterances to students' responses were coded as follow-up moves, which means that in case there was no response to teachers' initiations and therefore no follow-up, I didn't regard that case as 'no follow-up'. In the same way, in case the teachers answered their own question, I did not consider it as 'no follow-up'. The follow-up moves by the teacher were categorized according to whether there was feedback to the responses, if not, whether the teacher asked another student to answer or started to explain himself. If there was feedback, feedback was categorized as whether the response was affirmed, praised, probed, commented on, repeated, asked to be repeated, or discussed (Table 12). In case the teacher gave more than one type of follow-up to students' responses all feedback was counted, although this was not very often.

Table 12 Mean and percentage of follow-up moves to students' response

Types			Code	Mean number	%
No feedback to the response	**Implicitly accept response**		FT1	37.9	29.9%
	Doesn't accept response	**Ask others**	FT2	1.8	1.4%
		Start explaining correct answer	FT3	2.2	1.7%
Affirm (Accept/ reject) the response			FT4	5.0	4.0%
Praise/Appreciation			FT5	3.5	2.7%
Probe/ Ask clarification			FT6	4.5	3.6%
Comment			FT7	10.9	8.6%
Repeat			FT8	35.8	28.3%
Ask for repetition of the response			FT9	22.2	17.5%
Discuss responses			FT10	3.0	2.4%
Total follow-up by the teacher				126.8	100.0%[12]

[12] The sum of percentage in each category does not become 100% because of rounding up.

The findings displayed in Table 12 show that about a third of the responses by students either individually or chorally were not followed up by the teachers. Most of the responses which were not followed up by the teacher were when the response was to the initiation of 'checking understanding', 'Yes･No question', or 'Cued elicitation', in which case the response was implicitly accepted by the teacher (e.g. Table 8). However, teachers also sometimes did not give any feedback to wrong answers or unexpected answers given by students and started to explain 'correct answers' by themselves or asked the same question to other students. This neglect of the students' answer was observed in all six lessons. Fuller and Snyder (1991) and Prophet and Rowell (1993) also reported the same issue – teachers' acknowledgement of only certain correct answers in Botswana. Prophet and Rowell (1993) explained the reason as being in order to reinforce teachers' position of power and keep their authority and to control students' knowledge.

In observed lessons, two teachers (teacher E and F) also explicitly rejected students' responses by saying '*It's wrong*', '*It's not true*', without explaining the reason why it was not acknowledged by them. This also happened when a student was working at the board solving a question and failed to get a 'correct' answer. For example, in teacher F's lesson, a boy was asked to solve a numerical problem on the board and he made a mistake. The teacher just said '*It is not correct*' and asked another student to delete the first student's answer and solve it on the board on his behalf. The second boy also did exactly the same mistake perhaps because the teacher did not give feedback to the first student. Then another boy was called to work at the board after deleting the second boy's answer. The teacher's justification for deleting wrong answers immediately was '*in order to avoid copying from what has been done because it is wrong*'. A girl in teacher E's class in the rural 9YBE school also deleted an incorrect answer written by another student on the board before starting to write her own answer. A girl in teacher A's class in the urban boarding school also tried to delete wrong work done by another girl on the board although it was stopped by the teacher. These observations imply that students were generally supposed to delete the answer written by other students if it was wrong before working on the board themselves. This clearly alludes to the classroom discourse that the process of how students construct knowledge is not given importance but paramount importance is attached to being able to produce the 'correct' answer in the 'correct' way. This can be evidenced by the interview with teacher D who did not give any feedback to a boy who got a wrong answer due to the wrong approach, and started to explain the 'correct' answer by himself (Table.13).

Table 13 Transcript of an interview (A teacher's view about feedback to wrong answers)

	Interview transcript
Researcher	'*Do you remember in the exercise one boy sitting behind wrote the answer on the board and did mistake? Why you didn't give feedback to this boy*?'
Teacher D	'*So it's just because I have seen that he has failed that's why I have done that one directly.'*
Researcher	'*Do you think he understood the reason why his answer was wrong?'*
Teacher D	'*OK. Yes. Because for me I have explained. So it means for him was just write. But for me I have explained how to do that one depends on what formula.*'
Researcher	'*Do you think he understood*?'
Teacher D	'*Yes, I hope he can try.*'

The conversation with teacher D clearly indicates the teacher's strong belief in a behaviouristic approach. The discovery of the process of how the student got to the wrong answer through talking was not regarded as important in learning by the teacher but showing the 'correct' answer so that students can memorize the way is placed with higher value. Wrong or unexpected answers often help teachers to know students' misconceptions or misunderstandings if they are carefully probed through feedback. By being probed and then by being given a cognitive conflict situation which opposes their initial understanding process, students would be able to internalize the ideas, and as a result their cognitive skills would develop (Alexander 2006).

'Probing or asking for clarification' of what the students said was rare, amounting to only 3.6% of all of the follow-up, although it was observed at least once in all observed lessons. However there was a huge difference in the number of probing in follow-up moves in each teacher's class. While teacher B in the urban boarding school gave 12.5 probing feedback in a lesson converted to 50 minutes, only 0.5 feedback was given in teacher F's class (Average of 6 teachers: 4.5). The following table, Table 14, shows the active verbal interaction between teacher B and students, where the teacher succeeded in learning a student's misconception due to his probing feedback technique.

Table 14 Transcript of verbal interaction (Use of probing as feedback)

Turn		Verbal interaction	Move	Code
1	Teacher B	Who can give us examples, the example of luminous body?	I	IT2
2	A female student	Papers	R	RS4
3	Teacher B	Can you get light of papers?	F	FT10
4	Students (Choral)	Yes/No	R	RS2
5	Teacher B	How?	F	FT6
6	A male student	By burning them	R	RS5
7	Teacher B	But in that case you are taking them. We are saying bodies which are able to produce by their own light.	F	FT7
8	Teacher B	Nhh? Another one?	I	IT2
9	Students (Choral)	Candles	R	RS2
10	Teacher B	Candles? Nhh.	F	FT8
11	Teacher B	Candle are luminous object but we are talking about luminous bodies which are able to produce naturally the light like sun like stars and you can find another ones, like torch and like candles those ones are able to produce light but they cannot.. they are not natural.	F	FT7
12	Teacher B	Is it clear?	I	IT6
13	Students (Choral)	Yes / No (very few)	R	RS2
14	Teacher B	Now, there are some properties of light. (Moved to a different topic)		(informative)[13]

The teacher at first shared a girl's response with other students and attempted to understand how other students viewed the idea (Turns 2→3→4). He succeeded to understand not only how the responded student but also how some of others had got to the same views. Then the teacher asked the reason why they supported the idea (Turns 5→6). The teacher succeeded to understand students' misconceptions that things which were combustible can be categorized as luminous bodies and tried

[13] As mentioned in section 5.1.2.1, the initiation which is informative was not coded in my analysis since it does not require verbal response.

to comment in a way which made sense to students in order to correct their misconception. The explanation might not have been enough, yet the teacher took students' views into account while teaching. This verbal interaction was a good example of an interactive dialogic approach. However the teacher did not ask further questions to make sure whether students really understood what luminous bodies were and instead did pseudo-checking, and ignored students' voices who said '*No, (It is not clear)*' to the teacher (Turns 13→14).

While other teachers apart from teacher B also used probing as a follow-up technique, none of them succeeded in both of eliciting students' own points of view and giving appropriate and reasonable feedback. During the interview, teacher B told me that he had won many prizes from the government of Kigali city because his students have passed national examination highly in the last 5 years.

'Praise and appreciation' such as 'Good', 'Clap for him/her', 'Thanks', 'You tried' were also very rare at 2.7%, and only observed in the class of teacher A (14.5 times) and B (5.2 times) in urban boarding schools and teacher E (1.1 times) in the rural 9YBE school. Some praise was used in inappropriate ways such as giving praise to students who just repeated the response by somebody else chorally, as will be seen in Table 16.

'Repetition' was very frequently used as a follow-up technique with 28.3% of all follow-up moves. Teachers used this technique not only for correct answers but sometimes also for wrong answers as sole feedback. This might have confused students in figuring out whether the response was correct or not as shown in Table 15.

Table 15 Transcript of verbal interaction (Use of repetition as feedback for both correct and incorrect answers)

Turn		Verbal interaction	Moves	Code
1	Teacher B	Can you find the some of the examples of converging beam of light?	I	IT2
2	Students (Choral)	Sun	R	RS2
3	Teacher B	Sun, OK good.	F	FT8/FT5
4	Teacher B	Sun rays and electric torches		(informative) [14]
5	Teacher B	Other ones there for converging beam of light?	I	IT2
6	A female student	Mirror	R	RS4
7	Teacher B	A mirror, anh?	F	FT8
8	Teacher B	Ahh… there is what you call a converging lens. (Moved to a different topic)		(Informative)

In table 15, it is clear that the student's answer '*Sun*' was accepted by the teacher because he gave feedback of not only repetition but also praise (Turns 2→3). However it might not have been clear for students whether the answer '*Mirror*' was accepted by the teacher or not because the teacher just repeated the response by the student (Turns 6→7) and moved immediately to another topic (Turn 8).

'Asking for repetition of the response' is another type of follow-up which was frequently observed. This follow-up was sometimes given because the students' voice was too small and could not be heard by the teacher, but in most of the cases it was given in order to have more students involved in choral utterances in the class. The interaction pattern, that the teacher first asks an individual or choral question and if the response from the student(s) is correct then encourages the whole class to repeat the response, was observed in all 6 lessons. The following table 16 is an extract from teacher A's class in an urban boarding school.

[14] As mentioned in section 5.1.2.1, the initiation which is informative was not coded in my analysis since it does not require verbal response.

Table 16 Transcript of verbal interaction (Asking for repetition of an answer to encourage whole class to be involved as feedback)

	Verbal interaction	Move	Code
Teacher A	What is the formula of mechanical advantage?	I	IT3
Teacher A	Yes (↗)?		(nomination)[15]
A female student	Mechanical Advantage is equal to load over effort.	R	RS4
Teacher A	Mechanical advantage is equal to (↗)?	F	FT9
Students(Choral)	Load over effort	R	RS1
Teacher A	Load over (↗)?	F	FT9
Students(Choral)	Effort	R	RS1
Teacher A	Very good.	F	FT5

The above interaction pattern shown in Table 16 was highly ritualized and was often continued until the teacher was satisfied with the amount of choral voices from the students.

'Discussing responses', where the whole class is asked whether a response was correct, was seen in 5 lessons, all but teacher D's class. However, in most of the cases, the teachers did not ask students to elaborate on why they agreed or disagreed with the response, like the example in Table17. The use of discussion for active verbal interaction like in Table 14 was rare.

[15] As mentioned in section 5.1.2.1, 'nomination' was not coded in my analysis

Table 17 Transcript of verbal interaction (Use of discussion as feedback but not elaborated)

	Verbal interaction	Move	Code
Teacher C	Who can give me an example of contact force?	I	IT2
A male student	Me teacher!		(bidding)[16]
Teacher C	Yes, You?		(nomination)[17]
A male student	Magnetic force	R	RS5
Teacher C	Magnetic force	F	FT8
Teacher C	Magnetic force is contact force (↗)?	F	FT10
Students(Choral)	No	R	RT2
Teacher C	(No follow-up)	F	FT1
A female student	Me teacher!		(bidding)
Teacher C	Yes?		(nomination)
A female student	Spring force	R	RS4
Teacher C	Spring force	F	FT8
	(Continued…..)		

The verbal interaction in Table 17 indicates teacher C failed to understand whether the male student believed magnetic forces have the characteristics of contact forces or if he misunderstood what contact force was. From this verbal exchange, what the male student learned was 'Magnetic force is NOT contact force' but he could not understand the reason why. Without being proved and given opportunities to reflect on their own ideas, students' cognitive skills do not develop (Alexander 2006).

I-R-F analysis of verbal interaction between teachers and students revealed teachers' authoritative behaviouristic teaching approach which controls students' answer and participation. In addition the use of the English language as MOI also prohibited active students' learning and participation in class, which is discussed in the next section.

5.1.3. English language

Teachers' use of code-switching was observed only in 2 lessons (teacher C and teacher E's classes). There the teachers often explained in English at first and when the response from students was not good, they repeated the same explanation in Kinyarwanda. Students were free to use code-switching during the lesson on the contrary to the finding in Botswana where only the teachers were allowed to

[16] As mentioned in section 5.1.2.1, 'bidding' was not coded in my analysis.
[17] As mentioned in section 5.1.2.1, 'nomination' was not coded in my analysis.

use code-switching (Arthur 1996). The effectiveness of code-switching in student involvement was clearly shown in their response to especially cued elicitation. Choral responses were always much bigger when initiations were done in Kinyarwanda.

The sampled teachers in general spoke English well with clear pronunciation despite the fact that 4 of them studied in the Francophone system when they were at school as mentioned in Table 5. Only teacher C had some problems in pronouncing words correctly, which made it hard for students to grasp what he meant. The teacher himself mentioned his non-proficiency of English during the interview. An active girl in teacher B's class mentioned that some teachers at her school pronounced and wrote words in a French way which made it difficult for her to understand.

Students in 9YBE schools struggled with listening, speaking, and reading English. Students were struggled to understand the teachers' explanations or questions in English. Sometimes they could not answer questions in English properly because they did not understand what the teacher was asking or because they could not describe their thoughts in English. They also struggled to understand the meaning of questions in the exercises in English. Even when they were asked questions whose answers were written on the chalkboard, they sometimes still could not answer. The following example (Picture1, Table 18) was from teacher C's class where a male student was struggling to answer the question from the teacher due to his lack of listening and speaking skills in English.

Picture 1 Chalkboard of teacher C's lesson

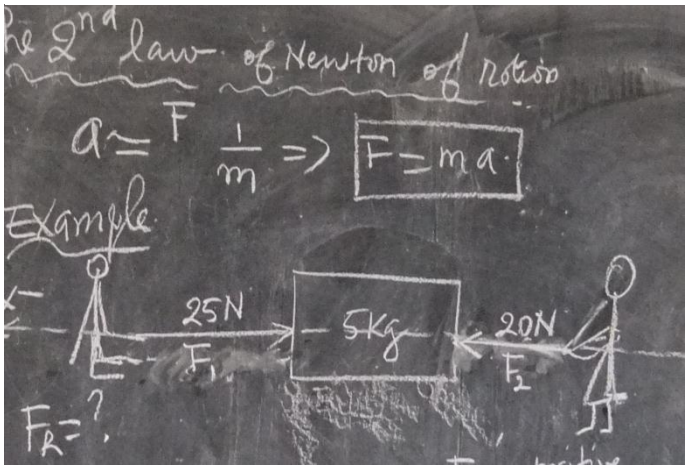


Table 18 Transcript of verbal interaction (A student struggling to answer a question in English)

Turn		Verbal interaction	Move	Code
1	Teacher C	Who can tell us the direction in which this block will move?	I	IT2
2	Teacher C	Yes?		(nomination)[18]
3	A male student	Take 2. Take first newton, first.	R	RS5
4	Teacher C	Are you meaning the direction?	F	FT6
5	A male student	Yes	R	RS5
6	Teacher C	Perhaps there is direction, up, down what, left what, right what and so on, which direction?	F	FT6
7	A male student	The X of axes. Ax..axes.	R	RS5
8	Teacher C	Direction of axis?	F	FT6
9	A male student	Ax axes	R	RS5
10	Teacher C	X axis?	F	FT6
11	A male student	Yes	R	RS5
12	A female student	Negative axis		(comment by peer)[19]
13	A male student	No positive axis	R	RS5

The verbal exchanges shown in Table 18 indicate that the male could not describe the direction of the resultant force in English (Turns 1→3). Moreover, even though the teacher gave him a clue of how to describe the direction, he did not use this; instead, he used his own way of expressing the direction (Turns 6→7).

The following example from teacher F's class indicates that students struggled to understand the sentences written in English (Picture 2, Table19). The teacher wrote a numerical problem on the board and asked the whole class to read aloud at first, then asked students to state what the question was saying in Kinyarwanda.

[18] As mentioned in section 5.1.2.1, 'nomination' was not coded in my analysis
[19] Follow-up by student was not coded in my analysis

Picture 2 Chalkboard of teacher F's lesson

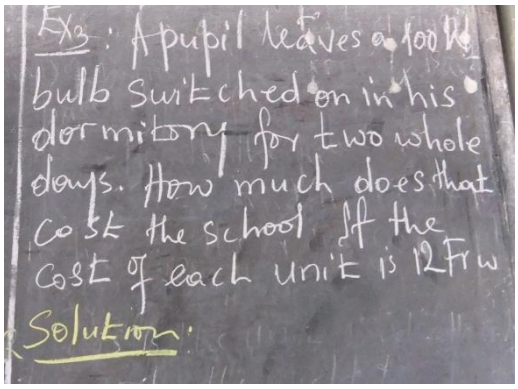


Table 19 Transcript of verbal interaction (Students struggling to understand a sentence written in English)

Turn		Verbal interaction	Move	Code
1	Teacher	Ngaho dusobanire icyo cyivuka ? (Tell us the meaning of the question?)	I	IT3
2	Teacher F	Who can explain it in Kinyarwanda?	I	IT5
3	Teacher F	Baravugango iki? (What is it said in English?)	I	IT5
4	Teacher F	Tell me, muravugangoiki? (Tell me what do you say?)	I	IT5
5	Teacher F	A pupil leaves a 100W bulb switched on in his dormitory for two whole days. How much does it cost the school if the cost of each unit is 12FRW (Reading exercise question on the board)		(informative)
6	Teacher F	Muravugangoiki? (What do you say?)	I	IT5
7	Teacher F	Muravuga iki? (What do you say?)	I	IT5
8	Teacher F	Hari uwumva icya bivuga? (Does anyone understand what it means?)	I	IT5
9	Teacher F	Ehh? What does it mean?	I	IT5
10	Teacher F	Ikibazo kirimo hariya N'iki, N'icyongereza? (What is the problem, in English?)	I	IT1

11	Students	(No response: Some students were mumbling)	R	RS7[20]
12	A male student	Umnyeshuri wagize amasaha watt kimwe..ijana…(Started to explain)	R	RS5[21]
13	Teacher F	Hari undi wagerageza? (Is there anyone who can try?)	F	FT2
14	Teacher F	Ninde wundi wakidusobanurira icyo kivuga? (Who else can explain what the question mean?)	I	IT5
15	Students	(No response: Some students were mumbling)	R	RS7
16	Teacher F	OK.		(marker)[22]
17	Teacher F	Nukuvuga ahangaha 100W ni irani power (Stared to explain in Kinyarwanda)		(informative)

The teacher succeeded in eliciting only one student's response to the question about translating the exercise questions written in English to Kinyarwanda regardless of the teacher's effort to repeat questions many times and give time to answer. This example clearly indicates that most of the students were struggling to understand the sentence written in English although there might have been some students who could do but hesitated to answer.

All of the students in 9YBE schools interviewed about the medium language of instruction agreed that they wanted to be taught through mixing English and Kinyarwanda for better understanding. Teachers in 9YBE schools also agreed that code switching helps students understand the class better and therefore they sometimes use Kinyarwanda in class despite all of them knowing that the MOI must be English. Teacher C mentioned his ambivalent view of MOI; although he knew from experience that it was better to use code-switching for the active participation of students, he could not do so when the head teacher was in the class or passing near to his class because it was prohibited.

From classroom observation, interviews with students and teachers, it is clear that teaching only in English can be an inhibitor to meaningful learning.

[20] No response to turn 10
[21] Response to turn 9
[22] As mentioned in section 5.1.2.1, the initiation which does not require response was not coded in my analysis, therefore 'marker' was not coded.

5.2. How classroom environment influences the interaction of the teacher and students

This section discusses how classroom environment influences the classroom interaction. It first discusses the issues of the prevalence of corporal punishment, exclusion and verbal abuse which undermines a child-friendly interactive climate in section 5.2.1. Then the influence of teachers' authoritative attitudes on students' participation and behaviour is discussed in section 5.2.2.

5.2.1. Corporal punishment, exclusion and verbal abuse

Across three schools except the rural boarding school, evidence of corporal punishment, exclusion, and verbal abuse was observed. The corporal punishment I observed in schools included thrashing with a stick, hitting with a fist, and being forced to kneel down. These punishments were either conducted by the teacher, a discipline master or a patron. The reasons for giving those punishments were '*not taking notes*', '*disturbing others*', '*not following the instructions*', '*having a notebook uncovered*'. Those unreasonable rationales given by teachers indicate teachers' authoritative roles over students within school hierarchies in Rwanda. Moreover, teachers' authoritative attitudes prevented students from explaining reasons why they behaved in a way which was not accepted by the teachers. A girl was ordered by teacher A to kneel down for the rest of the class for the reason of '*disturbing others*'. According to the student, she was actually not disturbing others but just asking her neighboring students whether they had seen her notebook but the teacher did not give her an opportunity to express the reason why she was talking to them. A boy and a girl who were hit strongly by fist by teacher A were also misunderstood in what they were doing by the teacher, and, without room for an explanation, were hit by the teacher. Teacher A reflected on his punishment and stated that the punishment was successful because it not only succeeded in discontinuing the misbehaving students' behaviour it also succeeded in creating fear in other students that if they misbehaved, they would be punished in the same way. Corporal punishment was used to keep powers in teachers' hands to control the classroom and to secure the teachers' symbolized and hierarchical dominance over learners, forcing students to be submissive and unquestioning without allowing students' voices (Morrell 2001).

One boy in the urban 9YBE school who was not taking notes during the class was called to the patron's office and thrashed many times with a stick very hard in front of me and other students. Due to the strong pain he tried to dodge the thrash but the patron continued to thrash even harder. Later in an interview, the boy said that '*Beating is like culture of this school*' and that the head teacher of the school also encouraged beating. The head teacher's acceptance of corporal punishment was also mentioned by another active girl at the same school. I also saw a girl who was writing a letter of forgiveness with her mother at the patron's office to school administrators due to her refusal of

corporal punishment. The patron even looked like he enjoyed his authoritative power, being able to implement corporal punishment. In informal discussion, the patron proudly told me that he beat students more than 10 times a day '*to make them in a right line*'. In the same school, another girl also reported the English language teacher's abuse of his authoritative power. '*If he (the teacher of English) says put pens down and if you don't do it down quickly, he comes and slap you every day, every day*'. Corporal punishment was not only used to correct the students' behaviour but also to reinforce the asymmetrical power relation between the teacher and students in the school hierarchy and make students obedient to the teacher. Students who did not conform to the teacher were judged as punishable by the teacher.

As mentioned in section 3.3, corporal punishment has historically widely been used based on the belief that it is the most effective way to correct children's behaviour in Africa and even parents in Africa strongly believe in the efficacy of corporal punishment as well as children. Teacher C mentioned that corporal punishment had been a habit in Rwanda before the genocide in 1994. It had been common for every teacher to hold a stick in class and continue to beat students till they got the right answer. He speculated on the reason for the continuation of the punishment due to the teachers' own experience in their own schooling. He further speculated that high percentage of the parents accepted having their children beaten. Moreover, several students including those who were beaten by the teacher stated that corporal punishment was good because the teacher was correcting mistakes. However, two teachers (teacher A and teacher C) stated their view against corporal punishment and clearly mentioned that they used other kinds of punishment which helped them academically such as giving additional homework. Contrary to what they stated, I found that one of them (teacher A) was using corporal punishment as mentioned above and the other (teacher C) was using exclusion during classroom observation. This implies that teachers know that corporal punishment and exclusion should not be used as punishment but their strong belief in the efficacy of corporal punishment might have prevailed.

Exclusion from class, such as forcing students to stand behind the classroom and to clean the compound during the lesson, was also observed in urban and rural 9YBE schools (teacher C and teacher F's classes). These were justified by the teacher as punishment due to '*not following the instructions (did not stop writing when the teacher said to stop)*' or '*being late for the lesson*'.

The use of verbal abuse was also reported by a non-active and an active girl in the urban 9YBE school. Although I did not observe any verbal abuse said by the teachers in English, they reported that some teachers including teacher C used such expressions as '*You are useless*', '*You don't know anything*', '*Keep quiet, you stupid*'. This verbal abuse by teachers prevented students from asking

questions during the class. The non-active girl said she felt scared to ask the teacher questions because sometimes the teacher did not answer her questions, instead she was verbally abused. Very similar case is also reported in Botswana; many females don't participate in the class even if they know the answer because they fear being ridiculed by peers, or verbally or physically abused by the teacher (Humphreys 2013). The girl also mentioned the teacher's frequent use of a harsh voice saying '*You do this one*!', which made her afraid.

These heavy punishments reinforce the power relation between the teacher and students and prevent the creation of a child-friendly, interactive environment in the classroom. Students are required to behave in a way which fits the classroom discourse determined by the teacher, otherwise they are punished. In this kind of classroom environment, dialogic climate could never be fostered. In addition to punishment, the teachers' attitudes and the atmosphere they create also influences students' participation and behaviour in class, which is discussed in the next section.

5.2.2. Teachers' authoritative attitudes

All the interviewed students except for two students stated that it was easy for them to ask teachers questions, yet at the same time they mentioned the existence of students who usually did not ask teachers questions in the classroom. They described those students as '*shy*', '*being afraid*', or '*not brave*'. The teachers speculated the reason for not asking questions was due to '*lack of confidence*', '*being afraid of making a wrong answer*', or '*language problems*'. These might be true but what the two students mentioned more related to the relationship to the teacher. One non-active boy in the urban boarding school stated he had never asked any questions to teachers since he had entered the secondary school because he had not been a close friend to any of the teachers, although he asked many questions when he was in primary school because he had been close to teachers. One non-active girl in the urban 9YBE school stated that her fear that her question might be ignored or be responded to with verbal abuse by a teacher prevented her from asking the teacher questions. An active boy who is taught by the same teacher C also reported that teachers sometimes did not answer his question, saying '*It's not your level*'. In total, 3 students mentioned about the creation of a friendly environment in class as a suggestion to the teachers.

Although most of the interviewed students stated that it was easy for them to ask questions to the teacher, there was only 2.9% of total initiation done by students, most of which were asking for clarification of explanation of the teacher as mentioned in section 5.1.2.1. This indicates that the primary purpose of questioning by students was to absorb teachers' knowledge accurately and not to facilitate their own meaning-making or knowledge. Therefore, when teacher F wrote contradicting information on the board ('*Passive receptor converts all electrical energy into heat*' and as examples of a passive receptor, '*secondary cells, electric motors, and bulbs*'), no students asked the teacher questions. Two possible reasons for this can be speculated: students did not understand the meaning of the sentence on the board because it was in English; or, students understood the meaning but hesitated to ask questions to the teacher. I speculate that the reason was the latter because the recorder caught one quiet female voice, a girl sitting at the front, saying about the contradiction of the information given by the teacher to a boy sitting next to her. This argument is backed up by the claim by Earnest and Treagust (2002) that students in Rwanda are culturally supposed to respect the ability of the teacher and therefore they do not question a teacher's knowledge.

However, I suggest it is not only cultural respect for a teacher's knowledge but also the classroom atmosphere which teachers create. While teacher F was teaching, he never smiled at students or called students' names when he picked individual students to answer. On the other hand, teacher D was smiling at students and sometimes called students' names when asking for individual answers. When he substituted a wrong number to a formula on the board, students chorally shouted '*Teacher*

No!' and then the teacher corrected following the students' comments. This indicates that teacher D succeeded in producing a more child friendly and free climate to participate than teacher F. However, when teacher D was solving a question which was related to the topic of the previous lesson in a completely wrong way and a female student asked a question about that, the teacher just said, '*No, we have done it.*' and did not repeat the process at all. This was perhaps because the teacher himself was not confident enough about his solution. I saw that the teacher immediately deleted what he wrote for explanation from the board after finishing explanation, which he had not done when he solved the previous questions. Not surprisingly, two students interviewed by me later said they had understood that question. When I probed their understanding, they told me their own logic they had used to make sense of what the teacher had explained to them. This indicates that if students learn something which does not make sense to them, they just transform it so that it makes sense to them instead of questioning the teacher.

6. Conclusion

This micro-level analysis provides insight into what goes on inside classrooms and has highlighted the asymmetrical power relations between the teacher and students in Rwandan secondary physics classrooms. Teachers generally used a teacher dominant knowledge transmission approach, in their classrooms that controlled students' participation and behaviour by using highly ritualized question and feedback techniques. To add this, teachers frequently used humiliating and degrading punishment such as corporal punishment, exclusion, and verbal abuse. This teaching approach and punishment worked to reinforce the teachers' authoritative power and inhibited active classroom interaction. The operation of such a non-dialogic classroom environment inhibited students' cognitive development as they were not given opportunities to reflect on their own thoughts and internalize the ideas. Other research has already suggested that such an authoritative approach is embedded in African school culture (although it might have been brought about through colonization), and this, accompanied by teachers' lack of subject or MOI knowledge, facilitates authoritative non-dialogic approaches in order to reduce the risk of exposing limitation to teachers' knowledge. The lack of students' MOI knowledge also discourages their active participation in the class.

The ritualized classroom discourse which was found in this study was characterized by the prevalence of closed short-answer questions, pseudo-checking of students' understanding, and cued elicitation responded to mostly by students' choral responses without sufficient or appropriate follow-up being given by teachers. Open questions were rarely asked because the purpose of teaching and learning was to reach one 'correct' answer in a 'correct' way. Therefore, students' wrong or unexpected answers were sometimes ignored or rejected by the teacher without explanation. Probing of students' answers was also rare, so opportunities to explore students' preconception and how they process meaning making were missed. More broadly, the processes through which students internalized school knowledge were disregarded by the teachers. However, in one class dialogic interactive verbal exchanges between the teacher and students was observed, and in this case the teacher was discovering students' knowledge and cognitive processes. This was a very positive observation that suggests that more research and a larger sample, perhaps in a wider range of subjects, would be worthwhile in exploring teachers' reasons for using dialogic or other teaching methods. This study suggests the importance of introducing teacher training which focuses dialogic interactive teaching approach which facilitates students' cognitive development. However, since how teachers teach is influenced by how they were taught in primary or secondary schools rather than by formal teacher training programme, just providing teacher training for dialogic teaching would not be effective enough to change teachers' belief on classroom practice (Schwille,

Dembele and Schubert 2008). Guskey (2002) claims the importance of giving teachers the evidence of effectiveness of new teaching approach, dialogic teaching, through regular feedback which encourages critical reflection. This will help teachers internalize the interactive pedagogy.

Humiliating and degrading punishment was implemented by teachers not only to correct the students' behaviour but also to reinforce the asymmetrical power relations between the teacher and students in school hierarchy and make students obedient to the teacher. Teachers knew corporal punishment and exclusion did not assist the development of students; nevertheless they did employ such methods, probably due to strong traditional belief in the efficacy of corporal punishment and their own experiences in school. This implies that the GoR should set a strict guideline regarding these punishments and launch effective monitoring system. At the same time, classroom management and organizational skills should be emphasized in initial teacher education and continuous professional development so that teachers can create friendly atmosphere and all students can equally participate in class.

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Appendix

Appendix A. Comparison of the number and percentage of initiation moves by teachers

Initiation types			Urban boarding school				Urban 9YBE school		Rural boarding school		Rural 9YBE school			
			Teacher A		Teacher B		Teacher C		Teacher D		Teacher E		Teacher F	
			Number[23]	%	Number	%	Number	%	Number	%	Number	%	Number	%
Authentic question	Closed	Yes • No/ Multiple choice	13.2	9.3%	8.3	7.1%	6.9	9.0%	4.7	4.3%	2.1	1.3%	1.4	0.7%
		A single word/number /phrase	36.8	25.9%	18.8	16.1%	23.3	30.3%	43.0	39.4%	30.9	18.5%	40.6	18.8%
		Sentence/ solving numerical problems	22.4	15.7%	9.4	7.1%	4.3	5.6%	14.0	12.8%	17.0	10.2%	5.7	2.6%
	Open	Opinion/ Reasoning	5.3	3.7%	9.4	8.0%	0.0	0.0%	0.0	0.0%	0.0	0.0%	0.0	0.0%
Rephrasing/repeating questions			32.9	23.1%	12.5	10.7%	5.2	6.7%	11.6	10.6%	13.8	8.3%	7.1	3.5%
Checking understanding			19.7	13.9%	54.2	46.4%	24.1	31.5%	25.6	23.4%	58.5	35.0%	120.8	56.0%
Cued elicitation			5.3	3.7%	4.2	3.6%	11.2	14.6%	8.1	7.4%	40.4	24.2%	37.7	17.5%
Teacher direct			6.6	4.6%	1.0	0.9%	1.7	2.2%	2.3	2.1%	4.3	2.5%	1.9	0.9%
Total initiation by the teacher			**142.1**	**100.0 %**	**117.7**	**100.0 %**	**76.7**	**100.0 %**	**109.3**	**100.0 %**	**167.0**	**100.0 %**	**215.1**	**100.0 %**

[23] Number of utterances in each category was converted to 50 minute units.

Appendix B. Comparison of the number and percentage of initiation moves by students

Initiation types	Urban boarding school				Urban 9YBE school		Rural boarding school		Rural 9YBE school			
	Teacher A's class		Teacher B's class		Teacher C's class		Teacher D's class		Teacher E's class		Teacher F's class	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
Clarification of explanation	1.3	100.0%	2.1	33.3%	2.6	100.0%	4.7	57.1%	2.1	100.0%	1.4	75.0%
Ask their point of view/ Correct teachers' mistake	0.0	0.0%	2.1	33.3%	0.0	0.0%	1.2	14.3%	0.0	0.0%	0.9	25.0%
Repetition of students' initiated question	0.0	0.0%	3.1	33.3%	0.9	0.0%	2.3	28.6%	0.0	0.0%	0.0	0.0%
Total initiation by the student	1.3	100.0%	7.3	100.0%	3.4	100.0%	8.1	100.0%	2.1	100.0%	2.4	100.0%

Appendix C. Comparison of the number and percentage of response moves to teachers' initiation

Response types			Urban boarding school				Urban 9YBE school		Rural boarding school		Rural 9YBE school			
			Teacher A's class		Teacher B's class		Teacher C's class		Teacher D's class		Teacher E's class		Teacher F's class	
			Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
Student	Choral	Class choral	10.5	6.9%	3.1	1.9%	22.4	22.2%	25.6	18.2%	29.8	15.4%	34.0	14.2%
		Class few choral	55.3	36.2%	66.7	40.5%	36.2	38.0%	70.9	50.4%	64.9	33.5%	103.8	43.7%
		Demonstration in unison	0.0	0.0%	0.0	0.0%	0.0	0.0%	0.0	0.0%	0.0	0.0%	0.9	0.2%
	Individual	A girl	30.3	19.8%	45.8	28.5%	7.8	8.3%	11.6	8.3%	27.7	14.3%	3.8	1.6%
		A boy	14.5	9.5%	12.5	7.6%	12.1	12.0%	5.8	4.1%	17.0	8.8%	3.3	1.4%
		Demonstration	7.9	5.2%	1.0	0.6%	1.7	1.9%	2.3	1.7%	4.3	1.6%	1.4	0.6%
	No response		21.1	13.8%	25.0	15.2%	8.6	9.3%	4.7	3.3%	17.0	8.8%	73.6	30.8%
Teacher			5.3	3.4%	7.3	4.4%	0.0	0.0%	8.1	5.8%	6.4	3.3%	11.8	4.7%
Students and teacher in unison			7.9	5.2%	2.1	1.3%	7.8	8.3%	11.6	8.3%	27.7	14.3%	6.6	2.8%
Total response			152.6	100.0%	163.5	100.0%	96.6	100.0%	140.7	100.0%	194.7	100.0%	239.2	100.0%

Appendix D. Comparison of the number and percentage of response moves to students' initiation

Response types		Urban boarding school				Urban 9YBE school		Rural boarding school		Rural 9YBE school			
		Teacher A's class		Teacher B's class		Teacher C's class		Teacher D's class		Teacher E's class		Teacher F's class	
		Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
Teacher	Answer student's question	0.0	0.0%	4.2	40.0%	2.6	75.0%	4.7	57.1%	1.1	50.0%	2.4	75.0%
	Ignore student's question	1.3	100.0%	0.0	0.0%	0.9	25.0%	3.5	42.9%	1.1	50.0%	0.0	0.0%
	Ask clarification of the question	0.0	0.0%	3.1	60.0%	0.0	0.0%	0.0	0.0%	0.0	0.0%	0.0	25.0%
Total response		1.3	100.0%	7.3	100.0%	3.4	100.0%	8.1	100.0%	2.1	100.0%	2.4	100.0%

Appendix E. Comparison of the number and percentage of follow-up moves to students' response

Follow-up types			Urban boarding school				Urban 9YBE school		Rural boarding school		Rural 9YBE school			
			Teacher A's class		Teacher B's class		Teacher C's class		Teacher D's class		Teacher E's class		Teacher F's class	
			Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
Teacher	Implicitly accept		23.7	18.0%	35.4	23.0%	28.4	37.9%	34.9	28.0%	47.9	36.0%	57.1	40.1%
	Does not accept	Ask others	1.3	1.0%	2.1	1.4%	0.0	0.0%	2.3	1.9%	3.2	2.4%	1.9	1.3%
		Start explaining correct answer	2.6	2.0%	2.1	1.4%	2.6	3.4%	2.3	1.9%	2.1	1.6%	1.4	1.0%
	Affirm		6.6	5.0%	9.4	6.1%	5.2	6.9%	0.0	0.0%	5.3	4.0%	3.8	2.6%
	Praise/Appreciation		14.5	11.0%	5.2	3.4%	0.0	0.0%	0.0	0.0%	1.1	0.8%	0.0	0.0%
	Probe/ Ask clarification		1.3	1.0%	12.5	8.1%	6.0	8.0%	3.5	2.8%	3.2	2.4%	0.5	0.3%
	Comment		15.8	12.0%	18.8	12.2%	3.4	4.6%	17.4	14.0%	6.4	4.8%	3.3	2.3%
	Repeat		34.2	26.0%	41.7	27.0%	21.6	28.7%	29.1	23.4%	36.2	27.2%	52.4	36.8%
	Ask for repetition		28.9	22.0%	16.7	10.8%	6.9	9.2%	34.9	28.0%	24.5	18.4%	21.2	14.9%
	Discuss response		2.6	2.0%	10.4	6.8%	0.9	1.1%	0.0	0.0%	3.2	2.4%	0.9	0.7%
	Total follow-up by the teacher		131.6	100.0%	154.2	100.0%	75.0	100.0%	124.4	100.0%	133.0	100.0%	142.5	100.0%

Appendix F. Information sheet for teachers

University of Sussex
Education & Social Work

INFORMATION SHEET FOR PARTICIPANTING TEACHERS

You are being invited to participate in the following research study! Before you decide whether you want to take part, it is important for you to understand why the research is being done and what your participation will involve. Please take time to read the following information carefully and discuss it with other members of staff from your school if you wish. Please ask me if anything is unclear or if you would like more information. Take time to decide whether or not you wish to take part.
Thank you for reading this.

Study Title
Learning about learning in Rwandan secondary school classrooms

What is the purpose of the study?

The purpose of the study is to investigate O-level secondary school teachers' practice and their pedagogical approach towards students' learning in Rwanda by classroom observation and interview.

Do I have to take part?
It is up to you to decide whether to take part or not. If you decide to take part you are still free to withdraw without giving a reason during the interview or any time after the interview until July 1. If you withdraw from the study all data will be withdrawn and destroyed.
If you do decide to take part you will be given this information sheet to keep and be asked to sign a consent form. In addition, you would be very welcome to a copy of the final report of this study.

Why have I been chosen?
You are being invited to take part in this study because you teach ordinary-level in one of the two secondary schools which were selected based on the recommendation by REB.

What will participation involve?
If you decide to participate, your classes might be observed by the researcher and you might then be interviewed by her in the school library, which will take approximately 30 minutes. Both of the classroom observation and interview will be audio recorded.

Will my information in this study be kept confidential?
All information collected in this study will be kept strictly confidential and your personal responses will not be identified to you. Your name and working place will be removed from the information and anonymised. That is to say that it should not be possible to identify anyone from my reports on this study.

In the event that this information is published, the school and teachers' names will be changed.
All Information will be stored in a password protected electronic file and no one else will have access to this information.

Please note that: during the interview,

- **You can decide to stop the interview at any point**
- **You need not answer questions that you do not wish to**
- **Your name will be removed from the information and anonymised. It should not be possible to identify anyone from my reports on this study.**

If this study has harmed you in any way you can contact University of Sussex using the details below for further advice and information:
Supervisor's name: Mairead Dunne
Department address: University of Sussex, Sussex House, Falmer, Brighton BN1 9RH, UK
Email: mairead.dunne@sussex.ac.uk

Contact Information
Researcher's name: Sawa IWAKUNI
Department: MA International Education and Development, University of Sussex
Address: University of Sussex, Sussex House, Falmer, Brighton BN1 9RH, UK
Email: si80@sussex.ac.uk Phone: (+44)7922092115

Appendix G. Information sheet for students

University of Sussex
Education & Social Work

"Learning about learning in Rwandan secondary school classrooms "

Information sheet for you!

Hello, my name is Sawa. I am conducting this research as a part of my Masters in International Education and Development. I am looking at teachers' practice towards students' learning in secondary school classrooms for better teaching and learning in Rwanda!

What is the study about?

This study is to explore secondary school teachers' practice and their teaching approach towards students' learning in Rwanda.

Why have I been chosen?

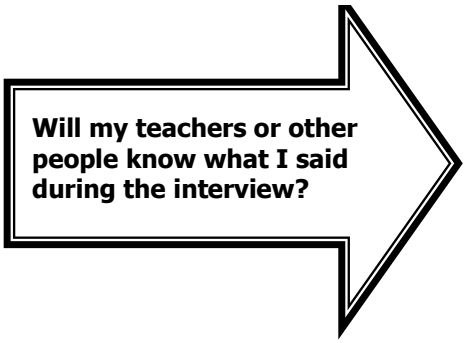
Because you are currently studying O-level in one of the schools recommended by REB. Other students are also selected so don't worry!!

What will I do?

You will be interviewed about 'teaching and learning' by Sawa for approximately 30 minutes in the school library.

What language am I going to speak during the interview?

You are supposed to speak English. However, fluency of English is not required as long as you can communicate in English.



No. The interview will be known only by Sawa. Your own words might be word processed but your own name will not appear in my report. So no one can identify you from my writing.

Please feel free to contact me with any questions:

Researchers' name: Sawa iwakuni

Email address: si80@sussex.ac.uk

If you feel this study has harmed you in any way you can contact the University of Sussex using the details below:

Supervisor's name: Mairead Dunne
Email address:mairead.dunne@sussex.ac.uk

Must I take part in the research?

It is your decision whether or not to take part. If you do decide to take part you will be given this information sheet to keep and be asked to sign a consent form. If you decide to take part you are still free to withdraw without giving a reason during the interview or any time after the interview until July.1.

If you are happy to take part then please sign the accompanying consent form and return it to the researcher. If you are under 18 and would like to take part, then we will need the consent from the head teacher of your school as well.

Murakoze chane!

Appendix H. Consent form

University of Sussex
Education & Social Work

CONSENT FORM

Project title:
Learning about learning in Rwandan secondary school classrooms

Name of Researcher:
Sawa Iwakuni

I agree to take part in the above the University of Sussex research project. I have had the project explained to me and I have read and understood the Information Sheet, which I may keep for my records.

Please initial box

1. I confirm that I have read and understand the information sheet for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily. ☐

2. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reasons until July 1. ☐

3. I understand the observation/interview/discussion will be audio recorded. ☐

4. I understand that any information given by me may be used in future reports, articles or presentations by the researcher. ☐

5. I understand that my name will not appear in any reports, articles or presentations. ☐

6. I agree to take part in the above study. ☐

Name of Participant	Date	Signature
Researcher	Date	Signature

Sawa IWAKUNI
MA International Education and Development, University of Sussex
-Address: University of Sussex, Sussex House, Falmer, Brighton BN1 9RH, UK
-Email: si80@sussex.ac.uk
-Mobile :(+44)7922092115

Appendix I. Classroom observation schedule

<table>
<tr><td colspan="2">Classroom observation schedule</td></tr>
<tr><td colspan="2">Date: / / 2014</td></tr>
<tr><td>School:

School type:</td><td>Teacher:
(Year of experience:)
(Qualification: unqualified/ certificate/ diploma/ degree)
(Speciality:)
(Sex: M / F)</td></tr>
<tr><td>Class:

Time period:</td><td>Number of students:

Tot: M: F:</td></tr>
<tr><td colspan="2">Prior learning of students:</td></tr>
<tr><td colspan="2">Topic of lesson:</td></tr>
<tr><td colspan="2">T/L materials:</td></tr>
<tr><td colspan="2">Condition of class room:</td></tr>
<tr><td colspan="2">Seating plan:</td></tr>
</table>

Time	Teacher's activity	Students' activity	Comments