EXPLORING THE DIDACTIC CONTRACT IN THE TEACHING AND LEARNING OF MATHEMATICS AT FORM 4 LEVEL.

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Abstract

The study was aimed at identifying the forms of the didactic contract and their effects in the teaching and learning process of mathematics at form 4 level. The population of the study included the three form 4 classes of Madamombe High 2017. From the population came a sample of students who came from one class chosen at random. The chosen class had 40 learners. For the study to be successful, three members of staff helped the researcher to carry out the lessons. Among the teachers chosen, they used the discovery methods of teaching, research type of teaching and sometimes exposed the learners to child centred methods and also at times lectured to them a bit. The topic of concern was “transformation” which include concepts such as translation, rotation and reflection. As part of the study, exercises, tests and interviews were given to the learners and direct observation was used by the researcher to evaluate behaviour changes and skills development. Skills expected included rotating, translating and reflecting figures the best the students could do. Data were collected and presented in tabular form, graphs and analysis by word. Pie-charts, histograms and bar graphs were used. Analysis of results looked at key points such as common results and exceptional cases. The following were the major results of the study. Learners found rotation and reflection to be difficult concepts and this means that interactions should be refined for learners to gain. As for recommendations, teachers should use learner oriented methods of teaching. Teachers should use deductive and discovery methods.
Acknowledgments

Total success of this project rested on a number of hard working members whose names are below: Cleophas Mudemba M., Mr Ndemo (Supervisor); Chandipwisa, C, Chabata Merjury and Maths department members: Mr Majoni and Munyenyiwa who gave a lot of help. The researcher has also to thank the Head of Madamombe High School for his support for the success of the project.
Dedication

This project could not have succeeded if it had not been the total support from Dzingisai family members who included my dear wife –Eggneta Vengai. Daughters Prospect and Rejoice, Sons: Takunda and Tatenda.
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CHAPTER 1
BACKGROUND OF THE STUDY

1.0 Introduction

This chapter presents the background to the study, statement of the problem, research questions, objectives, significance of the study, delimitations as well as the contextual definitions of terms with regards to the didactic contract and its effect in the teaching-learning of Geometrical transformations at Form 4 level. Under Geometrical transformation, the key concepts of the isometrics (translation, reflection and rotation) shall be studied and taught and the teacher’s and students’ expectations shall be examined.

1.1 Background of the study

The present study rests on the axles of the “didactic contract”. This construct is a result of the teacher expectations on learners’ performance and the learners also have expectations on the teacher to teach well (Brouseau 1997). The teacher has objectives to be fulfilled by the learners and the learners expect the teacher to deliver usually what learners understand. The issue here is about the intended curriculum against the achieved where in most of the cases there are breaks in the contract. This same contract does not include the teacher and the pupils only. It also includes the how, the when and the why aspects and others, which are commonly known as the “milieu”, (Perrin-Glorian 2005). The learners’ interaction with the milieu has a heavy bearing on the understanding of what is to be learnt.

Hersant and Perrin-Glorian (2005) pointed out that other important features of the contract include, the domain which includes the knowledge to be taught, the didactic status of knowledge, the nature of the ongoing didactic situations and the distribution of responsibilities between the teacher and the learner. All these affect the didactic contract.

Now this study attempts to examine the various didactic contracts in the learning of Mathematics. It also tries to determine the effects of various contracts in class as regards the performance of the pupils. The breaks so formed as a result of the breaches on the contract can result in mismatches and this has resulted in below average performances. Some contracts to be discussed and their effects shall include the Ostention contract, Mayeutic contract and the didactical contract. The structures of the major didactical contract shall also be studied. These include the macro, micro and meso levels of the contract.

When the teacher is to give tasks as per contract specification, the following has to be noted, what type of tasks are given, how and why they are given. Where students are supposed to do
a task and fails or succeeds the study shall try to find out why. The study would want to know how the rules operate, change or be adjusted as the rules cannot remain constant over time. The rules change from time to time and from class to class (Sarrazy 1995). As stated by Sarrazy (2005) the macro, micro and meso issues need to be studied seriously as they have their own effect on the class performance thereby affecting the contract. The contract itself, according to Benard Sarrazy (1995), is a set of rules, and strategies of a game between a teacher and a learner. The contract is explicit somehow but largely it is implicit. The contract is not signed anywhere and it’s not formal.

It could be noted that most of what happens in class is a result of the class rules (contract) and as such the rules need to be understood so that the learning outcomes could be focussed in a favourable direction. Failure to study and understood the contract at play in classroom situation aids the already existing string of mismatches one after another which leads to unfavourable situations in class and unbalanced and unsupported conclusions. Thus the study in short aims to understand the ‘didactic contract’ in its totality, the effects of the contract on performance and general pupil/teacher behaviour in a classroom situation.

1.2 The statement of the problem
The study aims to find the forms of the deductive contract and its effects in the teaching and learning of geometrical transformations at form four level. The researcher has chosen “geometrical transformation” because he feels that a lot will be learnt from the on goings around this tough topic to many students.

1.3 Research objectives
• Determine didactic contracts at a play in a mathematics lesson at form 4 level.
• Identify the effects of didactic contract in a mathematics lesson at form 4 level.

1.4 Purpose of the study
Mathematics is a key subject in almost all key parts of the market. It has wide applicability but it is obvious that it is not easy for many students. The reasons for its assumed toughness may be attributed to the effect of the didactic contract. Thus this study wishes to come up with possible solutions that relate to the adjustments on the didactical contract and the ‘milieu’. In short the major focus is on the effect of didactic contract to the performance of pupils in the learning of Geometrical transformation.

1.5 Research questions
• What didactic contracts are at play in a mathematics lesson at Form 4 level?
• What skills are brought about by the didactic contract in the teaching and learning of mathematics?
• What behavioural effects are brought about by the didactic contract?

1.6 Significance of the study
The study intended to help a number of elements who include, the researcher, other researchers, mathematics teachers, school authorities, curriculum planners, students involved in the study and the ministry of Primary and Secondary education.

THE RESEARCHER
It is hoped that the findings will help the researcher in many ways. The researcher shall gain knowledge on the effects of the type of the contracts in the class which are associated with the lesson going on. The researcher shall learn of possible solutions to the problematic areas of the contract. The researcher shall learn new skills needed to deal with tricky concepts such as Geometric transformation. Teaching techniques which are more efficient are also learned. Above all modern teaching-learning methods must be embraced. The methods may include, The Maths Analysing System (MAS). The internet itself is a powerful method of accessing modern and recent data.
One method that needs special mention is the constructivism method of learning where students explore the world on their own but doing it through the solution of mathematical problems. This method helps learners retain confidence with the subject which will be good foundation for the future studies.

THE OTHER RESEARCHERS
Other researchers shall learn the clear fact that there are key processes in the learning process which advance or hinder learning in the classroom. These processes include the didactic contract which needs to be handled with great care. The researcher shall learn of the various effects of the contract and what possible solutions could be implemented. After learning about the existence of the didactic contract and its effects especially in the learning of Geometrical transformations the researchers shall be enlightened on the tricky aspects of the concepts. This shall propel them to venture more on the concept and theory, and come up with more meaningful findings. This will encourage more discussions and researches.

TO OTHER MATHEMATICS TEACHERS
It may be clear that the existence of the didactic theory, contract and situations are relatively new developments to many mathematics teachers in Zimbabwe. Thus the effects of the contracts are also far-fetched to them. Thus this study is opening new avenues in the analysis
of performance by learner especially in mathematics. Mathematics teachers shall understand that the didactic contract has a heavy bearing in the learning. Its effects are heavy too and a clear understanding of this should be present. The understanding makes teachers adjust their teaching methods and sphere of reasoning and argument.

Teachers should accept the fact that proper learning of concepts needs direct pupil involvement. This involvement means real working of problems by pupils. If it is possible, the use of Mathematics Analysing System (MAS) may be used and this makes mathematics easy and enjoyable rather than boring. Through the didactic contract mathematics teachers should realise that the job of teaching is reciprocal as the learners we teach expect from us as teachers and as we write down objectives in our scheme books we are formalising their expectation. At the end of the teaching-learning episode (as a teacher) evaluates. One is taking stock just like in a business. In this study the effects that are the achievements or failures are attributed to the didactic contract.

To sum up, the researcher thinks that better learning on the part of teachers can be aided by seminars and workshops where they will share findings and help come up with the way forward to enhance performance in mathematics under the effect of the didactic contract.

SCHOOL AUTHORITIES
This study aims to inform school authorities on the existence and effects of the didactic contract and how best they can help the teachers and learners overcome the bad side of the effects. School authorities should provide needed equipment to mathematics teachers so that they do their duties more efficiently. If teachers request the provisions of Mathematics Analysing Machines System (MAS), Computer Aided System (CAS) and other modern types of calculating devices they should make effort to provide. These instruments have proved to aid learning quite a lot. They leave permanent marks in the learner and will make applications of learnt concepts almost automatic in future. As a working example, the concepts on Geometrical transformation need tools so that practice is possible. The practice carried out will become easier if tools are enough and development of needed skills is obvious. The theoretical approach to teaching Geometry leads to a student handled as a spectator which closes his/her exploration of the world. Skills do not come or develop by more watching. Authorities should be witnesses to this.

THE CURRICULUM PLANNERS
The research findings will go a long way in assisting curriculum planners to emphasize on the correct methods of lesson delivery. They will do this through circulars and seminars. It is hoped
that the idea of constructivism is one of the best solutions for the best results. Thus the planners are expected to provide materials needed somehow. As the didactic contract has a big role in achievement, the planners of the mathematics curriculum are expected to ‘hammer’ a lot on it and encourage a lot of research for further refinements on the contract in general.

1.7 ASSUMPTIONS

- The didactic contract, theory and situations are generally new terms in mathematics learning especially at lower levels.

- Participants chosen in the study shall be honest and willing enough to go even an extra-mile as the study may demand a lot of effort and commitment.

- Observations made shall relate to the didactic contract and thus the conclusion that shall follow are a result of the didactic contract only.

- The effects of the didactic contract shall dominate the lessons to be carried out and thus the result shall be a reflection of the contract.

1.8 LIMITATIONS

The study suffered some constraints that included packed duties as students were preparing for their end of course examinations. Also the researcher depended on information from foreign sources. Our own local scholars have written very little on the didactic contract. It could be true that the non-availability of new teaching methods such as MAS could have changed the direction of the results to the advantage of the learners.

1.9 DELIMITATIONS OF THE STUDY

The research was done at Madamombe Secondary School in Chivi District of Masvingo Province. A total of 40 pupils were involved. All are in form 4 at Madamombe School. Four mathematics teachers were involved in the study. The researcher was the fourth teacher in the study as he conducted some lessons too.

1.10 DEFINITION OF TERMS

- The term ‘didactic contract’ is defined by Broussen (1988) as a combination of rules that determine, partly explicitly but mostly implicitly, what each partner in the education relationship has to manage and his/her responsibilities are to the other partner in the relationship. Broussen (1988) adds that, the didactic contract means the teacher’s behaviour expected by the students and the student behaviour expected by the teacher.

Mercier, (1997) defines the didactic contract as expectations transformed through action.
On the other hand, Garcion Vantour (2002) refers to didactic contract as the changes which are related to time and behaviour and the teacher and child. When combined, the didactic contract refers to a frame for analysing classroom interactions. This comes down to a complex matrix of relations between the teacher and students where the relations are explicit but mostly implicit. There is a system of reciprocal obligation which was also stated by Trouche (2005) and Warfield (2006)

Then what it means is that the term didactic contract is about responsibilities which are shared between teachers and students. Good but turning out to be too long. Move some ideas to literature review section

That means teachers must play their role of providing needed conditions by learners while learners play their part so that needed results can come. Then this study tries to find out what would have gone wrong if results do not come.

- FORM FOUR LEVEL

Form four level according to Gordon [2001] refers the third and the fourth years after the completion of grade seven [primary school]. This refers to the Zimbabwean situation. In South Africa this level is equivalent to grades nine and ten.

1.11 SUMMARY

This chapter gave the background to the study, statement of the problem, significance of the study, limitations, delimitations and definitions of terms. In short the chapter gave an attempt on the real meaning of the didactic contract in the learning of mathematics at Form 4 level. The chapter went on to give and define examples of the ‘contracts’ in the classroom. The same chapter shall lead to chapter two which is concerned with literature related to the didactic theory and didactic contract as is relates to the learning of mathematics.
2.0 INTRODUCTION

This chapter shall examine the Theoretical framework concerning the idea of “didactic contract” and its effects in the learning of mathematics-geometrical transformation at form 4. Work on the conceptual framework on the didactic contract shall also follow later. A number of scholars who contributed to the works shall be dealt with and common points shall be stressed as the work progresses.

First it has to be noted that the major theory at stake here is the didactic theory which states that the teacher cannot provide all that needs to be learnt by the student but can only provide the necessary conditions that are necessary for learning (Brousseau 1997). Expanding the contents of this theory shall reveal that a lot has been covered by this theory as this same theory ‘supports’ the idea of the didactic contract which according to Brousseau (1997) means a relationship which determines responsibilities between teacher and student. The same idea of didactic contract involves constructivism to some extent as the student at last has to do most of the job.

2.1 THEORETICAL FRAMEWORK

As has already been alluded in the introduction to the chapter, the idea of ‘didactic contract’ as related to the theory of didactics, shows connectivity with reciprocal tendencies. According to Brousseau (2002 p 31-32), the didactic contract, referred to a system of reciprocal obligation. Here, the teacher creates sufficient conditions for the appropriation of knowledge and must recognise this appropriation when it occurs. The conditions must be satisfied for the contract to be sustained. It has to be noted that the didactical relationship must continue at all cost if learning is to take place.

Scholars such as Quessada and Clemence (2007) also agree to the fact of the importance of the connection between the teacher and learner. Even though there is sharing of roles between the teacher and the learner, at first the teacher plays a pivotal role. As an example of the teacher has attitude towards a concept, then this is transferred to the learners who also develop the same attitude. Thus what should be taught, how and why it should be taught depends on the teacher initially (Kroksmark 1987). Sometimes even the meaning of a concept will rest with the teacher depending on what method has been used. If the teacher explains everything and works most of mathematics problems and proofs alike then meanings of concepts maybe subjective somehow (Lundgre, Salio and Liberg 2010).

The didactic contract also refers to the teacher’s behaviour expected by the learners in relation to the learners’ behaviour as seen by their teacher. The teacher’s behaviour will refer to a
variety of developments to include his teaching style that is explaining everything or working everything giving direction to the work to be done. The main idea will be for learning to take place. Thus decides somehow how mathematics should be taught, thus how learning should take place. Doverburg (1999) and Samaelson (1999) noted that teachers decide what should be learnt and how and sometimes explain why according to their objectives and goals. As examples teachers prepare specific problems and want them be solved in a certain way such as manipulation of vertices as one rotates figures. Good point here Each vertex is taken as point and by considering them all the skill of rotation would have been archived.

The contract under study can be divided into three categories which are the Ostension, Mayeutic Socratic and the adidactical situations. As parts of our study they need to be looked into and their characterisations noted together with their effect examined briefly. As contracts or parts of the main contract, they are described generally as keen games by Sadovsky (2005) where the teacher communicates sometimes explicitly but implicitly in most of the cases. The teacher will do the communication through words, gestures, attitudes, silences and other aspects related to the functioning of the mathematical affair that is treated in class (Sadovsky 2005). Meanings are negotiated and expectations are transmitted, methods are suggested or inferred, norms are communicated or interpreted (Sadovsky 2005).

Now under the Ostension contract the teacher will do most of the following as he attempts to teach the learners;

- Giving oral exposition about the studied topic and in my case the teacher will explain geometrical transformation to the best of his knowledge.

- The teacher will indicate what the children have to write.

- Students are expected to listen.

- Students do exercises

- Students are supported

Under the adidactial check contract the teacher is expected to do the following;

- Teacher proposes a problematic-situation which allows students to construct the new knowledge as the optimal solution.

- Students formulate and validate strategies to solve the problem.
• Plans situations where teacher evokes, formulates, rationalise and justifies their propositions.

• Assign responsibility to students.

MAYEUTIC SOCRATIC CONTRACT
The teacher is expected to do the following;
• Dish a spectrum of questions.

• Modifies questions including rhetoric for example analogy and metaphors in order to obtain answers he/she expects (Broussea 1996).

• Students affirm or deny.

• After two attempts or so and failing, the teacher will give the answer anywhere.

Then as an addition there is the potential adidactical contract which is quite close to the second one dealt with above (adidactical). This was exposed by Morgolines (1993) in Sadovsky (2005) where there is some intellectual obligation that student has with the environment. It is entirely up to the student to create or come up with knowledge.

The learner accepts the compromise to answer questions and try to perform tasks assigned by the teacher.

• Student elaborates the questions

• Students answer other students’ questions and not the teacher’s questions

• Students explain their suggestions

• Students justify techniques

• Propose varying strategies

The teacher is expected to teach students some or all of the following;
• Strategies to value ideas ( making explicit and value references )

• To construct and make coherent arguments

• To refute arguments

• To be careful of not making abusive generalisations
• To be good listeners

As a way to proceed I should quote some great scholars concerned with the idea of didactic contract such as Albert Einstein (1879-1955) who stated that “Education is not learning of facts but the training of the mind to think”. Supporting his trajectory I feel that he was correct as facts are too many and they disappear with time, but the mind which is well trained will solve the problems as they come no matter when.

In the same footing was Plutarch (AD 46-AD 120) stated that “the mind is not a vessel that need filling but wood that need ignition…..”. This relates to the fact that learners are not supposed to be told facts but discover facts themselves. They should explore the world themselves through a subject and its content. This is where the concept of constructivism comes into picture.

Now as part of our learners in the research used some form of machines to work out problems thus something must be said about the contract in relation to calculators and the Mathematics Analysing Software (MAS). Under this notion learner view the teacher as having the responsibility to teach skills. Students somehow may see the learning of technology as critical while the truth being that the learning of mathematics being the key issue. With the other half using MAS the contract seems to have shifted as teacher involvement for example writing on the board would have stopped. Learners play around with the machines and they find pleasure as the MAS sometimes confirm to them if the work has been done well. Shape sketches could be made and calculations became very easy for example on translation which is direct addition and the shape is thrown onto the Cartesian plane. In other well to do institutions, spread sheets, geometric packages and other system for example Computer Algebraic Systems (CAS) can be used and they motivate learners a lot.

According to Hersant and Perrin-Glorian (2005) there are four different dimensions to the didactic contract in general which include, 1. Domain – knowledge to be taught and learnt, 2. The didactic status of the knowledge, 3. Nature and characteristics of the ongoing didactic situation, 4. The distribution of responsibilities.

Hersant and Perrin-Glorian (2005: p 119) also point out the fact of the contract being as good as a legal one which has clauses. The didactic contract also includes the ‘Milieu’. The ‘milieu’ includes the environment which compromises concrete materials, textbooks, white board, mathematics problems posed and many others. The learner in short should negotiate with these successfully in order to obtain results. According to Roger Wader (March 17,
2006), the student’s intellectual condition may be part of the milieu. His/her interaction with the milieu play a key role in fulfilling the contract and actually learning something. Now the basic relations of Teacher-Knowledge-Pupil commonly referred to as the “didactic triangle” is the key to the learning environment as the two persons (teacher and learner) are connected by knowledge. Any other connections are supposed to be done properly which are within the triangle for progress to be made especially by the learner.

Other developments that need visiting in the contract and the related theories include barriers to learning which can be encountered. There are generally onto genic, epistemological and didactical barriers. Under the onto genic class there are three other categories. The onto genic difficulties relate to the learners’ readiness. The psychological one relates to the child’s lack of concentration in learning due to low motivation and interest of study.

Under the instrument aspect which is the second, students experience technical difficulties that make them (students) unable to follow what is going on probably because the topic or concept is not understandable to the student. The third aspect relates to the conceptual difficulties which relates to design thinking or conceptual demands that may be too high that causes the student to lose orientation and develop frustration. Also there are pedagogical obstacles which refer to methods and methodology in the learning of mathematics.

Also of consideration under the theory of didactical situations are the following aspects which play a big role in the fulfilment or non-fulfilment of objectives in mathematics lessons. Among others there are; the situation of action, formulation, validation and institutionalization.

Under formulation learners form images and maps on concepts as the learning process progresses. Under validation, students should be able to apply what they learnt in the real world situation while under the eye of the observers. In institutionalization, the learner gives an attempt or possible solution and the teachers accept or rejects. Usually institutionalization acts as a stamp by the teacher to confirm the sense in the suggested work.

Also under the didactic contract especially in Geometrical transformations pupils have to reason and carry out procedural fluency (methods) as they rotate figures. Practicality is also found in the work as when figures have been reflected, they show positional changes different from the original position.
From findings, the learner’s disposition affects success and learners tend to use different strategies when faced with a challenging problem. Dispositions are associated with thinking and thinking is related to understanding. A change in thinking builds a change in understanding.

Misconceptions which are a result of wrong beliefs, are an indicator of a ‘rupture’ in the contract (Wayner 1981). This rupture occurs often and has also been noted by Brown and Clement (1989). Misconception lead to wrong conclusion and actions (Bazzini, 1995). The ‘noosphere’ that in the textbooks, magazines and others supplied by teachers are part of the contract. These media have signs which help derive the concept. If students are not taught well they may spend too much time on understanding signs and not concepts which are the backbone of learning. Concepts form the bases of understanding (Martin, 2005).

Teachers’ beliefs are ‘forced’ into students somehow (D Amore, 1999). One more important point in this section concerns variability of the teacher as an aspect of the didactic contract. Different teachers bring different contracts even though they might use similar or the same lesson plans with same content. Now students are exposed to different situations which are forced to sort of diversity the operational registers so as to bring integration and differentiation in the work. If a teacher gives less work, they will adopt. Drevillon (1980 p36) points out that if another teacher comes and demands exercise after exercise, still students adapt. The variability being referred to above provides cognitive registers in relation to a conceptual field (Vergnaud, 1979).

When all having been said, the few exceptions include the sharing of responsibilities between the teacher and the learner. This aspect is very critical in the learning of mathematics especially form 4. This is so because at last it is the student who must be equipped with real skills for life and knowledge which will carry him/her ahead. For MAS lessons a lot takes place which is a bit different from what transpires in a traditional lesson (chalk-talk-scenario).

Usually teachers give instructions to student at the beginning, middle and rarely at the end except for feedback. Students expect the involvement of the teacher because usually the students are not sure of what to touch and where to go. Teachers like to help and this varies with classes as some classes especially of bright students already what to do with MAS. They can even wait for the teacher to come and just start the on button which they all see. This is because they are under a ‘contract’. The teacher must do it first and then they follow. If the teacher has done it, the students then go ahead and even up to finding solutions before the teacher reaches the stage. Students often check with other students.
Other teachers want students to do a step by step following on computer operations in mathematics. They fear that some students may be left behind and will finally ignore the procedures. They have the contract at heart. Some teachers give little direction and let the learners wonder to meet the solution. These teachers are employing the constructivism aspect.

Some teachers accept a variety of methods from students. Some go as far as accepting anything suggested but will throw it to the floor. The floor will decide what is acceptable and what is not. It has been found out that both teachers and students accept that teaching using technology is necessary as some devices check solutions and steps which becomes very easy to the teacher and students in particular.

Further for every mathematics lesson, writing notes is a necessity whether the lesson is conducted traditionally or in a modern way (use of Mathematics Analysing Systems-MAS). The contract states that reasoning and proofs are the order of the day. Interactions among students and tutors is expected as tutors are there to institutionalize ideas and beliefs. Pupils are expected to cope with pressure in mathematics lesson and worse still in Geometrical transformation of figures which will look like the original even after operations. This is so because the isometrics do not change the shape’s size.

Having touched on what I believe to be critical issues on the contract I should go back to do a recap of the main issues. Dubinsky (2001) points to the fact that crucial points of the contract should include all or the majority of the following which include sequencing, structuring, discovery, feedback, validation and meaning making. Others include adaption, behaviour, devolution, fundamental situations, and the milieu.

D’Amore (1991), concurs and adds classifications, interaction. The latter being pivotal as the interaction bring meaning to whatever is happening in the contract. Finally it can be hypothesised the didactic contract and its effects has a lot in it and has huge effects in the learning of mathematics.

2.2 THE CONCEPTUAL FRAMEWORK

Here, the paper shall look into the ideas related “conceptual framework” first. Go to its history and its applicability in the work studied so for. The term “conceptual framework” deals with the ‘why’ of a project and D’more (2002) defines it as an argument about why a topic one wishes to study matters and why the means proposed by to study it are appropriate and rigorous. Arsae (2002) defines conceptual framework as a guide and ballast for empirical research, situating specific questions and strategies for exploring them with the wide universe of what is already known. He (Arsae 2002) goes on to posit that the
framework matches research questions and aligns our analytic tools and methods with our questions. Chavallard (1982) goes on to add on the uses of the concept and soups that it is this framework that enables researchers to collect data, analyse it and make descriptions and interpretation on the data.

Chavallard (1982) points out that the framework in summary must show reason and rigour. He points out that the framework helps researchers organise and guide empirical research. According to D’more (2002) the research framework enables researchers to design and implement strategies more efficiently as the framework enables researchers to chart course, design studies, and make informed methodologies (choices). Researchers identify questions that matter most to them. So the framework monitors and makes researchers reflect on their research progress.

In Sharon M Ravitch and Matthew Riggan of the university of Pennslyvania publications, researchers are helped to combine existing knowledge (theory, methods, examples and empirical research) in conjunction with their own interest and observation so that they can ask better questions. The researchers will also develop robust and justifiable strategies for exploring questions of research. Thus the conceptual framework plays a key role in the execution of a research. Its contribution have been laid down and without proper coordination of its parts a research exercise has little chances of progressing well.

Further Sharon and Mathew pointed out clearly the fact that for the framework to function well or produce results then the researcher must be well conversant with the parts of the framework. The key parts include; the main theory being studied, methodology to be implemented and literature review which shows what already exists concerning the topic.

Now having exhausted the concept’s possible definitions the paper shall consider the history of the conceptual framework in relation to the didactic contract.

2.3 THE HISTORY OF THE CONCEPTUAL FRAMEWORK OF THE DIDACT CONTRACT

After a brief history of the conceptual framework has been done then this paper shall go into the details of why the research on the didactic contract is necessary. A number of scholars shall be consulted and the relations in the contract shall be examined as the researcher thinks that they have a bearing in the issues of concern. Types of contracts and a way forward (solutions) shall be examined.

In the 70s and 80s n Chamrouse, France, Yves Chavllard gave his first course on didactic transformation. Ideas such as didactic systems, didactic situations, didactic contract,
didactic engineering and other related concepts where discussed. The theory of didactics spread from region to region depending on culture and social settings.

Many ideas started in France and Gilbert Arsae accurately depicts the evaluation of the didactic transformation and other related aspects up to the 90s (Arsae 1992). In Spain, the idea of didactics was spread by Dilma Fregona and when the idea spread to Argentina, Aique which took the translation and new entities were affected by the ideas. The English people learnt through the works of Jeremy Kilpartrick. Now the idea of didactics and didactic contract has spread to every part of the world.

In as far as the didactic contract is concerned in particular, the relationship in the learning environment need to be examined because they affect what is learnt and the type of interactions taking place. According to Chavallard (1982) the relation can be modelled by a triangle with vertices and sides. Vertices are the players that is; teacher-knowledge-pupil. The sides represent relations. In general there needs to be effective interactions between each vertex and these interactions are supposed to be there for learning to take place. The pupil must receive instruction from the teacher to get knowledge. The teacher must have knowledge to share with the pupil. The pupil must accept the knowledge. Thus conceptually the contract affecting the three elements exists and has to be accepted somehow. If technology such MAS has to be used then we will have a relation which has four members which include; pupil-knowledge-tutor-author as for Parlan et al (1996) is concerned.

According to Parlon and others (1996), the author plays an important role he/she is or may be a group of specialist who dominate the knowledge domain as the group consists of pedagogical experts, communication experts, professionals, philosophers and others. These have a heavy bearing on what is to be learnt and their works impact on the interaction and results.

Then, the knowledge gain depends on the method used on traditional or modern teaching/learning styles. ICT used means simulations, manipulations, animations and now knowledge horizons opening. The actual knowledge to be learnt varies with the method used and the didactic contract is affected somehow as the learners change behaviour depending on whether they are using MAS or the traditional chalk-talk method. Under the chalk-talk method teachers who practice it expect total silence in class usually and mostly interactions are given green light by the teacher at a certain stage.

When lessons are machine helped with students working on the machines themselves, there is no standard contract rules to follow (Ellict 1988). The rules that govern the lesson depend on children-learner’s responses to the machine output. According to Cornoldi et al (1995)
the environment needs to be studied thoroughly in order to foster actual attention to the “fundamental stones of the foundation…” of knowledge and competencies. Nicholas at al (1990) also agrees with the need to understand the environment within which the learner practices. If the environment is not right no proper learning takes place. Also the tutor, that is any teaching agent this maybe a (human or artificial) able to intervene on student’s learning. The didactic contract, on the part of the tutor refers to elaborations, creation of the sequences, tools and material organisation so that objectives are reached. Every research exercise need proper coordination of the above for success to be witnessed (Sarrazy, 1995). Also Cosetti and Pallavisini (2002) accept the idea of tutor being critical in the didactic contract functioning.

**2.4 RELATIONS**

1. **AUTHOR - KNOWLEDGE**

The author must make sure that the learner constructs knowledge by herself/himself and he/she may not know that.

- The author offers devolution to the learner either by style, language and other questions.
- Author must motivate and shall allow for choice of content.

2. **AUTHOR- PUPIL**

- Feedback must dominate
- Author continuously corrects courseware as learning progresses
- Relation are mediated by knowledge

3. **AUTHOR- TUTOR**

Need to cooperate and collaborate. Collaboration is needed for the author and tutor to avoid misconception, different methodologies which can cause difficulties.

4. **TEACHER-PUPIL**

The teacher is there to facilitate and guide learners. The harmonising comes as bits of attention and emotional support (Trouche, 2004). In some cases, the teacher may act as an investigator and possibly as a “solver” of problems, but sometimes as an “orchestra”,

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director which allows management of time, reference point for either learning styles or content.

5. TUTOR- KNOWLEDGE

The tutor is there to manage, defines program, homework, deadlines and priorities among other things. As part of the contract’s conceptual framework, the tutor again is seen as pivotal for if he does not play his part, his position is like a bridge. When it is not present when it is supposed to be used there is chaos. Pupils do not actually know exactly what to do and how. Now as for as the didactic contract is concerned, learners have to solve mathematical problem. The teacher would have presented the problem as is generally expected (contract).

6. PUPIL- PUPIL

In as far as the contract is concerned pupils must socialise by way of either natural interaction or learning something from someone. In MAS lesson learners learn ICT systems, methods and other related issues. In group learning a lot of things are learnt as communication is intense and learners must identify themselves in a group for them to benefit.

One might want to understand the reason why Mathematics Analysing Systems (MAS). This aspect has a lot of advantages which include

- Time management- time needs to be used efficiently
- Feedback- the MAS programme is efficient in offering feedback
- Concentration will be on qualitative aspects not methods. This means less work.

Thus with all those positives then the use of MAS is encouraged as when time can be covered. This can have a positive impact on the final result.

Now, as the conceptual framework deals with the why part of the research this means that the types of contracts should be examined in greater deals. What they are and their possible effects as stated on the research questions. The first is the Ostension contract. This exists in the learning environment as there are some teachers who think that their explanation to mathematical problems are enough even with learners not questioning. This kind of contract exist and its effects shall be studied in greater detail. Following is the Mayeutic Socratic Contract present in the learning of mathematics. Some teachers ask a variety of questions and redirect their questioning to the learner who has to answer as to the
satisfaction of the teacher. My research would want to establish the extent of the effect of this contract.

Finally there is the adidactical contract which has a teacher who just prepares the ground for the learner to use his senses to read and understand the presented content. This kind of a situation employs an equivalence of constructivism which was advocated by Piaget. Here the learner discovers knowledge on his /her own. It is advantageous as knowledge discovered this way seems to stay longer in one’s system. This contract is probably the most favoured one as it seems that it accounts for more learning.

When effects are considered it should be noted that traditional methods seem to be causing boredom in class and too much domination by the teacher who tries to offer most of solution and defining concept. This work is supposed to be carried out by the learner himself/herself. On the other side MAS led lessons seem to be having motivation in learner. This study would want to ascertain the extent of MAS in the learning of mathematics. Interactions seem to be activated by machine aided learning. Thus the extent of the effects are to be examined further.

Mismatches happen in the learning of the mathematics. This study attempts to find the general causes of the mismatches and find possible solutions. Now the gap between students and teacher expectations or learner expectation against teacher performance has been made clear enough. Attempts to close the gap have to be made with help of literature from other renounced scholars.

As part of the solutions this paper may suggest the following:

- The use of the adidactical contract (as a method) will see learners being given a fitting platform to generate knowledge.

- Use of MAS is highly encouraged

- Training of teacher on new methods of teaching welcome

- Constructivism needed greatly

If the above possible solutions are upheld the increment in good interactions are expected and also better results would be expected.

Thus the above contributions seem to be pointing to the existence of a gap of expectations versus results either of exercises given or change of behaviour as a result of interaction. Thus the research has seen the need for a thorough study of the key concept of didactic contract so as to find a way forward.
2.5 SUMMARY
The chapter dealt with the theoretical framework, conceptual framework and the history of the didactic contract. Under the theoretical framework ideas such as relations and connections between players (teacher, pupil and knowledge) were examined. Under the conceptual framework the idea of reason and rigour were also discussed. The latter ideas were supported by a number of key scholars such as Chavallard (1982) and D’more (2002) and many others. The next chapter deals with research methodology.

CHAPTER 3
RESEARCH METHODOLOGY
3.0 INTRODUCTION
This chapter has been set out to outline a number of key aspects of the study. Amongst them are the research design, research paradigm population sample instruments of data collection
data analysis procedures, findings and presentations. As this chapter is critical to the present study it shall tackle each aspect separately as a sub-heading. What was done and expected shall be spelt out. If hindrances were met they shall be exposed. As a matter of fact, the present study on the didactic contract can be well understood if inferences are made on results and observations. The main reason being that the contract, is more of implicit than otherwise and as a way to unearth what is being sought in general interview and class observation and tests were used. Then as a way to complete this section the definition of the major term here, ‘methodology’ needs to be visited. A number of scholars have written about methodology. Some scholars defined methodology as a body of methods, rules and postulates employed by disciples. They also adds and said that this process can be put as a theoretical analysis of methods applied to a field of study.

Other academics put methodology as a system of broad principles of rules and specific methods or procedures which may be derived to interpret or solve problems within the scope of a particular discipline unlike an algorithm, a methodology is not a formula but a set of practices. As may be noted methodology is not as simple as a method or rule but it is a set of plans of how to go about a study which encompasses, the instruments, analysis plans, representations and others.

3.1 RESEARCH PARADIGM

A number of scholars have written a lot about research paradigms. CresWell one word (2009) defines a paradigm as a belief of objective reality which comes from observable data. Borg and Gall (1989) define a paradigm as a philosophical or theoretical framework of scientific school or discipline within which theories, generalisation or experiments are performed in support of their formulations. Thus a paradigm is a whole framework of beliefs, values and methods within which a research takes place. So a paradigm is about “shared understanding of reality”
which can be dealt with qualitative and quantitative research methods. It can be noted that paradigms are philosophical world views which are a collection of methods and techniques. They underpin the actions of researchers. The paradigms influence designs, population, sample and instruments used and data collection procedures. Amongst a number of them, the first relevant one to my study was positivism. This strives for objectivity, measurability and controllability. The second one is interpretive paradigm which seeks to understand the world from a subjective point of view. It uses interviews and participatory observation. The paradigm type-positivism, was first used by Kuhn (1962). In 1977 Kuhn referred to a paradigm as a ‘culture’.

The third paradigm type is the critical theory. This combines the post-modernisation and post-structural theories (Guba and Lincolin 1994). The three make up the qualitative research methodology. In my research positivism took a supplementary stage as observation and reason were the order of the day. There were certain behaviour that needed thorough observations for changes or shifts to be noted. One needed to apply some scientific method (August Conte) in order to enhance precision in describing parameters. To uncover truth one had to use empirical means. In order to for me to get the hard knowledge of behaviour change I needed to be objective as human behaviour was not static. It was controlled and determined by external environment (outside the classroom). As the researcher I tried to bring conditions to conformity he would sometimes lack the needed objectiveness as result of human nature which sometimes falls prey to inevitable subjectivity (Gephart 1999) and Phillips (1990) also noted this weakness of humans.

In my studies as a researcher I would in many occasions use the interpretive paradigm. This paradigm tried to make sense of the world. When the researcher would witness differences between expectations he would dig to find out why really. In many of the cases he would infer the mismatches. Now the problem with interpretive method, there seems to be no correct or
wrong theory (Willis 1995). If nothing cannot be proved as incorrect then it has to be accepted. The researcher was forced to accept certain behaviour changes only because they could not be proved irrelevant. From the third aspect of the paradigm, the critical type would not observe developments from the surface. The process digs down and needs reasons as to why things happen the way they have done (Guba and Lincolin 1994). In my study certain behaviours would not be described as changes or patterns or shifts. They probably would be seen as extensions of the old regime. These were conditional and it made their study uncertain.

So it can be noted that paradigms play a key role in the execution of a research. Of particular note should be the three key levers of the quantitative system. There is validity, reliability and broad applicability. Validity refers to the extent to which an instrument measures what it is supposed to measure. The interview, tests and exercises given did just what was expected. The aspect of reliability referring to the extent to which an instrument continuing to give consistent results no matter the condition prevailing as long as there are no monumental shifts. The idea of broad application is about a system being able to apply to many situations.

The paradigms that the researcher used applied to the present study specifically. In as far as tests were concerned the researcher employed the quantitative approach. This is so because marks which were recorded and presented as quantities on tables and graphs are quantities. Graphs used included the histograms, pie charts and Bar-charts of which had an aspects of quantity. Thus practically the two aspects, quantitative and qualitative techniques were used but with the qualitative having a dominant effect. The reason why dominance by the qualitative was mainly because exploitation on the didactic contract needed more of inferences than calculation (quantities).

As might have been alluded somewhere in the study, the paradigms held play a key role and their justification can be spelt out here. First the qualitative style has been made dominant because of some or all of the findings which follow. “Process is more than outcome”
(Richardson, 1995). As learners are busy doing the learning, their behaviours are better understood as they manifest quite easily. As a real example under the didactic contract as learners do the learning and the researcher would be observing the behaviour changes which included facial expressions, beliefs and skill expositions. For groups of people learning, the qualitative method of understanding their behaviour has proved to be a useful tool (Price, 2002). You are touching on too many aspects here

As human behaviour is complex the use of quantitative research would not cover much ground rather it is the qualitative approach which can unearth the various needed information systems within human behaviour (Domegan and Fleming 2007). Pre-tests and tests are not suitably explored by qualitative though but the quantitative approach as they involve quantities which are objective analysis. As human behaviour is complex an approach that calls for a scenario encompassing multiple reality and the understanding of social situation is the right tool to use.

This qualitative approach that the researcher used was seen to be flexible and the research design comes out as the project advances. There are no hypotheses that are needed before hand. I as a researcher had no hypothesis already prepared as human behaviour is unpredictable. Most of the developments witnessed were inductive (followed each other almost naturally. The other strong part approach is that as a researcher was participating he also was observing behaviour changes within the learners in particular. Also the qualitative approach is context based, that is to say the meanings derived are restricted to the present study.

On the other hand when the researcher used the quantitative approach on tests, the advantages included the fact that this approach has what is termed ‘single’ reality. No two ways about a test result thus the score found by students becoming a straight issue of success or failure. As the issue of tests was part of the exercise the aims were the formulation of hypothesis was needed right at first. This method ‘closed’ all gaps that might have been left out by the previous approach so this brought out a complete study of the didactic contract. Further the quantitative
approach was deductive as the results found shed a picture of the contract. The only disadvantage of the quantitative approach might be the fact that as a researcher one just becomes an observer as learners struggle especially with the test, but the results of a well-constructed test and its analysis in terms of the didactic contract are universal. Thus universality calls for exactness on the upholding of global standards for the sake of reliability, dependability and validity. Thus generalizations under the quantitative approach can be made quite easily. So in summary the qualitative approach chosen showed that participants should understand meanings for what they were doing. Under the same approach unidentified phenomena in the past could be explained at the end by qualitative approaches. Processes were understood much more clearly than before. On disadvantages there was research bias, which was counter-balanced by the test. The unequalness of subjects was another setback which the researcher allowed participants to be interviewed on two separate platforms. One being the individual interview, focus group interview and finally the test. All those combinations had the potential of bringing accurate information about the effects of the didactic contract. One more disadvantage maybe that the analysis of results may be biased but the researcher worked with the other three teachers to come up with fair results and fair result analysis. Thus fairness was practised at a high level as data came from various sources.

3.2 RESEARCH DESIGN

Macmillan (1989) defines a research design as a plan and structure of investigating used to obtain evidence. Gabriel (1989) defines the research design as an overall plan of how a research can be conducted. The plan should address issues such as where, whom, when and others in the bid to obtain accurate data. In the present case four teachers were involved in teaching learners.

The topic to be handled was “Geometrical transformation”. The isometrics (rotation, reflection and translation) were dealt with. The three teachers who accepted to help belonged to the maths
department. The fourth teacher was the HOD (Mr Dzingisai). The 40 learners (form 4) were taught as a single class. The teachers who helped accepted supervision from the researcher without any grudge. After lessons which were carried for over three weeks, the teachers would regularly come for a briefing where progress would be discussed. The researcher himself taught in either class and also came up with findings. When it was felt that enough had been done then the test was given to the class. It should be noted that objectives from the teachers were the same. The teachers started with translation, moved to reflection and rotation at last. Pupils were asked to provide their own stationary for example graph papers, pencils and any other necessary equipment as the school could not provide. Interviews are known to be very necessary as Christensen (2004) points out that this instrument helps researchers solicit information from participants. Also tests as is generally known tell a lot on the making of objectives for the study. Experience has taught us that a well formulated and well supervised and weighted test is a true barometer of the amount and quality of data gained. So tests are very good instruments for use.

Thus the present study design must give a clear course of action starting from who was involved and why. It should also spell out what was being done and why, how it was done and why. If the three basic questions can be answered then this research design would be complete.

Further with the explained research design above there are advantages and disadvantages that the design is attached to. First there is the idea of teaching the class of 40 using any method available that’s giving the students the opportunity to master any one. The only disadvantage of the design might have been probably the involvement of inexperienced teachers for a tough topic like Geometrical transformation. The ‘gap’ between what teachers expect and what learners revealed could have been made worse by the inexperience of some members involved. When results are analysed what really could have caused the breach may not be clear enough. Gabriel (1989) rightly puts it that a research design is an overall plan. Within the plan interviews and tests are also part of the system. For interviews they make the gathering of information quick. This is a quick method as interviewees need not write down any answers. They answered as quickly as they could. Besides the above, interviewers could ‘read’ some
information form respondents faces (Chimedza 1999). Also some questions may be answered well before they come because respondents tend to expand answers even when they are not supposed to do so, so time is cut. Probably a disadvantage of an interview maybe that some people may not be serious with their answers, so the researcher tried to ‘set’ the correct stage for honest answering. Again as part of the overall design tests written at the end of the exercise meant a lot. For a well-structured test, what the learner has understood comes out like that thus a test is one of the most appropriate instruments for examining understanding of concepts. Thus the use of tests and interviews can be justified.

For the involved class worksheets were provided so that group work complements individual work. The said worksheet would have been designed cooperatively by the teachers involved so as to facilitate group discussions as it is felt through discussion in groups, learners learn a lot in terms of skills and behaviour changes.

Thus as indicated in the sub topic earlier on, the research design is a guiding tool which gives direction. The given direction may include all or some of the listed which will include methods of data collection, instruments for data collection which will include interviews and tests. Now as a way to sum up only this part it should be noted that the researcher also planned how the teachers were going to carry out their lessons and how the tests and exercises were going to be held. Fortunately for the interview it was the HOD who carried out the exercise of course with consultations with department members. Tests and the exercises were there for objectivity which is of great importance in researches. In interviews held, the researcher was examining the conduct of lessons and learners evaluations which would help find out how the contract would be involved. Now out of the 40 learners 6 were going to experience a more intense interview to improve our observations and conclusions on the types and effects of the components of the didactic contract

3.2 DATA COLLECTION PROCEDURES

Data collection procedures are those processes that are followed in order to collect data from a chosen sample (Tuckman 1994). The researcher sought permission from the School Head of Madamombe for him to carry out research with a form four class. The researcher also asked from the head of the station permission to be assisted by Department members who in turn accepted to offer as much help as was possible. Special appointments were held by the teachers who gave their time-tables which would then be used by the Head of Department to carry out his research. For the data to be collected then exercises and tests were chosen as they would measure the aspect of skills and knowledge gained in direct relation to the didactic contract. The interviews held would unearth both the skills, knowledge aspects (domain based) and the
general didactics for example rule changes, rule abiding, responsibilities sharing, expectations from the teachers and expectation from the student side. The expectations would be the general rules as per contract. The specific rules entailed the objectives teachers set as they go for specific lessons.

As teachers went on with their lessons they would give exercises and from the performances they would see the responses. They would find out how their objectives tally with the learners’ performances. Even participation in the class would tell teachers how much has been gained and how the learning rules are being followed or “ruptured”. To some extent these developments helped the researcher come up with effects of the didactic contract as the learning exercises progress. The researcher would make notes and compiled them as parts of the needed proceedings. Even pupils’ comments on subject/topic toughness was part of the findings.

It should be noted that for interviews, findings would be logged in a corded document and similar responses would be grouped according to their correlation as part of correct responses. The only possible problem could be subjectivity when it comes to similar responses warded differently usually the work of synthesizing has problems.

Anywhere the researcher tried his level best to represent information as presented by the respondents. On collecting test results just a mark register was needed and it was quite straightforward. The mark for a learner was known as recorded and which parts were failed constituted some of the information recorded by the researcher. The recorded information besides marks would confirm each marks existence. The comments meant that the teacher’s expectation and the learners’ were supposed to be examined. This examination meant the exploration of the didactic contract.

3.3 POPULATION

Population refers to the totality of cases or figures in an investigation (Chimedza 1999). In the same text a population is referred to as the target population, underlying population or universe. Ravntree (1981) refers to population as a statistical term which refers to an entire set of entities that are relevant to the study. Best and Kuhn (1993) refer to a study population which is a group of individuals that have one or more characteristics in common that are of interest to the researcher.

3.4 SAMPLE AND SAMPLING TECHNIQUES

A sample is part of a population selected for the study in an investigation (Chimedza 1999). Tuckman (1998) defines a sample as a representative group from the population that serves as respondents. In my research, the sample is the form 4 one class of 40 students that were chosen. In choosing this class I used the hut technique and 4A1 came out winners. This method is an
example of simple random sampling. Of course the choices were limited. If they were many the researcher could have used the random number system which would see participants given numbered cards. If a student would correspond to a chosen card then he would be accepted as part of the sample. These have sizes that are acceptable depending on the situation obtaining. As an example Cox and West (2001) suggested that a sample should be 50% and not less than 10% of the population. In my case in general one class (40) out of 3 (120) means 33% which is within range {40 out of 120 is fair}.

For the sampling techniques used the researcher saw the simple random method as the best among the three Form 4 classes only. It depended on the concept under the study. Form ones, twos and even threes could not do it so there was some purposive sampling at first. This refers to almost judging which to exclude straight away. Here some form of purposive sampling was done with the aim of targeting the appropriate elements. This method was suggested by Thomas (2009) where there was necessity and the need to cut costs and time. In as far as Haralambos and Holborn (1995) sampling means the selection of a group of people to represent a large population. Springer (2010) refers sampling to a process where a member is chosen to become part of a chosen few (sample). Thus a sampling technique is a method used to choose members of a sample. When the form 4 class has been chosen, there was no need for any other selections as the class was already there for being studied.

3.5 DATA COLLECTION INSTRUMENTS

THE TEST AND EXERCISES

Basically there were three components of the knowledge domain by the names of rotation, reflection and translation. When learners were done with a single aspect an exercise would be given and at the end of the three aspects a major test was given. This test is thought to have been comprehension enough as it covered the objectives of the three sub-topics. General the objectives to be met include;

1 define, (a) translation (b) reflection (c) rotation.
2 plot images of figures after they had been (a) rotated (b) reflected (c) translated.
3 combine the transformation, translate, rotate and reflection.

Also the exercises given were based on the topic dealt with currently. From the test a lot could be deducted pertaining the didactic contract’s state of affairs. As a result of time limitations the test (final one) was short and was written in an hour.

INTERVIEWS

Besides the test and the exercises used as a way to collect data, the interview was also used. An interview according to the Chikoko and Mhloyi (2000) is a face to face questionnaire. The
interviews enabled the researcher to gain more information on attitude changes, beliefs, perceptions, knowledge, experiences and the understanding of the problems being researched. The interview is the dialogue between the researcher and the respondent. According to Litchman (2010) an interview is more flexible than a questionnaire as in an interview questions can be followed and further refined and redirected. The researcher can gain from verbal and non-verbal responses. Chiromo (2006) concurs with other scholars dealt with above when he agrees that researchers gain a lot from facial expressions and gestures. Now in any case interviews enabled me to gain knowledge on the effects of the didactic contract both in behaviour change and in real mathematics skills gained.

On how the lessons went on and the understanding of concepts and skills and knowledge gained learners were open enough to express their persistent confusion on the isometric operations especially reflection and rotation. Translation was a bit straight forward according to most respondents. As respondents were expressing their judgement one could see some frustration and lack of confidence. Even though an interview guide was present, there were some questions which needed redirection and further refining depending on some of the respondents. Even though an interview is verbal so to speak students would need to jot down as they explained issues of non-compliance. One major concern of interviews was the difficult that would be encountered when it came to recording findings as responses to a single and same questions had dimensions depending on the respondent’s motivation.

3.6 DATA ANALYSIS PROCEDURES

Data was captured by interviews, tests and exercises and by simple observation. Data captured by test is not a problem as after the tests had been written, the papers were marked and scores were recorded and question by question analysis were made and recorded. It is the section on observation where it was not too easy to determine the breach of the didactic contract or the effect of the didactic contract so easily. At first, as an example learners seemed to lack confidence. At last confidence seemed to have been gathered. What went on between may not be too clear as to whether it was effect of the contract or other variables such as whether or other factors inherent in peoples as beings. So even though observations were made, other factors could have attached themselves to the contract but as hinted either on under assumption the effect or changes experienced should be taken as the result of the didactic contract.

For interviews, as there was a guide, it looked quite simple and practical. Learners were asked as to how the concept compared. As a working example many witnessed that translation was no problem. Rotation especially the centre and angle of rotation ideas were tough just to express
it as it was conveyed to the researcher. Of course as per plan the two sides of the effects of the didactic contract, that is the skill part and the behaviour part needed to be researched and results needed on exactly what changed in the two fields. Yes the aspect of results is not for this chapter and it shall be seen in the forthcoming chapter. As already been hinted the issue of didactic contract needs inferences and jacket straight proofs some analysis shall probably encroach into what may be termed “offside” territory but the research has tried to make clear boundaries so that result analysis becomes as understandable as is possible.

3.7 PRESENTATION OF FINDINGS

Findings were presented in two basic methods. Some could be represented by graphs for example bar chart and pie charts. Tables could also be used to represent the findings. The second basic method dealt with detailed explanations and summaries of what went on. Interview results were also tabled accordingly. From the same tables, bar chats and his pie charts could be used. Even though with pie charts and bar charts drawn, explanations were made that had something to do with the represented results. Pie charts were also used and after them explanations were done to give a picture of what went on. Thus the research findings were presented in variety of ways which showed the need for clarity and diversity which helps understanding.

3.8 SUMMARY

The chapter on methodology began by defining the key term “methodology”. It described the research paradigm, research design, population, sample, and sampling techniques. It went on to discuss particularly qualitative and quantitative approaches. Data analysis and data presentation were also dealt with. It dealt with data collecting tools for example the interview, tests and the literature review was another hidden data collection tool which just appeared as a point of reference. The researcher was given direction by a number of writers, scholars and other educational expects who have history of theory in question or who had written something on the topics dealt with for example on paradigms and research designs. So this chapter three shall lead to chapter 4 which shall deal with presentation, interpretation and discussion of findings.
4.0 Introduction
This chapter shall concentrate on key issues such as data presentation, interpretation and discussion on findings. Presentations shall be in the form of bar-charts tables and pie charts. Discussions shall be on both quantitative and qualitative approaches. The researcher shall try to show the relevance of each paradigm used and shall try to make it clear enough that though the two aspects that is quantitative and qualitative approaches are used they help each other to complete the gap and shall also bring the behavioural aspect to the open. Human behaviour cannot be studied in completion by quantitative means but by qualitative ones. Also the use of a variety of data collection and representation techniques was a direct response to the need for reliability, validity and generalisation (all under quantitative approach). On the qualitative approach such ideas as triangulation and intense explanations and discussions were done. In qualitative approach reliability cannot be as human behaviour is not static.

On the part of qualitative data results shown and explanations must make up the foundations and superstructure of the research. According to trustworthiness (the extent to which data and its analysis can be believed) make up pillars of the discussion on human behaviour. The data to be dealt with shall be on exercises, test, general interview and a special interview given
which was a result of observations and comments made by participants. The researcher shall
deal with exercises first, test, interviews and the special interview- observation lastly.

4.1 Data Presentation

Exercises

Exercises 1: Translation

<table>
<thead>
<tr>
<th>Question</th>
<th>Concept</th>
<th>Success rate</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Defining</td>
<td>20/40</td>
<td>Wording problems</td>
</tr>
<tr>
<td>2</td>
<td>Plotting translate</td>
<td>30/40</td>
<td>Good scales</td>
</tr>
<tr>
<td>3</td>
<td>Translate</td>
<td>30/40</td>
<td>Good responses</td>
</tr>
<tr>
<td>4</td>
<td>Translate</td>
<td>26/40</td>
<td>Subtraction problems</td>
</tr>
<tr>
<td>5</td>
<td>Comment</td>
<td>16/40</td>
<td>Poor comments</td>
</tr>
</tbody>
</table>

Table 4.1.1

Learners were weak on commenting. Generally the success rate was 61% meaning good performance on the concept in question.

Exercise 2: Reflection

<table>
<thead>
<tr>
<th>Question</th>
<th>Concept</th>
<th>Success rate</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a) (i)</td>
<td>Plotting Reflection (x = 0)</td>
<td>18/40</td>
<td>Fairly done</td>
</tr>
<tr>
<td></td>
<td></td>
<td>14/40</td>
<td>Not well done</td>
</tr>
<tr>
<td>b)</td>
<td>Reflect (y = 0)</td>
<td>12/40</td>
<td>Difficult</td>
</tr>
<tr>
<td>c)</td>
<td>Reflect (x =y)</td>
<td>10/40</td>
<td>Difficult</td>
</tr>
<tr>
<td>d)</td>
<td>Matrix use</td>
<td>8/40</td>
<td>Failing to perform</td>
</tr>
<tr>
<td>E</td>
<td>Comment I</td>
<td>14/40</td>
<td>Poor skills</td>
</tr>
<tr>
<td>F</td>
<td>Matrix use</td>
<td>10/40</td>
<td>Not satisfactory</td>
</tr>
<tr>
<td>H</td>
<td>Compare and comment</td>
<td>12/40</td>
<td>Not satisfactory</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>49/100</td>
<td></td>
</tr>
<tr>
<td>Percentages</td>
<td></td>
<td>30,6%</td>
<td></td>
</tr>
</tbody>
</table>

Table 4.1.2

A success rate of 30,6% is well below average and the teacher’s expectations and this is an indication of the difficulty of the concept and is an example of a breach of the contract.

Exercise 3 (Rotation)

Table 4.1.3

<table>
<thead>
<tr>
<th>Question</th>
<th>Aspect</th>
<th>Success rate</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Plot</td>
<td>32/40</td>
<td>Very good</td>
</tr>
</tbody>
</table>
The comments very good, fair and below average refer to the rating by the researcher on an aspect or concept’s understanding level. The concept of rotation has a big success rate in this exercises. Thus, it should be noted that the rotation 180° was problematic to the learners despite the success.

Project test

Table 4.1.4

<table>
<thead>
<tr>
<th>Question</th>
<th>Aspect</th>
<th>Success rate</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1(a)</td>
<td>Plotting</td>
<td>28/40</td>
<td>Good</td>
</tr>
<tr>
<td>b)</td>
<td>Translation</td>
<td>22/40</td>
<td>Fair</td>
</tr>
<tr>
<td>2(i)</td>
<td>Reflect (x =0)</td>
<td>20/40</td>
<td>Fair</td>
</tr>
<tr>
<td>ii)</td>
<td>Reflect (y = 0)</td>
<td>18/40</td>
<td>Fair</td>
</tr>
<tr>
<td>iii)</td>
<td>Reflect ( x = y)</td>
<td>14/40</td>
<td>Below average</td>
</tr>
<tr>
<td>3a)</td>
<td>Plot</td>
<td>24/40</td>
<td>Good</td>
</tr>
<tr>
<td>b)</td>
<td>Rotate 90°</td>
<td>18/40</td>
<td>Fair</td>
</tr>
<tr>
<td>c)</td>
<td>Rotate 180°</td>
<td>16/40</td>
<td>Below average</td>
</tr>
<tr>
<td>4</td>
<td>Matrix use</td>
<td>12/40</td>
<td>Poor</td>
</tr>
<tr>
<td></td>
<td>Plotting</td>
<td>8/40</td>
<td>Poor</td>
</tr>
<tr>
<td>Percentage</td>
<td></td>
<td>45%</td>
<td>Poor</td>
</tr>
</tbody>
</table>

An overall rate of 455 shows weaknesses on the concepts of the test. Much of the problem seems to be centred on reflection and matrix use. Determination and use of axis of reflection had been stumbling blocks.
Main interview results

1. Definition of isometrics – 26/40 of the learners could define isometrics quite clearly while 14/40 could not and this showed that a good number of learner have difficulties with reporting. Describe some of the definitions given

2. Translation

Table 4.1.5

<table>
<thead>
<tr>
<th>Translation</th>
<th>Easy</th>
<th>Moderate</th>
<th>Very difficult</th>
</tr>
</thead>
<tbody>
<tr>
<td>frequency</td>
<td>24</td>
<td>10</td>
<td>6</td>
</tr>
<tr>
<td>Percentage</td>
<td>60</td>
<td>25</td>
<td>15</td>
</tr>
</tbody>
</table>

The terms easy, moderate and very difficult were used to refer to the level of understanding by the learners on the concept translation. Moderate referring to not too difficult nor too easy.

Slopping leftwards to indicate increasing easiness. A rate of 60% shows that translation is easy.

3. Reflection

Table 4.1.6

<table>
<thead>
<tr>
<th>Translation</th>
<th>Easy</th>
<th>Moderate</th>
<th>Very difficult</th>
</tr>
</thead>
</table>
The bar-chart shows a distribution which is a normal one as the extremes balance and the in-between shoots up above the wings. Overall the moderate rating dominates and when added to 27.5% of the easiness then it shows that the concept of reflection was accepted.

Table 4.1.7

<table>
<thead>
<tr>
<th>Rotation</th>
<th>Easy</th>
<th>Moderate</th>
<th>Very difficult</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>8</td>
<td>11</td>
<td>21</td>
</tr>
<tr>
<td>Percentage</td>
<td>20</td>
<td>27.5</td>
<td>52.5</td>
</tr>
</tbody>
</table>

A rating of 52.5% on very difficult on rotation shows the extent to which the concept is viewed

5. **Rotation, Reflection and Translation**

Table 4.1.8

<table>
<thead>
<tr>
<th>Isometrics</th>
<th>Easy</th>
<th>Moderate</th>
<th>Very difficult</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>8</td>
<td>10</td>
<td>22</td>
</tr>
</tbody>
</table>
Overall the aspect “very difficult” for the whole topic of isometrics dominates.

7. Conduct of lessons

Table 4.1.9

<table>
<thead>
<tr>
<th>Translation</th>
<th>Fairly well</th>
<th>Well</th>
<th>Very well</th>
</tr>
</thead>
<tbody>
<tr>
<td>frequency</td>
<td>5</td>
<td>10</td>
<td>25</td>
</tr>
<tr>
<td>Percentage</td>
<td>12.5</td>
<td>25</td>
<td>62.5</td>
</tr>
</tbody>
</table>

The handling of lessons was well done as a convincing percentage of learners revealed that. The 62.5% for very well is a big success.

Table 4.1.10

<table>
<thead>
<tr>
<th>Rotation</th>
<th>Fairly well</th>
<th>Well</th>
<th>Very well</th>
</tr>
</thead>
<tbody>
<tr>
<td>frequency</td>
<td>15</td>
<td>10</td>
<td>15</td>
</tr>
<tr>
<td>Percentage</td>
<td>37.5</td>
<td>25</td>
<td>37.5</td>
</tr>
</tbody>
</table>
Fairly well and very well are having each 37.5%. The other aspect which is ‘well’ having 25%. The three almost balance. Thus the concept of rotation seems not to have been well received in general

9. Instructions

<table>
<thead>
<tr>
<th>Instruction</th>
<th>Clear</th>
<th>Not clear</th>
<th>Vague</th>
</tr>
</thead>
<tbody>
<tr>
<td>frequency</td>
<td>18</td>
<td>10</td>
<td>12</td>
</tr>
<tr>
<td>Percentage</td>
<td>162°</td>
<td>90°</td>
<td>108°</td>
</tr>
</tbody>
</table>

Table 4.1.11

An angle of 162° dominates so there is clarity on instructions

10. Class rules

<table>
<thead>
<tr>
<th>Class</th>
<th>Simple</th>
<th>Difficult</th>
<th>Complicated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>25</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>Percentage</td>
<td>225°</td>
<td>90°</td>
<td>45°</td>
</tr>
</tbody>
</table>

Table 4.1.12
11. Prior knowledge of existing rules

<table>
<thead>
<tr>
<th>Rules</th>
<th>All ten</th>
<th>None</th>
<th>Between 1 and 4</th>
<th>Between 5 and 9</th>
</tr>
</thead>
<tbody>
<tr>
<td>frequency</td>
<td>2</td>
<td>3</td>
<td>25</td>
<td>10</td>
</tr>
<tr>
<td>Angles</td>
<td>18°</td>
<td>27°</td>
<td>225°</td>
<td>90°</td>
</tr>
</tbody>
</table>

Table 4.1.13

Generally between 1 and 4 rules are known thus the majority of the learners have not idea of the full rules.

12. Methods

<table>
<thead>
<tr>
<th>Method</th>
<th>Lecture</th>
<th>Discovery</th>
<th>Exposition</th>
</tr>
</thead>
<tbody>
<tr>
<td>frequency</td>
<td>21</td>
<td>10</td>
<td>9</td>
</tr>
<tr>
<td>Angles</td>
<td>189°</td>
<td>90°</td>
<td>81°</td>
</tr>
</tbody>
</table>

Table 4.1.14

The table shows the dominance of the lecture methods (189°/360°).
13. Level of understanding

<table>
<thead>
<tr>
<th>Level of understanding</th>
<th>Yes</th>
<th>Not quite</th>
<th>Not at all</th>
</tr>
</thead>
<tbody>
<tr>
<td>frequency</td>
<td>6</td>
<td>24</td>
<td>10</td>
</tr>
<tr>
<td>Percentage</td>
<td>15</td>
<td>60</td>
<td>25</td>
</tr>
</tbody>
</table>

**Table 4.1.15**

60% of the respondents indicated a not quite stance which showed that the success rate (understanding) is far below expectations.

14. Revision needed: Table 4.1.16

<table>
<thead>
<tr>
<th>Revision</th>
<th>Translation</th>
<th>Reflection</th>
<th>Rotation</th>
</tr>
</thead>
<tbody>
<tr>
<td>frequency</td>
<td>8</td>
<td>17</td>
<td>15</td>
</tr>
<tr>
<td>Percentage</td>
<td>20</td>
<td>42.5</td>
<td>37.5</td>
</tr>
</tbody>
</table>

Reflection and rotation have come out clear that they need revision. So they are tricky areas.

15. Expectations of the lesson ahead

31/40 which is equivalent to 77.5% showed that they had no idea of the lesson ahead.

16. Revision of Reflection

Revision on reflection indicated that of reflection. 7.5% needed reflection axis of reflection and 20% on matrix use.

17. Revision on rotation

30% needed revision on matrices while 42.5% needed revision on manipulation of rotated figures.

18. Teacher ratings

Teacher effectiveness was rated as follows: (0-49)% got 50% of the respondents which showed lack of confidents on a huge chunk of respondents (50-69) % got 37.55 of the respondents (70-100)% got 12.5% of the respondents. As already concluded too many learners showed no respect on their teacher performances. What was the basis of such a rating
Self- rating
Learners rated themselves on confidence and skill development in general and for the ratings 0-49%, 37% of the respondents placed themselves in this low rate. For the class (50-69)% 52, 5% of the respondents placed themselves.

19. Teacher demands
62, 5% of respondents confessed that they did not understand teacher demands. The 25% from students who think that teachers are good trainers is a somewhat small figure which was expected to be larger by far. The 22.5% who had no response also did not go down well with the researcher as this number is too big.

20. Content depth
There were the categories;
Too shallow: 12, 5% enoug; 62.5% too difficult 25%
Understanding was reported here as 62.55 indicated.

21. Importance of Isometrics
Really important 5% not very important 25%
Not relevant 70%
70% showed the non-relevance of isometrics.
This already shows a negative state of the respondents’ minds.

22. Final rating- Teacher rating
Not responsible : 9/40 : 22, 5%
Good trainers : 10/40 : 25%
Boring and lazy : 21/40 : 52, 5%

52, 5% of the respondents thought that the teachers were lazy and boring. This stance is associated with lack of confidence and poor achievement. Which research question was being addressed here

4.2 Findings and the didactic contract
A number of findings have been made in the results of test, exercises and interviews together with observations. Methods used matter a lot in terms of achievement. Learners favour the
lecture method because it gives the less tasks but real learning is minimum. Samaelson (1999) refers to the lecture method as a vague in what senseway of teaching. Thus it should be discouraged. For manipulative skills learners must do the exact skills learners must do the exact skill they need to master later. Real involvement is necessary and without it skills cannot just come (Liberg 2010). The didactic contract has revealed that teachers should create an enabling environment somehow. If teachers are not effective in this area then students suffer. Doverberg (1999) also supposed the idea of teacher created conditions being necessary. In my study teachers gave learners enough time to study and directed them on what to study. Attitudes too needed to be adjusted as if wrong attitudes are within learners, there is discord in the process. If work is given and learners are to discuss and work it out they have to do just that. It is possible if learners trust their teachers.

In the special interview carried out, it was revealed that learners fall into various categories of the didactic contract. Each type of the contract enables a learner to solve problems in a special way. The special way depends on the exposure the learners went through so teachers must be particularly careful as to what method to use and why.

4.3 Overall findings on the interview

A run down the interview results shows the difficulties of the concepts, rotation and reflection. Translation has been seen to be an easy concept. Manipulation of figures to follow instructions has been quite a task. Learners revealed negative attitudes on teacher capabilities and their own confidence and have shown the non-significance of the topic being studied. Generally attitudes, beliefs and perceptions play a key role in attainment.

Overall 70% of the respondents thought that isometrics were not relevant and this alone affects the zeal to learn and commit oneself. Lastly 67% thought that the learnt content was enough and a good number believed that instructions were clear. Honestly to sum it up there is confusion among learners as on one hand they say they have understood concepts. Completely yet they fail tests and exercises meant to test the same concepts they claim to have grasped.
## Special group interview results

**Table 4.3.1**

<table>
<thead>
<tr>
<th>Learner</th>
<th>Concept</th>
<th>Most dominant contract</th>
<th>Comment on expectations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A</strong></td>
<td><strong>Reflection</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- able along ( y = 0 )</td>
<td></td>
<td>Reflection not done well</td>
</tr>
<tr>
<td></td>
<td>- no ( x = 0 ) ( x = 7 ) done</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Plotting</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- okay for ABC</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Rotation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Plotting of DEF was alright</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- no images seen for both ( 90^0 ) and ( 180^0 )</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Ostension</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>exposure</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Ostension seen</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Lack of adidactical contract</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Reflection</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Reflection not done</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Plotting well for both rotation and reflection</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>No rotation done at all</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>B</strong></td>
<td><strong>Reflection</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- nothing for either ( x = 0 ) ( y = 0 ) or ( x = y )</td>
<td></td>
<td>Nothing done for reflection</td>
</tr>
<tr>
<td></td>
<td><strong>Plotting</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Alright for reflection and rotation</td>
<td></td>
<td>Students revealed lack of real practice</td>
</tr>
<tr>
<td></td>
<td>- no manipulation of figures at all</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- scales poorly</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>C</strong></td>
<td><strong>Reflection</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- nothing on any axis</td>
<td></td>
<td>Nothing done on reflection</td>
</tr>
<tr>
<td></td>
<td>- plotting a bit better</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Rotation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- no figure rotated</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- no proper scales</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Ostension contract seen</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Ostension contract</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Lack of adidactical contract</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Nothing done on reflection</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>-some skills on plotting</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>No evidence of practice</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The table above was a summary of the findings on the special interview carried out to determine the types of the didactic contract forms at play in the learning process. Generally the table indicated a tendency on the majority of learners under the Ostension contract falling.

Their inability to plot manipulates and finds other possible ways of solving problems was a clear indication of lack of practice and the use of improper methods of learning. The methods would not give the learner enough time to play around with concepts so as to understand them.
complete. Just a few of the learners showed the existence of the didactical contract which is most favoured by many scholars as it allows the learner to discover concepts using her/his own senses. The later method is the bases of learning. Also it should be noted that the Mayeutic Socratic contract was not so dominant which may mean that teachers who carried out the work did not favour it.

**Behavioural tendencies associated with didactic contract**

As the previous section concentrated on the quantitative aspect of the findings this part should concentrate on the qualitative aspect.

Under the Ostention contract, the teacher would give examples, properties and techniques and students accepted them. The teacher was the centre of learning. This reveals that the students were passive receives of content and lacked practice concerning the origins of the knowledge they were supposed to take. This lack of practice might have driven confidence away from learners and the achievement of tricky concepts such as reflection and rotation could not be under such conditions.

Also under the Socratic contract style the teacher would not give learners time to discover knowledge on their own as the teacher would ask too many questions which he/she wanted learners to answer quickly. If learners failed the teacher would give solutions anywhere. Still learners lacked practice and sometime confidence and trust on the teacher who seemed to be concerned with results and not the process or the subjects’ welfare. Learners had no freedom of full interaction either with the object of study or with the environment or amongst themselves. Thus learning conditions were not free and no proper learning would take place.

Now under the potential adidactical contract proposed by Morgolinas (1993) the teacher creates conditions students evoke, formulate, rationalise and justify propositions. Teachers assign work for learners to practice skills. Teachers act as facilitators and wait to institutionalise ideas. Thus learners are supposed to be fully engaged and know what is going on all around them and why.

Learners respect other learner views, opinions, values, beliefs and arguments. Learners would challenge other learner views openly. At first many learners were not prepared for a challenge especially from another student. Thus teachers trained learners on a variety of skills such as to argue, communicate precisely and to know how to learn (Meta cognition). Thus teachers’
worries should include ideas as how best learners can be free and responsible in the learning process. The teacher’s dominance should be removed and the environment should allow critical thinking and creativity.

To sum it up, the researcher discovered that most learners respected their teachers. Learners had learnt to justify their solutions and interactions would just happen as and when the need arose. Student would ask each other and would answer each other. At first there was dead silence in lessons but as the process progressed real learning behaviour had been struck.

4.4 Summary
The chapter concentrated on data presentation, data analysis and discussion of findings. The chapter also came up with ideas on how the teacher can enhance learning by providing the correct methods such as those that involve constructivism. Methods used should be geared towards student involvement. Methods used should be geared towards student involvement. Also attitudes should be of the right mode for learning to take place. Also learner performance in terms of the existence of the three constructs of the didactic contract need to be highlighted. It was revealed that most learners fell in the Ostension contract and maybe some part of the Mayeutic contract in the way they worked problems. Just a few showed the existence of the adidactic contract. The manipulation of figures by some students showed the existence of the above contract. Of special note too should be the way teachers deliver their lessons. If learners are trained to discover concepts on their own then this becomes part of their learning and it is long-lasting.
Thus as the chapter has done enough it leads to the next one which concentrates on conclusions, recommendation, references and others.
CHAPTER 5
SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.0 Introduction
The last chapter, chapter 4, deals with data presentation, data interpretation and the discussion of findings. Data presentation was in the form of tables, pie-charts, bar charts and also general discussions were made. Interpretations were made on the drawn graphs and tables many of the tables had percentage conversions which made interpretations easier. Also a number of findings were made on the effects of the didactic contract to be precise. Even here it can be noted that the concept “didactic contract” plays an important role in the teaching-learning processes. Lastly discussion were made on a relatively wide spectrum which touched the test, exercises, interviews and observations all trying to close the mismatches in lessons. All having been exposed on the previous chapter then next are the contents of Chapter 5 which will deal with the summary, conclusions and recommendations of all the work done in the research.

The summary shall deal with the key issues discussed per chapter. Conclusions and recommendation will follow later. The conclusions shall deal with what can be deduced from the results while recommendations shall relate to the way forward for the identified ‘gaps’ so that further researches can continue to improve the situation.

5.1 Discussion of findings
Findings for the results come from various sources for example test, exercises, interviews and observations. Somewhere there might seem to be contradictions on results but the researcher tried to coordinate the source and results to the best of his ability.

The first aspect deals with student perceptions of the importance of geometrical transformations. The researcher discovered that only 5% of the learners understand the importance of the concept under study (isometrics). If the concept is not valued then why the sweat. Thus this is the point which needs fixing. Isometrics are applied quite often for example, clockwork, vehicle ball bearings, and flywheel. All are rotation issues importance of concepts plays a key role in achievement as it gives direction and energy. The other issue deals with rating students’ ratings of their teachers has a bearing on their performance. If students rate their teachers very low then this shows lack of trust and drives away the much needed confidence. Also own ratings have a bearing on their performance. If students are not sure of
their performance and understanding then there is nowhere confidence can come from. It should also be pointed out that performances in the test and exercises and interviews indicated as in interviews learners indicated differences high understanding of concepts generally but when it came to tests scores were low. One wonders where the mismatches begin. The researcher saw lesson objectives, test content and exercise content and lessons taught. The instruments had correlated work and one wonders where the ‘ruptures’ come from. Also methods used may have had a bearing. Learners revealed a wider use of the lecture method. The method is fast but student practice lacks. Further students declaration of a 40% understanding of teacher demands is a setback as a bigger rate is expected for progress sake. Understanding of teacher demands reduces the deviations in class.

Fortunate for some learners at the middle of the process of learning developed own methods of dealing with manipulations on rotation and reflection. They used paper as a method to rotate a drawn figure on the paper and moved the paper as a way to effect the rotation. Other students used any given centre of rotation as if it was the origin. They would rotate figures and count squares considering their relative origins. All this was a result of the potential adidactical contract used by the teachers who gave students proper conditions. The unfortunate part came when the test came as the students who used the tracing paper did not bring it as a tool and life became difficult for them. For matrices many learners could not multiply correctly and as a result came up with wrong vertices. Interpretation lacked as some would still plot them as they were bad. Here there is an issue as to if a learner learnt a concept using a machine for example but for a test the machine could not be used. Then why was the machines used under training, one would enquire. It is a bit tricky.

Now to sum it up, learners should be trained to discover knowledge on their own. The teacher should create conditions for the student to investigate the concept in any possible way. This way real understanding can be achieved.

5.2 Summary of the study
This study intended to find the forms of the didactic contract and their effects in the learning of Geometrical transformational at Form 4 level (Zimbabwe Code).

Chapter 1 looked at key issues that included the background to the study, the statement of the problem, purpose of the study, Questions related to the study, significance of the study,
limitations and terms for definition. The background to the study focused on the comparison of the intended curriculum against the achieved. Here learners performed differently thus the core of the study. The background also looked at the sharing of responsibilities between the teacher and the learner because this decides how much the learner benefits. So basically chapter 1 and the background check for flow of ideas especially aimed to make it clear the intention of the whole study which was grounded on the “didactic contract”. The statement of the problem was about how and why learners, teachers and parents wonder the low pass rates in Mathematics at Form 4 level.

The purpose of the study gave a justification for the study which indicated that the study would influence adjustments to the way processes operate in the teaching-learning in classes. This study under purpose confirmed the marketability of Mathematics and its applicability all over the world. Research questions were dealt with and in short they referred to the types of the “didactic contract” and their effects in the learning of Mathematics. The significance of the study was also considered where the researcher, other researchers, school authorities and curriculum planners who are some of the actors were involved. Limitation were also discussed where the major one might have been congested time during which the study was carried out were students were preparing their examinations (ZIMSEC). Lastly the chapter defined key terms such as “didactic contract” and Form 4 level.

Chapter 2 was about the literature review. This centred on two major aspects which are the theoretical framework and the conceptual framework. The notion of the didactic contract was also examined.

In as far as the theoretical framework is concerned a number of scholars had written about it. One of them was Kroksmark (1987). The framework deals with the relations between teachers and learners and the “milien”. The contract also includes obligations and reciprocity that are necessary elements. Different teachers have different styles of operating and these styles are referred to as teacher variability. Learners should adapt to anyone given so as to profit from the process. Teacher behaviours should be known as some meanings may depend on teacher variability Sadovky (2005) pointed out to say negotiated. If the ‘negotiation’ is not done well meanings can be mixed or interchanged or distorted which can cause chaos.

Chapter 2 also dealt with the three forms of the didactic contract which included, the Ostentation, Mayentic Socratic and the adidactic constructs check here. The chapter went on
to stress the importance of learners’ preparedness to receive knowledge. This preparedness maybe affected by concentration levels, motivation or general interests. The conceptual demand of a task may affect the three aspects dealt with in pedagogical issues which may be caused by teachers who may use unacceptable methods to suit their day. One method may be the lecture methods where learners are not practising anything. The act of not practising anything is not recommended in Mathematics lesson as it usually causes non-attention and learners end up having misconceptions. These lead to wrong beliefs (Wayner 1981) and wrong actions (Brazzini 1995). If concepts are not understood or practised from the start, their applications become problematic (Martin 2005).

The chapter went on to examine the conceptual framework of the present study. The conceptual framework refers to the why part of the study (D’man 2000). This framework enables proper alignment of research questions, tools and methods (Arsac 2002). It enables data collection, description and interpretation. Data monitoring is enhanced and researchers reflect on their work. Thus the conceptual framework according to Arsac (2002) should enable the research work to be appropriately done and rigorous done. Now the history of the concept “didactic contract” started to be exposed by a Frenchman called Chavallard on the seventies (70s). The idea spread to Spain and later to Britain. In Britain it spread because of a man’s called Feremy, Kilpartrick. The chapter also included work on the triangle of relations in the didactic contract. This triangle included the teachers need to coordinate efficiently if the learner has to gain. It was also, seen that if the learning involves machines like today’s modern learning then the relationship has four components which will add the machine used as another participant.

Chapter 3 deal with the research design, research paradigms, population, sample, instruments of data collection, data analyse and presentation of findings. The aspect of design which refers to the overall plan is quite important in the research. In the present study the design made it clear as to how lessons were to be held and by who and when as well as how and why. A general test was given to the participants at the end of the process and in between a minimum of 3 exercises was given. All was done in the bid to examine the “didactic contract” in terms of its components and effects. Also data collection and data collection procedures were spelt out. Data collection was done in the form of interviews, test and exercise while data collection procedure meant the seeking of permission from the responsible authority. In the case of this study, the researcher sought permission from the Madamombe High School Headmaster. He also sought permission for the use of the Form 4 students. The chapter also dealt with the
sampling techniques used, the sample and population of interest. The population comprise From 4 classes (120 students) and the sample become one class of 40 chosen. The research thought of this sample as enough following, researched literature from such scholars as Smith (1995) who posit that a sample can be between 10% and 50% of the target population. For data analysis chapter 3 based it on the results of interviews, the test and exercises as well as observation. The chapter also include the key concept of the paradigm of a research. A paradigm underpins research work and in a way it is the heart of the research. These paradigms influence research designs, population, sample and instruments. Basically there are three paradigms in research. They include the positivism, interpretive and the critical paradigm. There are other offshoots for example the post modernisation and the post structural theories.

Ideally the positivism paradigm rests on objectivity in determining reality. Interpretive paradigms depend on negotiated reality. Critical paradigm depends on analysing processes down to their core. The postmodernisation become a blended product of positivism and interpretive paradigm. Here, it is the interpretive and the positivism paradigms which took the centre stage. Why In the present study both the positivism and interpretive paradigms were used where for the texts and exercises the positivism approach was dominant and for behaviour changes, the interpretive approach was used. When it came to the why the behaviour and so forth, them the critical paradigm become useful. Chapter 3 also dealt with the two major schools of analysing results which are quantitative and qualitative approaches. The quantitative approach was based on tests, exercises and for interviews and observations the qualitative became dominant. One might want to know why the qualitative approach. The qualitative approach was able to deal with signs as facial expressions, gestures and even silences because all had a message. The message could not be tapped by quantitative approaches. One more reason of why the qualitative approach, is that the results were to serve the stated population so s to give way for further researches.

Lastly there was chapter 4 which dealt with data presentation, interpretation and discussion of findings. Tables, bar charts and pie- charts were used. Also discussions were made on the results shown and behaviour changes that were seen. Chapter 4 made it clear by expressing most quantities as percentages for easy comparisons and real understanding of what was going on. Chapter 4 also discussed questions by question even though tables were not constructed for every situation. On the special interview results of learner workings (methods and results) were tabled and comments made against viewed concepts. Concepts under study included rotation,
reflection and translation in relation to the “didactic contract”. Also behavioural changes were examined in discussion and effects of the contract were noted. Thus for chapter 4, it was data presentation, interpretation and discussions on findings.

Now on constraints, a lot of them were met but the researcher shall just have a sample of them as relevance matters here. First the researcher worked under pressure as time was quite congested as the learners involved were quite congested as the learners involved where quite busy as they were preparing for their final examination. It was also noted that the teachers involved in the project had to do with old books and methods as modern teaching-learning not available. This equipment was development sort of forced teachers and learners to favour the lecture or talk chalk method in most of the cases. Adding to the confusion was the concepts being dealt with that is rotation, reflection and translation. Usually these do not encourage learners and as a result they need fine preparations and executions. Also the theme of the study, that is the “didactic contract” was not common and at first even the teachers involved were not quite clear of the intension of the researcher who also saw full light latter than sooner. The school setup and the general environment were not so ready for the study. When other students knew of their exclusion from a topic possible to come in examinations they felt segregated and it did not go well with them. Unfortunately such topics as Geometrical transformations are found on the choosing section of paper 2 and many teachers discourage students to answer them so students may not be too serious about them. Other constraints included the unpopularity of the constructivism concept where May learners do not favour it. They showed bad attitudes whenever they were asked to do discoveries on their own. They always wanted teachers to explain and do everything while they watched. Lastly a bigger sample could have been dealt with but, the problem would be on handling these people and the results. As coordination and coding would need more personnel. Even though it was a small sample that was used I hope the results still hold.

5.4 Conclusion

- Basically the main issues in this study relate to the didactic contract and its effects as well as the components of the contract. When the special interview was carried out a lot was revealed. First the three key components of the contract were revealed. They are the Ostentation, Mayentic and the adidactical contracts. Most learners were attached to the Ostentation contract probably because their teachers used methods aligned to the contract. Also there seemed to have been lack of modern equipment for use by learners.
Much of the test and exercises needed real manipulation of figures (shapes) and students failed. The main cause could be the limited exposure to the much more practical a didactical approach. Many teachers are unaware of the power and existence of this approach.

Determination of axis was not a problem except for $x=y$. Many students had learnt the Cartesian plane some time back. The axis $x = y$ was not common.

The success rate of the test written was 45%. This was not good. The reason maybe that practice which was not taught properly had a too heavy weight in the test.

Instructions were not clear enough and this meant that learners were not following the lessons properly.

25% of participants claimed that the classroom rules were complicated. If classroom rules are complicated that means that the students were working under confusion. They were not free enough.

70% of the candidates declared that the topic learnt was not relevant. Failure to see importance is a danger. If learners cannot value the day’s work that is a problem. How can they be serious? It is quite worrisome. Now the importance is not known then effort put cannot be maximum.

Teacher ratings were poor. This shows lack of confidence.

Adidactical approach was out of favour probably because teachers were not taught that way or that was a result of lack of equipment for use.

The idea of constructivism was not fully operational.

Effective teacher monitoring needed for full learner engagement (no teacher dominance here).

Students interacted latter in the end of the project. This was due to confidence which had been gained.

Learners could argue support their views and could communicate precisely at the end of the project.

Most teachers are concerned with the coverage of data and not with real concept understanding.

Most teachers want to be centres of learning. This denies learners freedom of interaction.

Time allocated for Mathematics lessons are inadequate for Mathematic lessons.
• Doing work at their own free time at home or spare time has challenges as environments at home are not conducive.

• Drawing geometrical figures on board using chalk does not have a lasting impact on learners.

• Mathematics teachers should talk less and learners should be meaningfully and thoroughly engaged. Learners must explore the world through their Mathematics learning.

Too many statements not grounded in your results as discussed. Be focused. Conclude per research question

5.3 Recommendations

After results and conclusions had been made then the researcher has to make recommendations. These recommendations are thought to be possible solutions to the gaps that have been seen in the study. The present issue of recommendations shall include teachers, learners and the so called ‘milieu’ and to a lesser extent other players for completeness’ sake.

• Teachers must be aware of the existence and power of the components of the didactic contract in classes. This agreement should be respected and should be respected and should be seen working.

• Teachers are encouraged to make use of the adidactical approach at all cost as it ensures full engagement. Lessons taught must be full of real practice (manipulation) lacks in most Mathematics lessons especially were shapes need to be dealt with.

• Instructions either from teachers or written content should be as clear as is possible.

• Classroom rules too should be as clear and as relevant as is possible because they are the basis for learning new materials.

• At the start of new topics and concepts teachers and content writers should stress the importance of the present concept so as to catch the interest and energy of the learners.

• As students explore a concept, the teachers should monitor engagement and make sure that each learner has something to do. If some learners are not checked they usually relate and wait for others to come up with solutions. Now when teaches do the monitoring they should not be seen as dictating the pace.

• No teachers should act as just monitors who just give guidance Teachers should let learners lead the way in innovativeness and let them play around with the presented
concept so that they discover the needed material in their own ways so that the ‘new’ found knowledge is captured in their memories as original which ensures long life.

- As Mathematics needs a lot of practice by learners the researcher recommends the increase in lesson times from the current 40 minutes per single lesson to 50 minutes.
- Since most of the learners that the researcher dealt with came from rural setups they would not have extra time to study at their homes after school. In order to increase understanding in learners and cut the gap between teacher expectations and learner capabilities the researcher recommends that schools should help teachers with new methods of lesson delivery.
- The government and stakeholders should assist on the provision of internet connections to schools for easy and affordable services.
- Lastly the researcher recommends that content writers should aim at encouraging learner hands on concept building and run away from theory based learning.

References


Secondary mathematics: tasks to enhance prospective and practicing teacher learning. Springer.


Appendices
Appendix A
Written test: Total 20

1. a) Plot triangle A (2,0), B (4,0) and C (4,6) (2)
   b) Translate ABC by (2-0) and label the new triangle A, B, C (3)

2. Use ABC which is above and reflect it along lines (i) x = 0 (2)
   (ii) y = 0 (2)
   (iii) x = y (2)

3. Consider \( \triangle \) BCD with vertices
   (1, 1), (-1, 1) and (-2, 3)
   a) Plot the triangle
   b) Rotate it through 90° clockwise (2)
   c) Rotate it through 180°C clockwise (2) poor questioning technique e.g., centre of rotation given

4. Use the matrices of reflection
   To map triangle with vertices
   \[
   \begin{bmatrix}
   -1 & 1 \\
   0 & 0 \\
   \end{bmatrix}
   \]
   (1, 1), (-11) and (-2, 3) to its image and plot the result (3)

Special group interview [interview of 6]
(An extract from the general test)

1. Reflect triangle A (2,0) B (4,0) and C (4,6) through the following
   a) i) X = 0 (ii) y = 0 (iii) x = y
   b) Use the matrix
   \[
   \begin{bmatrix}
   -1 & 1 \\
   0 & 0 \\
   \end{bmatrix}
   \]
   Reflect triangle ABC with vertices A (2, 0) B (4, 0) and C (4, 6)
2. Consider triangle DEF with vertices

D (1, 1)    E (1, -1) and F (-2, 3)

(i) Use centre (0,0) and rotate DEF through 90° clockwise

(ii) Use centre (0, 0) and rotate DEF through 180°.

Appendix B
Project exercises

Exercise 2: TOTAL 20

1. For the triangle A (1,1) B (-1,1) and C (-2,3)

a)(i) Plot $\triangle ABC$ (3)

(ii) Reflect ABC along $x = 0$ (2)

(b) Reflect ABC along $y = 0$ (2)

c) Reflect ABC along $x = y$ (3)

d) Use the matrix of reflection $\begin{pmatrix} 1 & -1 \\ 0 & 0 \end{pmatrix}$ to map ABC onto $A_2 B_2 C_2$ (2)

e) Comment on answers a (ii) and d (2)

f) Reflect ABC by $\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$ to get $A_3 B_3 C_3$ (3)

h) Compare (g) and (b) and comment (3)

too many questions

Appendix C
Exercise 3 Total 10

1. Consider triangle $\triangle$ with vertices (1,1), (-1,1) and (-2,30)

   a) Plot the triangle (2)

   b) Rotate the triangle through $90^0$ clockwise and label the Images $A_1$ using centre (0, 0) (3)

   c) Rotate $\triangle$ through 180 and label it $A_2$ using centre (0,0) (5)

Appendix C
Exercise 1 TOTAL 8

1. Define translation (2)

2. A triangle has vertices A (2, 0), B (4, 0) and C (4, 4).
   Plot the triangle (2)

3. Translate the triangle by vector \[
\begin{pmatrix}
1 \\
0
\end{pmatrix}
\]

4. Use triangle BCD with vertices B \[
\begin{pmatrix}
3 \\
0
\end{pmatrix}
\] C \[
\begin{pmatrix}
5 \\
0
\end{pmatrix}
\] and D \[
\begin{pmatrix}
5 \\
4
\end{pmatrix}
\] and translate it by \[
\begin{pmatrix}
1 \\
0
\end{pmatrix}
\] (2)

5. Comment on (3) and (4) above (2)

Appendix D
PROJECT INTERVIEW GUIDE

This project interview guide aims to collect as perfect data as is possible thus it expects respondents to be as honest as is possible. This guide is for the student responses. Choose only one response per question.

1. What do you understand by the term isometrics?

2. How difficult is translation?
   A- Easy  B- moderate  C- very difficult

3. How difficult is reflection?
   A- Easy  B- moderate  C- very difficult

4. How difficult is rotation?
   A- Easy  B- moderate  C- very difficult

5. How were the lessons conducted on translation?
   A- fairly well  B- Well  C- very well

6. How were the lessons conducted on reflection?
   A- fairly well  B- Well  C- very well

7. How were the lesson conducted on rotation?
   A- fairly well  B- Well  C- very well

8. How were the instructions given to you
   A- clearly  B- not so clear  C- vague

9. What can you say about classroom rules by your Maths teacher
   A- Simple  B- Difficult  C- Complicated

10. Out of say 10 rules given how many did you know already
    A- All the ten
    B- None
    C- Between 1 and 4
D- Between 5 and 9

11. What methods did your teacher use for teaching you?
   A- lecture (chalk-talk) mostly
   B- discovery (pupil find solutions themselves)

12. What can you say about the teacher's involvement in your learning?
   A- Very actively involved e.g working on board and explaining
   B- Active but would work a few examples
   C- Active a bit and did not want to work any examples but give exercises to be done.

13. Can you say that you understood completely what your teacher wanted you to?
   A- Yes (completely)
   B- Not quite
   C- Not at all

14. Did you have any idea of what your teacher wanted you to learn at the start of the lesson?
   A- Yes          B- No

15. If revision of what you learnt has to be done, which area needs to be redone?
   A- Translation   B- reflection   C- rotation

16. If its reflection which ideas need re-visiting
   A- Axis          B- Matrices   C- physical manipulations

17. If its rotation to be revisited, which ideas (concepts) need to be redone
   A- Centres      B- matrices   C- Physical manipulations

18. If you were to rate your teacher, which mark would you give him for his performance in general?
19. If you were to rate yourself on the understanding of the whole topic on isometries, which mark would you give yourself as a percentage.

A- (0-49)  B(50-69)  C (70-100)

20. What three ideas did you learn as a result of lessons held under isometrics (ideas not content related)

1........................................  2........................................  3........................................

21. In general, do you think that students understood the teacher’s demands?

A- Yes  B- not sure  C- No

22. How do you rate the content given so far?

A- Too little  B- enough  C- too many

23. How do you rate the content given so far?

A- Too shallow  B- correct level  C-too difficult

24. Do you think that isometrics transformation is a relevant topic in life?

A- Yes really

B- Not very important

C- Not relevant

25. How do you rate those teachers who say a bit about a topic and ask you to lots of exercises which are marked thoroughly

A- Not responsible

B- Good trainers of hard working

C- Boring and lazy.