# *Evaluating the Impact of Students' Disconnection with Mathematics on Academic Achievement of Primary Five and Six Pupils*

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0361

The European Conference on Education 2013

Official Conference Proceedings 2013

Abstract

The study was carried out to find out the impact students' disconnection with some topics in mathematics have on academic achievement of primary five and six pupils. A case study research design was adopted to study 23 pupils from primary five to primary six in a particular private school. A four-point Likert scale questionnaire enquiring on areas of disconnection in mathematics learning within the time frame of primary five to six having 10-items, and a mathematics achievement test having 20-items measured with four options multiple choice questions evaluating mastery of course content were the instruments used for data collection. Findings showed that pupils' disconnections with certain topics in elementary mathematics reduce their learning achievements in the subject. Learning disconnection showed an direct relation to academic achievement. In order words, there exist a positive correlation between areas of pupils' disconnection and achievement in mathematics.

**Keywords:** Evaluating, Impact, Students' disconnection, Achievement in Mathematics

## Introduction

Mathematics is a science subject that deals with numbers, quantity and space (Courant & Robbins 1996). It is as important to a nation as protein is to a young human organism, and a vital tool for the understanding and application of science and technology; a discipline that plays the vital role of a precursor and harbinger to the much needed technological and national development- an imperative in the developing nations of the world (Bassey Joshua & Asim 2006). Mathematics is an indispensable part of the intellectual equipment of every cultured person, and it involves solving and discussion of solutions to mathematical problems. But today, unfortunately, the traditional place of mathematics in education is in grave danger. The teaching and learning of mathematics has degenerated into the realm of rote memorization; the outcome of which leads to satisfactory formal ability but does not lead to real understanding or greater intellectual independence (Courant & Robbins 1996).

Teaching mathematics is about educating learners, and for the learners to be educated mathematically; they must acquire mathematical knowledge, skills, and ability that will enhance applicability of concepts learnt effectively. Individual learner must be taught how to develop strategies and procedures specific to the content, and the development of more general skills which are necessary to understand how to derive a formula, a procedure, or a rule (Fuson & Briars 1990 Kamii & Joseph 1989) As such, the process of teaching and learning must involve an effective three-way communication between the teacher, the learner, and the instructional materials /strategies employed.

How well a teacher is able to communicate effectively with the learners, and the learning materials/strategies determines the extent learners are able to comprehend, learn, and perform well in mathematics (NBTE, 2008). Thus, in the new mathematics, the focus should be on problem solving, mathematical reasoning, justifying ideas, making sense of complex situations and independently learning new ideas. Students should be provided with opportunities to solve complex problems, formulate and test mathematical ideas and draw conclusions (The Education Alliance 2006).

A growing body of research in learning generally and mathematics learning specifically shows that pupils' achievement is more heavily influenced by teachers' quality than by pupils' race, class, prior academic records or the school a student attends (Aaronson Daniel Barrow & Sander 2007 Rivkin Steven Eric & John 2005 Gladwell 2008 Kristoff 2009 Felch Song & Smith 2010). The benefits associated with being taught by good teachers are cumulative. Scholarly studies indicates that the achievement gaps widens each year between students with most effective teachers and those with least effective teachers and this suggest that the most significant gains in students achievement will likely be realized when students receive instructions from instructionally competent and effective teachers over consecutive years.

The need for effective instruction in mathematics in Abia State particularly and in Nigeria generally is sequel to demand for mathematics teaching to focus students on problem solving, mathematical reasoning, justifying ideas, making sense of complex situations and independently learning new ideas. Students must be provided with opportunities to solve complex problems, formulate and test mathematical ideas and

draw conclusions. Students should be able to read, write and discuss mathematics, as well as use demonstrations, drawings and real-world objects in participating in formal mathematical and logical arguments (Battista 1999).

Reformers argue that the culture of the mathematics classroom should change. The teaching and learning of mathematics should not be on mirroring the subject as some unknowable reality, but should be in solving problems in ways that are increasingly useful to one's daily experience (Confrey 1991). As such, the teacher should encourage discussion, and allow students to generate and test their own theories.

Disconnection which a construct of great importance to students' learning adjustment in our technologically driven society of today is defined as a rupture in a relationship that result to withdrawal from the mutuality that had or should exist for a relationship (Edward 2010). A connection is experienced in a relationship when both parties experience a mutual, and growth fostering relationship. Indicators of disconnections include feelings of isolation from others (in this case, the subject- mathematics), and a lack of desire to learn and grow. It could involve the state or experience of being isolated from a group or an activity to which one should ordinarily belong or actively participate. A situation of which leads to the interpretation of the activity; in this case- the mathematics topics or curriculum as irrelevant to ones current and future needs.

Disconnection is a useful construct for understanding the mechanisms associated with undesirable learner outcomes and in developing strategies to circumvent student academic failure (Redden 2002 Taylor 2000 Thorpe 2003). The causes of pupils/students disconnections in the teaching- learning environment of mathematics are multifaceted and could include curricular, institutional, and socio-cultural factors (Brown Higgins & Paulsen 2003 Huffman 2001 Redden 2002 Rokach Bauer & Oreck 2003 Taylor 2001 Trusty & Dooley-Dickey 1993).
In the case of curricular disconnection; the main focuses of this study, pupils/ students feel incongruent with curricula and devoid of opportunities to establish meaningful connections. Such disconnection results in apathy in the learning process (Parish & Parish 2000). According to Mann (2001) disconnection is caused by a teaching-learning process characterized by compliance and bereft of creativity.

In most learning environment, the learner is largely removed from the content to be learned; individual opinion is devalued and reliance on personal perception is dismissed as unscientific. Rather, excessive focus is on utilitarianism, instrumentalism, measurable performance indicators, and standardized competencies (Frosh 1991). But as cautioned by Barnett (1994) 'to reduce human action to a constellation of terms such as 'performance,' 'competence,' and 'skill' is not just to resort to a hopelessly crude language with which to describe serious human endeavors rather, it is to obliterate the humanness in human'. Therefore, the barn of this study was to chronologically observe the selected sample of pupils and their mathematics teacher over a period of two years in order to discover possible areas of disconnections in the teaching- learning process and subsequent effects on the pupils' achievement.

## Purpose Of The Study

Specifically, this study sought to:

- Identify topics in mathematics in which primary five and six pupils experience disconnection during the teaching-learning process
- To understand their disconnections with mathematics so that the information can be used to inform mathematics teachers in primary five and six on areas they need to change and adopt other teaching strategies
- To add to the body of knowledge that already exist regarding students disconnections in mathematics learning

## Literature Review

A growing body of quantitative research supports the focus on students' disconnections and teachers' instructional effectiveness. A recent concept paper published by the American Mathematical Society has been influential in identifying some common areas of agreement about mathematics education. The identified areas of agreement are based on three fundamental premises which are students' basic skills with numbers, students' mathematics reasoning about precisely defined objects and concepts, and students' ability to formulate and solve problems.

The areas of agreement emerging from these premises according to Ball, Ferrini-Mundy, Kilpatrick Milgram Schmid & Scharr (2005) include the facts that:

- Mathematical fluency requires automatic recall of certain procedures and Algorithms
- Use of calculators in instruction can be useful but must not impede the development of fluency with computational procedures and basic facts.
- Using and understanding the basic algorithms of whole number arithmetic is essential.
- Developing an understanding of the number meaning of fractions is essential.
- Teachers must ensure that the use of "real-world" contexts for teaching mathematics maintains a focus on mathematical ideas.
- Mathematics should be taught using multiple strategies; however, the teacher is responsible for selecting the strategies appropriate for a specific concept.
- Mathematics teachers must understand the underlying meaning and justifications for ideas and be able to make connections among topics.

Karen (2010) studied the disconnections introductory college mathematics students experience with mathematics using the experiences of six former mathematics students from their earliest memories forward to present day. The study employed an interpretive case study and an action research methodology to present a detailed, historical record of the students' interactions and disconnections with learning quantitative material. The study has three primary purposes that included: to record faithfully each participant's story dealing with quantitative/mathematical learning experiences, to understand their disconnections with mathematics so that the information might be used to inform the author's reflective practice, and to add to the body of knowledge that already exists regarding students' difficulty learning mathematics. Findings of the study indicated that overlaying relational theory,

reflection, and students' knowledge construction leads to increased understanding, and brings the needs of students more clearly into focus while providing ways to proceed in the future. Students' firsthand accounts of a lifetime of disconnection with mathematics are unforgettable and compelling.

In another study by Vagliardo (2008) on nursing students' conceptual understanding of mathematics for nursing; described the nature of students' conceptual understanding of mathematics to resemble Cantor's Dust, fractalized, and discontinuous. In its most severe form of discontinuity, meaning for conceptual relationships between fractions, decimals, percents, and proportional procedures do not exist, are incorrect, or are inadequately developed. The study reported that in the absence of meaningful conceptual connections, students nurses rely on isolated knowledge of arithmetic methods, formulaic approaches, assumed infallibility of calculating devices. Thus, a significant numbers of students entering nursing school are inadequately prepared to use mathematics confidently and reliably in their work as nurses.

Elementary school mathematics is the starting point of mathematics learning and mathematics education. Therefore, the mathematics teacher should explain mathematical concepts and facts in terms of simpler concepts and facts so that pupils can easily make logical connections between different facts and concepts and recognize the connection when they encounter something new inside or outside of mathematics that is close to the mathematics they understand.

**Methods**

This study adopted case study research design. According to Yin (1984) a case study research method is an empirical enquiry that investigates a contemporary phenomenon within its real-life context, when the boundaries between phenomenon and context are not clearly evident; and in which multiple sources of evidence are used.

The area of this study- Abia State is made up of seventeen (17) Local Government Areas. It is one of the five states in the Southeast geopolitical zone of Nigeria. Abia State is situated between latitudes 04°45' and 06° 07f north and longitudes 07° 00' and 08° 1O1 east. Imo, Anambra and Rivers border it in the west, northwest and southwest respectively (Abia State Government 2013).

The sample for this study were 23 pupils in primary five who were systematically observed from September 2010 along side with their mathematics teacher until they completed their primary school education in July, 2012.
Purposive sampling technique was utilized since the researcher sought to understand what has occurred in the mathematics teaching- learning classroom, and the relationships between these occurrences (Honnigman 1982 as cited in Merriam 1998). This purposive sample provided real-life accounts of these pupils' experiences with learning mathematics and elicited rich informational cases to study in order to understand a variety of issues the participants identified as leading to disconnections in mathematic learning.

A pupil-to-pupil interview was used to collect data, which allowed the researcher to see learning experiences from an individualistic perspective. A measuring instrument tagged: "Topics of Disconnect and Mathematics Achievement Test" (TDMA) was used for data collection. The instrument had three sections; Section A sought some background information about pupils families, number of siblings, position in family, school(s) attended, and extracurricular activities. Section B contained 10-items short structured questions on possible topics of disconnect such as binary numbers, prime numbers and prime factors, multiplication of decimal numbers, ratio and proportion, algebra, temperature (relationship between centigrade and Fahrenheit), and problems on quantitative reasoning. Section C was a twenty-items mathematics achievement test (MAT) that covered topics identified by pupils and their teacher as area of disconnect.

Data analysis which in the views of Freeman (1998) is an objective look at the facts in a research work in order to construct appropriate meaning based on the information collected was done using description, simple mean, and correlation analysis. The 10-items short structured questions on possible topics of disconnect such as binary numbers, prime numbers and prime factors, multiplication of decimal numbers, ratio and proportion, algebra, temperature (relationship between centigrade and Fahrenheit), and problems on quantitative reasoning were analyzed using simple mean. Mean scores in Table 1 are expressed on a 4-point Likert Scale from 1 (low disconnect) to 4 (high disconnect). Individual pupils' responses to items in section B of the research instrument were then correlated with their achievement scores on the 20-items Mathematics Achievement Test (MAT).

**Results**

The results of data analysis are as presented in Tables1, and 2

**Table1: Mean analysis of topics of disconnect in primary school mathematics learning**

| | **n** | **x** |
|---|---|---|
| 1. Addition, subtraction, and multiplication of binary numbers | 23 | 4.74 |
| 2. Prime numbers and prime factors | 23 | 3.52 |
| 3. Multiplication of decimal numbers | 23 | 4.36 |
| 4. Ratios and proportions | 23 | 3.81 |
| 5. Algebra-opening of brackets and grouping like and unlike terms | 23 | 4.21 |

| | | |
|---|---|---|
| 6. Temperature: Relationship between centigrade and Fahrenheit | 23 | 4.15 |
| 7. Quantitative reasoning | 23 | 4.38 |

**Table2: Pearson-product moment correlation between topics of pupils' disconnection and achievement in mathematics (N=23)**

| Topics of disconnection | r |
|---|---|
| Addition, subtraction, and multiplication of binary numbers | 0.818 |
| Prime numbers and prime factors | 0.721 |
| Multiplication of decimal numbers | 0.665 |
| Ratios and proportions | 0.553 |
| Algebra-opening of brackets and grouping like and unlike terms | 0.749 |
| Temperature: Relationship between centigrade and Fahrenheit | 0.712 |
| Quantitative reasoning | 0.689 |

Significant at $p<0.05$, significant at $p<0.01$

Tables 1 show the mean rating of respondents on mathematics topics taught within the primary school curriculum in which they experience disconnections, while Table 2 shows the Pearson-product moment correlation between topics defining pupils' areas of disconnections and achievement in mathematics. A strong positive correlation was found between pupils' disconnections and their achievement in the mathematics achievement test (MAT) administered at three different intervals (six months interval) of the study time frame.

**Discussion**

The finding of this study agreed with the views of Karen (2010) who studied the disconnections introductory college mathematics students experience with mathematics at the University of Albany, New York using the experiences of six former mathematics students from their earliest memories forward to present day. Karen's findings indicated that overlaying relational theory, reflection, and students' knowledge construction leads to increased understanding, and students' firsthand

accounts of a lifetime of disconnection with mathematics are unforgettable and compelling.

The outcome of this research work also agreed with the study by Vagliardo (2008) who carried out a study on nursing students' conceptual understanding of mathematics for nursing at East Stroudsburg University and found out that discontinuous nature of mathematical conceptualizations exist among students nurses and inadequacy of problem solving methods are based on undeveloped conceptual cross linkages. Specifically, nursing students experience disconnections in its most severe form in understanding meaning for conceptual relationships between fractions, decimals, percents, and proportional procedures. In essence, a significant numbers of students entering nursing school were found to be inadequately prepared to use mathematics confidently and reliably in their work as nurses. More so, the outcome of this study is agreement with the findings of Marzano (2004) research work on classroom instructions that work: research-based strategies for increasing student achievement carried out in the United States.

**Conclusion**

This study reveals the impact of students' disconnections during the instructional process on learning achievement. The results of findings strongly suggest that learning disconnection is associated with academic achievement in a positive association, and portrays unequivocally that the importance of a good teacher is no secret. There exist a strong relationship between teachers' quality and student learning connections or disconnections as such; teachers are key factors in an educational system. Their subject matter knowledge has great impact on students learning achievement as well as the curriculum design as a whole. A good and effective teacher should have a well designed curriculum, and well defined innovative strategies for implementing such curriculum. The teacher must always be open minded in order to recognize the individuality of every child and their different learning pace in the teaching -learning setting so as to meet each child's needs.

The significant role of the teacher as one of the principal focus in all curriculum development is well appreciated. The teachers participate actively in developing new teaching-learning procedures and are the principal consumer of innovations in the field of education. Teachers have different strategies of getting the curriculum content across to the learners, and thus, must be articulate in the course of helping the learners achieve pre-specified learning goals. An effective teacher will not treat all learners the same rather the teacher's individual characteristics will affect the way the curriculum content is presented to individual students because the teacher understands how children learn and develop and thus, are able to support their intellectual, social, and personal development.

Learning connectedness is the belief held by students that the adults and peers in their school care about their learning as well as about them as individuals. Students who feel connected to school and the content of each subject taught are more likely to have a number of positive academic outcomes. Therefore, teaching to enhance students' connectedness with the subject contents for each topic taught in every school subject presupposes that the subject teachers, and school administrators strives to identifies

strategies to foster positive learning attitudes among students. In addition, the students that experience such connectedness with the subject content, teachers, and the general school environment are more likely to attend school regularly, stay in school longer, and have higher grades and test scores.

**Recommendations**

In order for learners of mathematics and any other educational discipline to make meaning and construct knowledge from their daily classroom interactions; teachers should in cooperate learning experiences that would help them understand and establish connections between their lives and mathematics or any other subject as the case may be. As such, the curriculum content design for each class session should be sequenced and paced along with the experiences that individual learner has with that content. An effective teacher and curriculum planner must understand some central concepts, and structures of the discipline he or she teaches in order to create learning experiences that will make the particular aspect of subject matter been taught meaningful for the learners.

A professionally wise teacher should use a variety of instructional strategies to encourage all diverse students' development of problem solving, critical thinking, and performance skills. A positive thinking teacher should understand the importance of motivation and should pass their positive attitude onto the student's in the classroom. Since being a positive role model for students is so important; a teacher must be a dynamic person who is always evaluating the effects of his or her choices and actions on others (students, parents, and other professionals in the learning community).

Finally, mathematics curriculum developers specifically, and educational curriculum developers generally should re-vision teacher education as a sustained and continuous teacher learning that begins at the pre-service stage and continues throughout a teachers' career. This is critical to the advancement of the teaching-learning in our schools generally and mathematics particularly. In-service professional development for teachers in our institutions of learning is critical in order to impact them with innovative knowledge and skills on how to most effectively teach for quality enhancement; a catalyst for quality assurance. The above call is inevitable if we are to solve the problem of students disconnect in learning.

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