THE ROLE OF COGNITIVE CONFLICT IN TEACHING AND LEARNING OF MATHEMATICS

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ABSTRACT

This paper discusses the role of Cognitive conflict in teaching and learning of mathematics. A case study of conflict and path- dependent logic was used to explore other options to turn conflict into gain for the students. Piaget principles of development of cognitive domain, assimilation, accommodation and equilibrium were adopted. It was discovered that, it would be wrong to separate emotional reactions from the cognitive side of learning. Suggestion were made that if learners were found to be in a state of conflict, it is the job of the teacher to resolve the conflict in a suitable and appropriateteaching- learning situation.

INTRODUCTION

The attainment of the objectives of teaching and learning mathematics in Nigeria requires a teacher who uses learner- centered teaching approaches as learning is actively involved during teaching and learning interaction. Hence, the challenge before a mathematics teacher is how to bring about meaningful teaching that will engender meaningful learning (Novak, 2012). In so doing, the teacher needs to take into consideration the learner's prior knowledge, which anchors the new knowledge (Limm, 2001). This prior knowledge could be origin of the student's cognitive conflict leading to misconceptions.

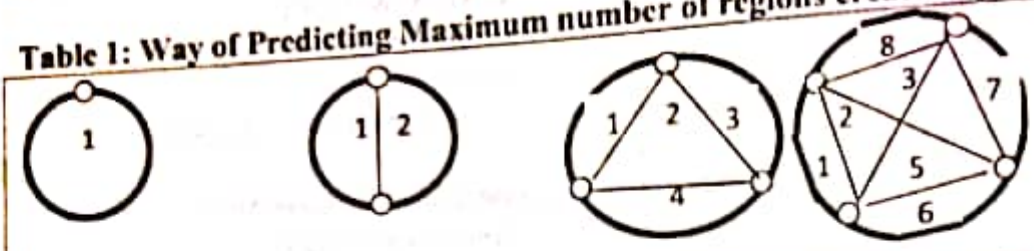
Knowledge is constructed when a learner encounters input from the environment and incorporates the new experiences to his or her existing schemes and mental structure (Piaget, 1977). When this new assimilated information conflicts with the previously formed mental structures, the result is called disequilibrium or cognitive conflict. This state of disequilibrium motivates the learner to seek equilibrium. The cognitive conflict approach to teaching is based on this assumption that learners will seek equilibrium.

A common challenge faced by the cognitive conflict approach to a mathematics teacher is that students often posses ' contradictory understanding' (from a mathematical point of view) without feeling the intellectual need to address the inconsistencies in their understanding (Zazkis&Chenoff, 2008). In other words, when instruction engages students in mathematical situations where some of their existing understanding about an idea or a topic no longer hold, students often do not see the importance (or necessity) to engage in a process of modifying their understandings to resolve the contradictions and they tend to tract the contradictions as exceptions. Such mathematical situations present

an opportunity for a potential conflict, which may or may not develop to a cognitive conflict for students.

For instance, the chords and Regions activity: Find a way of predicting the maximum number of regions created by chords connecting n point.

Table 1: Way of Predicting Maximum number of regions created by chords.



Points	1	2	3	4	5…	6	7
Regions	1	2	4	8	16	31	57

This activity is usually used to challenge students thinking that patterns observed will always hold true and that patterns can be used to proof as in geometry. The pattern observed will not hold true for $n > 5$.

The assumption that learners will seek equilibrium when they are put in situation of disequilibrium is not often the case. In the above activity, instead of being challenged, students could just accept the fact that the patterns stops after $n = 5$ and not try to think of a more general rule to cover all cases. As a teaching approach, the use of cognitive conflict has a lot of potential but it needs more than simply using the appropriate task to create the conflict.

The Notion of 'pivotal counter examples'

Mathematical problems present an opportunity for a potential conflict, which may or may not develop to a cognitive conflict for students. At what point can mathematical instructions transform a potential conflict into a cognitive conflict for students?

A way to address this is to strategically incorporate into instructional sequences collections of pivotal counter examples (Zazkis&Chernoff, 2008). A counter example is pivotal for a student if it creates a turning points in the students' cognitive perception,that is, if it creates a dissonance in the students incorrect or incomplete understandings of a particular topic or idea or if it helps develop a potential conflict into a cognitive conflict for the students. Although a counter examples is a mathematical concept, a pivotal counter example is a pedagogical concept.

Therefore, unlike a counter example that can be determined universally, a pivotal counter example can only be anticipated and recognized as such only after the implementation of the instructional sequence to which it belongs.

A counterexample is a special kind of example that disproves a statement or preposition. Counterexamples are helpful because they make it easier for mathematicians to quickly show that certain conjectures, or ideas are false. For example, consider the preposition, 'All right triangles are scalene. ' Again, it would be very time consuming to try and prove this proposition is true. There are infinite number of right triangles that can be drawn if

all possibilities are to be considered. So any effort to try and prove all cases would be wasted. We only need one counterexample, however, to prove this false. Consider a right triangle with two 45 degree angles; it would have two equal bases making it isosceles. This triangle would be a counter example.

The distinction between the mathematical notion of counter example and pedagogical notion of pivotal counter example offers a useful theoretical tool to explain why some counterexamples that are presented to students with the intent to create cognitive conflict are dismissed by the students and are treated as exceptions.

Cognitive conflict as an Instructional Strategy

Conflict happens when two perceptions, arguments or ideas which are at variance with each other cannot find agreement. Students may encounter conflict when their answer is different with the teacher's answer.

Piaget, one of the influential psychology theorists, described three main principles in development of cognitive domain; assimilation, accommodation and equilibration. Oaldey (2004). Described those three main principles as follows;

1. Assimilation means the process of putting new experiences into existing mental structure. Children develop cognitive structure to help them make sense of their world. And when they are challenged with new experience, they will put the experience into their structure as they have already developed.

2. Accommodation refers to the process of revising existing mental scheme with new experiences. It happen when children encounter a new experience and it does not fit with the previous structure. Therefore, they must develop their new structures in response to new experiences.

3. Equilibration address the process of understanding the world while encountering new experience and conflicts. Children attempt to fit their existing structure with the conflict in order to reach equilibrium.
   The equilibration in piagets theory refers to the cognitive conflict (Lee, et *al*, 2003). Students have their own prio knowledge as an existing structure or scheme. Then, they have to deal with a new concept which is partly or totally different with their own scheme. Therefore, as a human being who has needs to reduce the conflict, they attempt to find the equilibrium in oder to fit their scheme with the new concept.

Liman (2001), described some variables that could induce a meaningful cognitive conflict. He described the variables into three parts namely; (i) variables related to leaner (ii) Variable related to the social content and (iii) variables related to the teacher. Table 2 capture these variables in details.

Table 2. variables that might induce a meaningful cognitive conflict

S/N	Categories	Variables
	Related to the learner	• Prior knowledge • Motivation and interest • Epistemological beliefs. • Reasoning abilities • Values are attitudes to learning • Learning strategies
2.	Related to the social context	• Role of peers • Teacher – learner relationship
3.	Related to the teacher	• Motivation and interest • Level of training • Teaching strategies • Domain specific subject matter knowledge • Values and attitudes towards teaching • Epistemological beliefs.

Lastly, Limon (2001), described cognitive conflict paradigms as (a) Identifying students' current knowledge. A mathematics teacher can achieve this by giving pre-test in order to obtain the current knowledge and to look for the misconceptions of students.
(b) Confronting students with contradictory information;
(c) Evaluating the degree of change as a post-test to see the extent of conceptual change in students.

CONCLUSION

In the learning process, the role of the teacher is of paramount importance. The essential role of a mathematics teacher is to help in the schematic restructuring of the students. The occurrence of conflict in the mind of the learner will be apparent immediately to a sensitive teacher. The simplest manifestations are confusion, annoyance, fear, or just a dull look in the eyes. It would be wrong to separate these emotional reactions from the cognitive side of learning. They are all signs of the state of the brain. In terms of disequilibrium, they may help a good teacher to realize the nature of mental obstruction, an unsuitable line of thought, or even a path- dependent decision making. Then it is the job of the teacher to resolve the conflict in a suitable and appropriate teaching- learning approach.

However, by being sensitive to the possible conflicts in the mind of the learner, we may find a practical way of understanding cognitive conflicts in the learning mathematics.

RECOMMENDATIONS

1. Mathematics teachers should be more practically exposed to students psychological development of learning mathematics especially at the initial teacher training programmes (e.g. NCE, NTI, etc.).

2. More practical efforts is required of the curriculum planners to ensure that innovative teaching approach such as Piaget Cognitive conflict as an Instructional Strategy is included in the curriculum.

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