Towards Quality Education in Ghana: Using Evidence to Achieve Better Learning Outcome

PUPILS' UNDERSTANDING OF MULTIPLICATION & DIVISION IN MULTIPLE CONTEXTS

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INNOVATIONS FOR POVERTY ACTION

OUTLINE

- Introduction
- Theoretical framework
- Statement of the problem
- Methodology
- Result
- Recommendation

Introduction

- **Vast majority of studies on multiplication occur in the classroom [Confrey & Scarano, 1995; Izak, 2004]**

- **These studies have almost focused attention on relationship b/n addition and multiplication: [see Kami & Clark, 1996]**

- **Observed that multn is introduced and treated by many teachers as faster way of doing repeated addition**

  - chn tend to add instead of multiplying

  -ps difficulties in multn is a result of their inability to demonstrate understanding of the meaning of multiplication

- Vula & Berdynaj (2011) raise similar concern

  - use of repeated addition for multn; ps struggle with division due to the way it is taught

- **Burns (1989) had earlier bemoaned this trend as multn has not been treated fairly.**

  - aim shd be guiding learners to seek understanding of this fundamental math'cal concept.

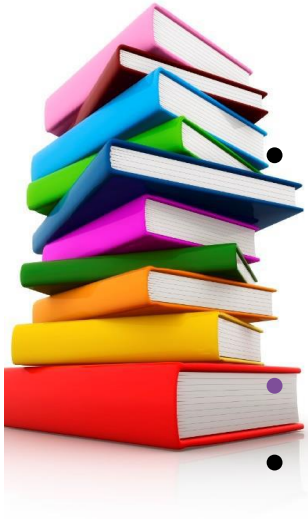
  - emphasizing equal grouping alone is seen by many researchers as problematic: eg , Vula & Berdynaj (2011), Anghileri (2001)

- Message: successful learning of multn & division requires the two to be taught together for ps to discern the relationship b/n them easily,

Theoretical Frame work

- Grounded on an emerging theoretical stance- advocating the use of MC [repns] in teaching

- to empower & help stds foster understanding of math'cal relationships & concepts



- MC provides stds with many different ways of looking at , & understanding concepts

- Analoguos to Dienes' (1971, 1964) teaching of math'cal concepts – calls for presenting ideas in as many forms as possible for stds to obtain the math'cal essence of abstraction as enshrined in his Principle of Multiple embodiment

- **Recent to join the crusade for MC in teaching is Baidoo (2015) who found that ps progress through 3 levels of multiplicative thinking**

- **multiplicative thinking level @ which ps can't fathom any immediate success**

- **Ps in this transition level have need of 'learning clutches' ; recommends the use of appropriate materials to ensure smooth passage to be solid multiplicative thinkers**

- **Concludes that use of MC in teaching multn & div impacted well on ps multiplicative thinking**

Statement of the problem

- Multn & Div are foundational concepts for many topics throughout school mathematics

  - chn's failure to understanding these concepts in their right perspective creates problems

- Presence of math texts is contributory factor to chn's predicament

- Math text projects 'equal grouping' aspect of multn & division [Kami & Clark, 1996] alone

- If trs see knowing as process, then they will accommodate different ways of knowing & enhance deep learning

- Constructivists note that chn form concepts thr' reconstruction of reality, & by imitation [Fletcher, 2005]
- Observation:

  - 'equal grouping' lacks multiplicative ideas & limits later interpretation [Anghileri, 2001], & the
- - advocacy for chn to be familiar with different relevant situations & contexts embodying multn & div [Anghileri & Johnson, 1988],

- mandate a call for a critical look at the teaching of multn & div in our pry schs where trs stress on 'equal grouping' representation & unduly emphasize memorisation.

Purpose of the Study

- Investigate chn's understanding of multiple contexts of Multn & Division thru' the use of MC.
- Assess the impact of teaching other contexts [besides equal grouping] on chn's understanding of , & ability to solve multn & div problems.

Research Question

1. Are pupils in the target population able to distinguish between multiplication and division concepts?

Hypotheses

1. There is no significant difference between the performance of children within the experimental and the control groups in their ability to distinguish between multiplication and division concepts.

Hypotheses - continue:

2. There is no significant difference between the performance of pupils in the experimental and their counterparts in the control groups in understanding of multiplication concepts.

3. There is no significant difference between the experimental group and that of the control group in understanding of division concept

Methodology

- used Quasi exp'tal research design [E & C grps]
- Employed pre-test & post test group design
- 4 pry four intact classes in the C.C.M. involved, n = 137
- Scores were ranked for the purpose of assigning grps into exp & control.
- Exp grp was taught with MC; Cont. grp with traditional equal grouping strategies
- Instrument – MDUAI was developed.

Results

- **R/Q 1: Are ps in the target population able to distinguish between multiplication and division?**
  - **Focused to measure ps' ability to distinguish b/n the appropriate opns needed to make numerical decision**

Table 1: Pupils' Ability to Distinguish between Multn and Division

Que No	Group				
	C.1	C.2	E.1	E.2	All
1*	7 (56.7)	16 (43.2)	24 (63.2)	16 (50.0)	73 (53.3)
10**	19 (63.3)	19 (51.4)	25 (65.8)	20 (62.5)	83 (60.6)
11***	8 (26.7)	18 (48.6)	22 (57.9)	19 (59.4)	67 (48.9)

C.1 (n=30), C.2 (n=37); E.1 (n=38); E.2 (n=32). C = Control E= Experimental

- Multiplication: Exp. Grps [E1+E2] = 64.3 %; Cont. Grps [C1+C2] = 56.7 %;
- Division: Exp. Grps [E1+E2] = 58.63 % ; Cont. Grps [C1+C2] = 38.87

Hypothesis 1

Table 2: Independent Two-Sample t-Test of Significance of Difference of Mean Scores

Var	N	$\bar{x}$	sd	df	t-value	p-value	Deci
C. Grp	67	1.45	0.85				
E. Grp	70	1.81	0.77	135	2.732	0.007	sig

$\alpha = 0.05$

- The result shows a statistically significant difference b/n exp. & cont. groups' mean scores .

- The magnitude of the treatment effect, called effect size, d = 0.4. [effect size is the standardised mean difference between the two groups]

Effect sizes = the average percentile standing of the average treated (exp) participant relative to the average untreated (control) participant.

- This index indicates that 66 % of the control group would be below average person in the experimental group.

- Thus 95 % C.I [0.12, 0.78] for d = 0.4 is entirely positive [i.e using MC of multiplication is better than the traditional equal grouping] and thus the difference might be quite large.

- Glass et al (1981) tie the usefulness of an effect to its relative costs and benefits.

- Coe (2002) argued that, as far as, it is possible to show that a small and inexpensive change result in a rise of academic achievement by an effect size, though little as 0.1, then it could be considered a considerable progress in education, principally when it is applied uniformly to all students, and even more so if the effect were cumulative over time.

Hypothesis 2

Table 2: Independent two-sample t-test results for pupils' understanding in Multiplication

Var	N	$\bar{x}$	sd	df	t-value	p-value	Deci
C. Grp	67	1.43	1.17				
E. Grp	70	2.17	1.06	135	3.869	0.001	sig

$\alpha = 0.05$

- the result shows a statistically significant difference b/n exp & cont groups' mean scores .
- d = 0.7. [large mean difference b/n the two groups].

- This index indicates that 76% of the cont. group [M = 1.43, Sd = 1.17] would be below average person in the exp. group [M = 2.27, Sd = 1.06].
- Differently stated, for an effect size of 0.7, the value of 76 % connotes that the average person in the experimental group would show deeper understanding in multiplication than 76 % of the control group that was initially equivalent.

Hypothesis 3

Table 2: Independent Two-Sample t-Test results for ps understanding of division

Var	N	$\bar{x}$	sd	df	t-value	p-value	Deci
C. Grp	67	0.82	0.068				
E. Grp	70	2.10	1.16	135	7.681	0.001	sig

$\alpha = 0.05$

- the result indicates a statistically significant difference in the mean scores of exp. & cont. groups in favour of exp. grp.

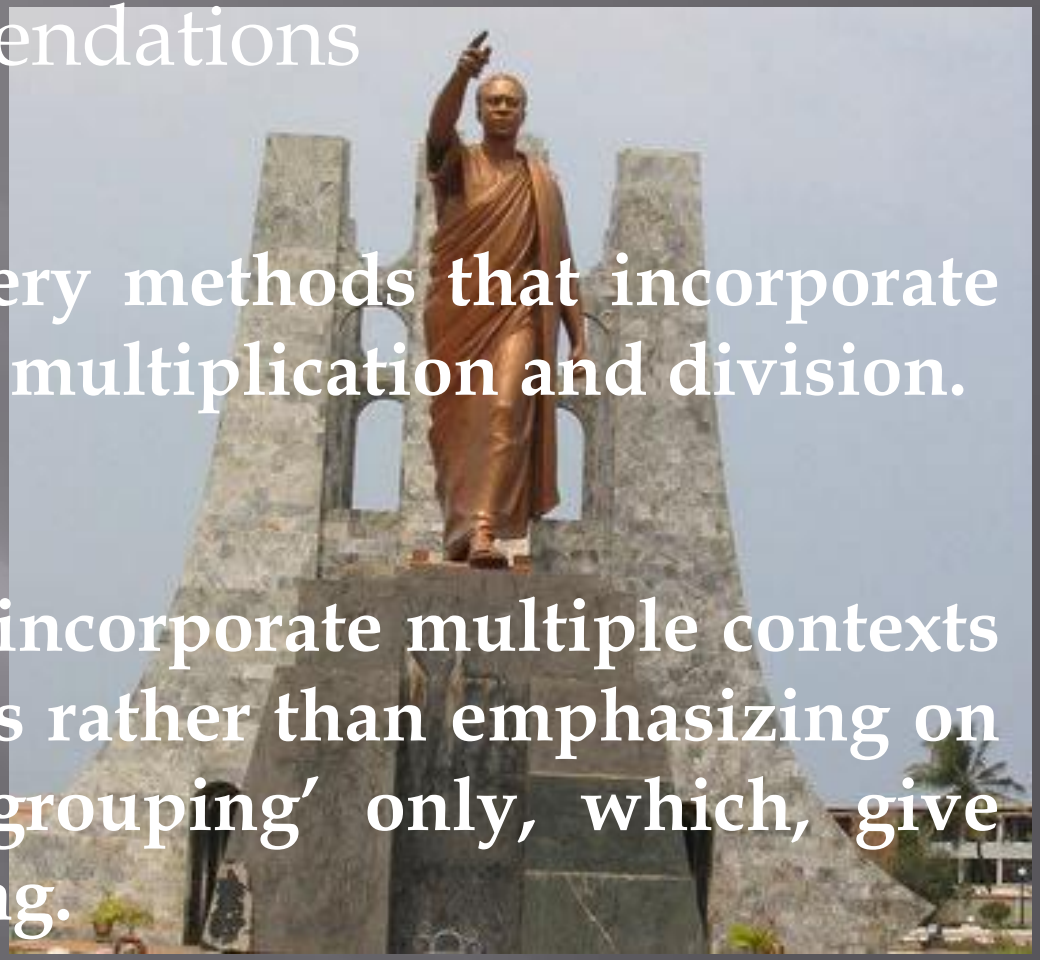
- d=1.6. [measures a large mean diff b/n the two groups.

- This index indicates that 94.5 % of the control group [M = 0.82, Sd = 0.068] would be below average person in the experimental group [M = 2.10, Sd = 1.16].

- Differently stated, for an effect-size of 1.6, the value of 94.5 % connotes that the average person in the exp. grp. would show deeper understanding in Division than 94.5 % of the cont. grp that was initially equivalent.

- At 95 % C.I. [1.18, 1.94] for the effect size 1.6, it is entirely positive and that the difference is very large

Recommendations



- Trs shd employ delivery methods that incorporate MCs in the teaching of multiplication and division.

- Maths textbks should incorporate multiple contexts of all math'cal concepts rather than emphasizing on 'sharing' and 'equal grouping' only, which, give restricted understanding.

- The practice whereby primary teachers teach multiplication before division ought to be revisited.

Policy Recommendations:

- **Turning Basic school classroom into rich learning environments [thr' the use of posters to show practical applications of key math'tcal concepts and operations including multiplication and division.**

- School –based continuing professional development programmes should develop teachers' skills in making connections between key operations in basic school mathematics.

- Successful teaching of basic numeracy and literacy enhances pupils' understanding of contextualised tasks in multiplication and division and should be part of the criteria for promoting basic school teachers.

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