Teacher Noticing: A Case Study of Students Cognition of a Course Content

Abstract

Improving classroom teaching and learning has been the core mandate of every educational institution across the globe. And this has become very necessary that varied approaches and varied shifts are learnt and inculcated into the educational system. Such includes the use and introduction of "Teaching Noticing" in the mathematics classroom to monitor what transpires in the classroom to boost progression. This study was a single case study conducted to seek the cognition of some university students in a course of study in a semester. In all, 15 university students for a course were diagnosed using a diagnostic quiz to measure their cognitive level of the courses' topics taken within two months. The conceptualized framework, "ACS model" was adapted to measure students understanding in three levels; "A" – "Accuracy", "C" – "Creativity" and "S" – "Stumbly". This same model was used a rubric for scoring students as 3, 2 and 1 point as "Accuracy", "Creativity" and "Stumbly" respectively. Eight coherent topics were covered with in the months period and results show that, students performed better (N = 8) with the percentage increase of 75.54% of topics treated by the course lecturer with 24.46% for topics studied by students in group work. It is recommended that course lecturers and teachers of mathematics must use diagnostic quizzes to notice students' cognition level of topics treated. Also, course lecturers and teachers should as well go through any topic (s) given to students to study in groups since that will increase their accuracy level to perform during assessment. Comparison to the topics treated by the lecturer shows higher means and lower standard deviation for Topics 2 and 4 (M = 2.8000, SD = .56061) and (M = 2.0667, SD = .88372). This could be attributed to the fact that; the topics were taught by the lecturer. Finally, it is

recommended that teacher noticing must be part of the classroom discourse for professional development.

Keywords:

Teacher noticing, Accuracy, Creativity, Stumbly, diagnostic quiz, assessment, students' cognition, mathematics classroom, ACS model, learning to notice framework, professional noticing

Background

Noticing has become a paradigm or a one of the dimensions for classroom assessment. This is seen when teachers use it notice students' cognition in the classroom observation (Simpson, Vondrova & Zalska, 2018), during teaching and learning. Studies on teacher noticing has mainly been conducted within the last two decades and has gained much attention due to it focusing on students and their mathematical thinking and its relevance to quality-oriented teaching (Bastian, Kaiser, Meyer, Schwarz, & Konig, 2021) in the classroom. Teacher mathematical noticing according to Choy, is a key component of mathematics teaching expertise and has been a focus of recent professional development efforts (2013) in an exploratory study.

According to van Es and Sherin, learning to notice framework (van Es & Sherin, 2010), is an essential part for developing teacher expertise. Jacobs and colleagues (2011), professional noticing framework has would be a better option than any other.

Recent studies, such as, Amador and colleagues (2021) whose systematic review on the methodological approaches in supporting and analyzing noticing for prospective teachers revealed that, there are no clear mood for collecting data. Some researchers used recorded videos (Santagata & Yeh, 2014, Santagata & Guarino, 2011), written artifacts.

Bastian and colleagues (2021) whose study on teacher noticing and its growth toward expertise: an expert-novice comparison with pre-service and in-service secondary mathematics teachers observed that, there is a sharp contrast between pre-service teachers, novice, and experienced teachers of mathematics, concerning classroom teacher noticing.

Barely two years ago, a study by Munson (2020) on noticing students' thinking observed that, noticing is critical to crafting instructional responses. Issues of students' absorption of contents studied from their responses could be a good ground for classroom teachers to present teaching in ways that would be meaningful to students. Notable among all these studies (e. g. Lau & Man, 2018, Castro, Pino-Fan & Velasquez-Echavarria, 2018, Kilic et al, 2019), all used pre-service or novice teachers. Hence, this study is aimed at looking at assessing the response level of students in a mathematics course that they have studied in a span of two months. In-service or practicing teacher was used for this study for noticing in the classroom. The theoretical frameworks of van Es and colleague (2011) and Jacobs et al, (2010) were conceptualized for this study. It is aimed at looking at the areas that students can accurately recall with, **A**ccuracy, the topics or contents they have mastered through critical thinking and **C**reativity, and those that, do not recall at all. That is **S**tumbling in the course. The "ACS" framework was conceptualized for this study.

Diagnostic quiz is a form of classroom assessment, likewise, teacher noticing. Diagnostic quizzes help students to recall what they have learnt. Diagnostic Questions are a quick and accurate way of assessing your students' knowledge and understanding of a key skill or concept, identifying fundamental misconceptions that they may have. Active recall is so important and powerful in learning due to process of memory retrieval itself. While remembering, you re-access information from the past which has been previously encoded and stored in your mind. Essentially, the brain 'replays' a pattern of neural activity created in response to an event.

Statement of the problem

The study was borne out of the interest derived from Miriam Gamoran Sherin, the co-author of the Leaning to Notice framework, (van Es & Sherin, 2010) whose papers I have read and have taken a paradigm shift on how I want to notice classroom situations.

Objectives

The objectives of this study were to identify:

1. the difference in performance of topics treated by course lecturers in topics studied by students in groups.
2. the Accuracy, Creativity or Stumbly level of students' cognition of topics treated by their course lecturer and topics studied in groups by students.

Research question

1. What is the difference in performance of topics treated by course lecturers in topics studied by students in groups?
2. What is the Accuracy, Creativity or Stumbly level of students' cognition of topics treated by their course lecturer and topics studied in groups by students?

Methodology and participants

The study adopted a largely qualitative approach using a single case study design which is very much in tune with the main purpose of this study. Single case design (SCD), often referred to as single subject design, is an evaluation method that can be used to rigorously test the success of an intervention or treatment on a particular case (i.e., a person, school, community) and to also

provide evidence about the general effectiveness of an intervention. The target population was Level 200 Diploma Mathematics Education students (N = 16) of M. T. Onwubiko University of Technology and Applied Sciences. The accessible population was Diploma Mathematics Education students (n = 15). A purposive sampling was used to select this class since the researcher was the teacher noticing specifically of this class and course lecturer.

Instrumentation

After two continues months of lecturer on the course, Introduction to Matrices, I decided to determine the level of cognition of the eight topics covered under this course. The topics were: Topic 1 - Definition of matrices, entries and dimensions, Topic 2 - Types of matrices, Topic 3 - Scalar of a matrix, Topic 4 - Operations on Matrices, Topic 5 - Transpose of a matrix, Topic 6 - Determinant of a matrix, Topic 7 - Inverses of matrices and Topic 8 - Adjoint application. Topics 1 to 5, (62.5%) where treated by the course lecturer, with 37.5% studied by students and presented in groups. The course lecturer course outline for the semester, his prepared lecture notes and students class written notes were checked consistency. This was then seen as reliable since there is coherency in the course content and topics covered. In the moment of before one morning lecture, the researcher went the class and shared plain A4 sheets to students. Asked them to write their Index Numbers with date. I wrote on the board, “Discuss any five (5) content topics, or things you have learnt in this course”. A maximum of 10 to 12 minutes was given to complete the given task.

The theoretical frameworks of van Es and colleague (2010) and Jacobs et al (2011) were conceptualized for this study. It is aimed at looking at the areas that students can accurately recall with, **A**ccuracy, the topics or contents they have mastered through critical thinking and **C**reativity, and those that, do not recall at all. That is **S**tumbling in the course. The “ACS”

framework was conceptualized for this study. The ACS model rubric was designed to measure the level of cognition of students. The “A” stood for “Accuracy”. This is where students were able to give verbatim, what was/were taught in the class with vivid examples to support their discussion. This is was awarded a point score of 3. The “C” stood for “Creativity”. This is where students were able to mention a term that was used in the various topics treated or studied. Also, students being able to generate his or her own understanding from what was taught or studied in groups without necessarily writing verbatim but in his or her own words. This was awarded a point score of 2. Finally, the “S” stood for “Stumbly”. This is where a student gets stacked, could not write, does not remember what was taught or learnt in the group. Nothing was written for either of the topics. This was awarded a point score of 1.

The results were coded into the SPSS and analyzed descriptively for each of the eight topics. From the model, a mean score of 1 – 1.49 would be considered as stumbly. Mean of 1.50 – 2.49 would be considered as being creative and a mean of 2.50 – 3.00 would be considered as being accurate.

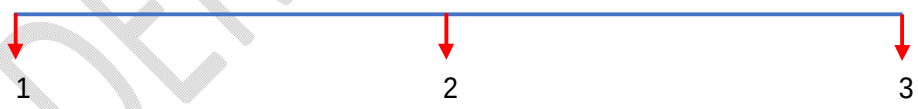

Figure 1: ACS conceptual framework (Accuracy: 2.50 – 3.00, Creativity: 1.50 – 2.49, Stumbly: 1 – 1.49) by Kwakye (2022).

Results and discussions

The following tables shows the output of the descriptive.

Table1: Descriptive Statistics of the eight topics covered for the course

	N	Mean	Std. Deviation	Std. Error Mean
Topic 1 - Definition of matrices, entries and dimensions	15	1.6667	.89974	.23231
Topic 2 - Types of matrices	15	2.8000	.56061	.14475
Topic 3 - Scalar of a matrix (enlargement and reduction)	15	1.4667	.83381	.21529
Topic 4 - Operations on Matrices	15	2.0667	.88372	.22817
Topic 5 - Transpose of a matrix	15	1.8667	.91548	.23637
Topic 6 - Determinant of a matrix	15	1.5333	.74322	.19190
Topic 7 - Inverses of matrices	15	1.2667	.59362	.15327
Topic 8 - Adjoint application	15	1.07	.258	.067

Source: Field Survey, 2022

Table 1 gives a fair descriptive statistic of the data collected for the eight completed topics in the semester course work.

Table 2: Topic 1 - Definition of matrices, entries and dimensions

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Stumbly	9	60.0	60.0	60.0
	Creativity	2	13.3	13.3	73.3
	Accuracy	4	26.7	26.7	100.0
	Total	15	100.0	100.0	

Source: Field Survey, 2022

Table 2, Topic 1 – "Definition of matrices, entries and dimensions", 4 (66.67%) out 6 students who attempted, gave a clear definition of "matrices" and scored a point of 3. The 2 (13.3%), one was able to explain, while one just mentioned "entries" and "dimensions" with no examples to show understanding. This shows that students are able to follow-through when definitions are well explained in the classroom. Implying that, teachers, upon noticing this, should give valid examples to support content to be treated to students. It is unbelievable to notice that, 9 (60.0%) of the total students could not attempt at all. This is an indication that, teachers need to develop professionally in noticing (Jacobs et al., 2011) in order to support students learning.

Table 3: Topic 2 - Types of matrices

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Stumbly	1	6.7	6.7	6.7
	Creativity	1	6.7	6.7	13.3
	Accuracy	13	86.7	86.7	100.0
	Total	15	100.0	100.0	

Source: Field Survey, 2022

In Topic 3 - Types of matrices of Table 2, 14 (93.7%) attempted writing something about this topic. 13(86.67%) of the students' accuracy gave verbatim explanation and discussion of what were taught by their lecturer on "Types of Matrices". This confirms the higher level (M = 2.8000, SD = .56061) in Table 1. The only student 1(6.7%) who did not tackle this scored 3.5 out of 5 in the overall scoring. Showing that he or she was not naïve of the types of matrices, neither the examples, but might be showing exceptionality.

Table 4: Topic 3 - Scalar of a matrix (enlargement and reduction)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Stumbly	11	73.3	73.3	73.3
	Creativity	1	6.7	6.7	80.0
	Accuracy	3	20.0	20.0	100.0
	Total	15	100.0	100.0	

Source: Field Survey, 2022

Topic 3 – "Scalar of a matrix" (Table 4), despite the fact that multiplication of a matrix by a scalar, either, enlargement or reduction, is very easy to recall, only 4 (26.7%) attempted this. In this quota, 90% of them perfectly gave examples to show their understanding. Examples given included the following:

a. "Multiplication of 2×2 matrix with constant, $k = 3$. And gave a 2 by 2 matrix,

$A = \begin{bmatrix} 1 & 3 \\ 2 & 4 \end{bmatrix}$,

$kA = 3\begin{bmatrix} 1 & 3 \\ 2 & 4 \end{bmatrix} = \begin{bmatrix} 3 & 9 \\ 6 & 12 \end{bmatrix}$".

b. "Scalar matrices are matrices whose elements are multiply by a factor. Example

$2\ by\ 2.\ A = 2\begin{bmatrix} 2 & 4 \\ 2 & 1 \end{bmatrix} = \begin{bmatrix} 4 & 8 \\ 4 & 2 \end{bmatrix}$"

It is also shown that, students were less creative (M = 1.4667, SD = .83381) from Table 1. Many 11 (73.33%) an indication in Table 1, show, students could not write about this the "Multiplication of a matrix by Scalar", being it enlargement or reduction. This is an indication that note all students are able to recall facts easily. It could also be that, the time or duration of the quiz did not favor some of the students.

Table 5: Topic 4 - Operations on Matrices

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Stumbly	5	33.3	33.3	33.3
	Creativity	4	26.7	26.7	60.0
	Accuracy	6	40.0	40.0	100.0
	Total	15	100.0	100.0	

Source: Field Survey, 2022

Topic 4 – "Operations on Matrices". The "operations on matrices" included, "addition", "subtraction" and "multiplication". 10(66.67%) attempted this (Table 5). 6(60%) of those who attempted gave valid examples to support their explanation with understanding of the topic. This gave an Accuracy score of 3 (Figure 1) with a high mean (M = 2.0667, SD = .88372) in Table 1. Here, it can be deduced and noticed that, the lecturer clearly stated examples to clarify a concept as students can as well give their own with understanding.

Table 6: Topic 5 - Transpose of a matrix

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Stumbly	7	46.7	46.7	46.7
	Creativity	3	20.0	20.0	66.7
	Accuracy	5	33.3	33.3	100.0
	Total	15	100.0	100.0	

Source: Field Survey, 2022

On Topic 5 – "Transpose of a matrix", transpose which was the last topic treated together with the operations on matrices had about 26.67% (4) of the students, mastering the courage to write about it. In all, more than half (N = 8(53.33%), M = 1.8667, SD = .91548) showed an appreciable level of understanding by "mentioning" or "listing", "transpose" in their write up. In their writing, only 25% of them were able to give valid examples to support their points.

Table 7: Topic 6 - Determinant of a matrix

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Stumbly	9	60.0	60.0	60.0
	Creativity	4	26.7	26.7	86.7
	Accuracy	2	13.3	13.3	100.0
	Total	15	100.0	100.0	

Topic 7 - Inverses of matrices

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Stumbly	12	80.0	80.0	80.0
	Creativity	2	13.3	13.3	93.3
	Accuracy	1	6.7	6.7	100.0
	Total	15	100.0	100.0	

Topic 8 - Adjoint application

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Stumbly	14	93.3	93.3	93.3
	Creativity	1	6.7	6.7	100.0
	Total	15	100.0	100.0	

Source: Field Survey, 2022

Topics 6, 7 and 8 of Table 7 being "Determinant of a matrix", "Inverse of matrices" and "Adjoint application", were areas given to students to learn in groups and present. In the diagnostic quiz for the teacher to notice students' absorption and recall, $4(26.67\%), 3(20.00\%)$ and $0(0\%)$ respectively shown knowledge. It is disheartening, seeing as much as, N = 14 (93.33%) of the whole students not attempting that. Again, in Table 1, a mean (M = 1.07, SD = .258) recorded shows not understanding that of the "Adjoint application" at all. This shows that, students still have much hope and trust in their lecturers. Despite the fact that they have studied in groups, presented in the classroom, they still want their lecturer to echo on them again.

Recommendations and Future research

The study was to observed whether there a difference in cognition level of topics treated by course lecturer and those learnt by students themselves in groups. The idea of teacher noticing was used to check on how students are responding the classroom discourse through the use of a diagnostic quiz. In the study, it was observed that, many students were on Accuracy level on topics treated by the course lecturer while many students were on the Stumbly level on topics studied by students in groups. It is recommended that course lecturers and teachers of mathematics must use diagnostic quizzes to notice students' cognition level of topics treated. Also, course lecturers and teachers should as well go through any topic (s) given to students to study in groups since that will increase their accuracy level to perform during assessment. Finally, it is recommended that teacher noticing must be part of the classroom discourse for professional development.

Future research must be conducted to span for a whole semester to see the trend of students' cognition. This will show the actual level of students in a course.

References

Literature Review of Methodological Approaches to Support and Analyze Noticing. *Teacher and Teacher Education*, 1-16. Retrieved April 16, 2022, from https://doi.org/10.1016/j.tate.2020.103256

Bastian, A., Kaiser, G., Meyer, D., Schwarz, B., & Konig, J. (2021, December 18). Teacher noticing and its growth toward expertise: an expert–novice comparison with pre-service and in-service. *Educational Studies in Mathematics*. https://doi.org/10.1007/s10649-021-10128-y

Choy, (2013). Productive Mathematical Noticing: What It Is and Why It Matters. In V. Steinle, L. Ball & C. Bardini (Eds)., Mathematics Education: Yesterday, today and tomorrow (Proceedings of the 36th annual conference of the Mathematics Education Research Group of Australasia). Melbourne, VIC: MERGA.

Jacobs, V. R., Lamb, L. C., & Philipp, R. A. (2010). Professional Noticing of Children's Mathematical Thinking. *Journal for Research in Mathematics Education, 41*(2), 169-202.

Kilic, H., Dogan, O., Arabaci, N., & Tun, S. S. (2019). Preservice teachers‘ noticing of mathematical opportunities. Paper presented at CERME11.

Lau, M. (2010). Understanding the dynamics of teacher attention: Case studies of how high school physics and physical science teachers attend to student ideas. [University of Maryland]. https://drum.lib.umd.edu/handle/1903/10897

Santagata, R., & Guarino, J. (2011). Using video to teach future teachers to learn from teaching. ZDM, 43(1), 133–145.

Santagata, R., & Yeh, C. (2014). Learning to teach mathematics and to analyze teaching effectiveness: evidence from a video- and practice-based approach. *Journal of Mathematics Teacher Education*, 17(6), 491–514.

Simpson, A. and Vondrova, N. and Zalska, J. (2018) 'Sources of shifts in pre-service teachers' patterns of attention: the roles of teaching experience and of observational experience.', *Journal of mathematics teacher education*., 21 (6). pp. 607-630.

van Es, E. A., & Sherin, M. G. (2008). Mathematics teachers' "learning to notice" in the context of a video club. *Teaching & Teacher Education*, 24(2), 244–276.

van Es, E. A., & Sherin, M. G. (2010). The influence of video clubs on teachers' thinking and practice. *Journal of Mathematics Teacher Education*, 13(2), 155–176.

APPENDIX A

ACS conceptual framework rubric

ID	Topic 1	Topic 2	Topic 3	Topic 4	Topic 5	Topic 6	Topic 6	Topic 6
004	Creativity	Accuracy	Stumbly	Stumbly	Stumbly	Stumbly	Stumbly	Stumbly
073	Stumbly	Accuracy	Accuracy	Creativity	Stumbly	Accuracy	Stumbly	Creativity
003	Stumbly	Accuracy	Creativity	Creativity	Creativity	Stumbly	Stumbly	Stumbly
006	Accuracy	Accuracy	Stumbly	Accuracy	Stumbly	Stumbly	Stumbly	Stumbly
063	Accuracy	Accuracy	Stumbly	Stumbly	Stumbly	Accuracy	Accuracy	Stumbly
078	Stumbly	Accuracy	Stumbly	Accuracy	Creativity	Creativity	Creativity	Stumbly
049	Stumbly	Accuracy	Stumbly	Accuracy	Creativity	Creativity	Creativity	Stumbly
001	Accuracy	Accuracy	Stumbly	Stumbly	Accuracy	Stumbly	Stumbly	Stumbly
066	Stumbly	Accuracy	Stumbly	Stumbly	Accuracy	Stumbly	Stumbly	Stumbly
074	Stumbly	Accuracy	Stumbly	Accuracy	Stumbly	Stumbly	Stumbly	Stumbly
073	Accuracy	Accuracy	Stumbly	Stumbly	Accuracy	Stumbly	Stumbly	Stumbly
007	Stumbly	Stumbly	Accuracy	Creativity	Accuracy	Stumbly	Stumbly	Stumbly
047	Stumbly	Accuracy	Accuracy	Accuracy	Stumbly	Creativity	Stumbly	Stumbly
068	Creativity	Creativity	Stumbly	Creativity	Accuracy	Creativity	Stumbly	Stumbly
002	Stumbly	Accuracy	Stumbly	Accuracy	Stumbly	Stumbly	Stumbly	Stumbly

Source: Field Survey, 2022