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STUDENTS EMOTIONAL DISPOSITIONAL EMPATHY ON MATHEMATICAL ENGAGEMENT AND THEIR PERFORMANCE

Isaac Owusu-Darko[i],
Winnifred Ansah-Hughes,
Robert Akpalu
Department of Mathematics Education, Valley View University,
Techiman Campus, P. O. Box 183, Techiman, Ghana

Abstract:
The focus of every pedagogical development is to enhance a greater percentage of students' engagement in mathematics education. Students interest in getting fully involved in mathematical lessons could be influenced by their emotional dispositions possess to appreciate their total commitment to lesson engagement in relation to their academic performance. The study used a cross-sectional quantitative survey design to study the influence of Emotional Dispositional Empathy on Mathematical Engagement (mathematical performance) among Atiwa Senior High School (SHS) students in Ghana, West Africa. Participants across SHS 1, 2 and 3 were selected from the three clustered SHS to take part in the study. The methodology used for the study was the descriptive research design purported to investigate the research questions along the magnitude of qualitative analyses using the Pearson independent chi-square test statistics. The study's hypothetical test of students' emotional empathy (SEE) is independent of students' mathematical engagement reflective of their Academic Performance (AP). Students' emotional disposition is seen to have adverse significant effect of students' Mathematical engagement. It is concluded however that, to some extent, students emotional empathy (SEE) can results in dislike in mathematics engagement which affect students' performance of the subject. After careful analyses of the study variables, we recommend that students should not be stressed up in the school or in the house with emotional indicative variables that could trigger students' emotions and affection in the classroom especially when students are preparing for mathematical lessons. Mathematics educators need to satisfy a paradigm aspect of students' affective domain so as to bring their affection on board even if they are

[i] Correspondence: email iowusudarko@vvu.edu.gh

stressed up emotionally. The used of corporal punishment in the teaching of mathematics should be discourage so as to prevent panic and negative stimulus to elicit emotional distress.

Keywords: emotions, dispositional empathy (DE), mathematical engagement, attitude, academic performance (AP), senior high school (SHS)

1. Introduction

The pedagogical development of mathematics to bring about effective teaching and learning has been the concern of all and sundry mathematics educators. Content delivery of mathematics seeks to engrossed students engagement proportionately by placing them in the center of learning to ensure a much prudent understanding. Mathematical conceptual building is seen through students commitment to mathematical engagement and should be appealed to the head, heart and emotional status more since it involves more reasoning and calculations perceived cognitively as difficult especially among students in Ghana, Owusu-Darko, (2017). The knowledge-based acquisition restrictions of the mathematical content and engagement could be measured along emotional dispositional empathies students attach to it. Issues of emotions should not be a major concern in adolescent's stage in human developmental stages. It is therefore imperative that mathematics teachers recognize these gender dispositions which cause difficulties in mathematical engagement and understanding.

The conceptual framework surrounding empathy is "*an individual's ability to experience the perspectives and feelings of other people's experience or what they are going through*", (Davis, 1994). The dispositional component means that, the ability to do so is something that is internal and not learnt and can be genetically bounded. In other words, dispositional empathy is the inherent ability to sense or feel what others are going through in such a way that it produces a willingness or desire to intervene and help (Decety and Lamm, (2006). Davis (1994) states that research on dispositional empathy started with emergence of two main perspectives. One perspective viewed dispositional empathy as affective in nature and the other viewed it as cognitive in nature. The other side of these allusions is the emotions student's attaches to mathematical engagement which need to be looked at. Therefore, earlier researchers made distinctions between cognitive empathy and affective sympathy. Researchers therefore took an "either or" approach towards an assessment of how cognitive and affective components interact to produce dispositional empathy. The current study therefore adopted the integrative approach to study mathematics engagement by

assessing emotional component of the dispositions with respect to students' mathematical engagement of Atiwa Senior High School (SHS) students in Ghana comprising the three principal SHS for which a similar study on gender was investigated in the same demographic setting with respect to gender dispositional empathy in students mathematical engagement, Owusu-Darko et al, (2017).

The senior high school of the educational system in Ghana is a crucial one because it is at this level that some specialization begins. It is from this level that specialized training colleges and tertiary institutions admit their students. However, this level of Ghana's educational system is hit with problems that are geared towards students' inability to appreciate mathematics and get along with it well. Salient among the root causes of this phenomena is the gender dispositional empathy viewed as either male or female perform better in mathematics, or perhaps, engage along well with the other respectively. This is why it has become necessary for researchers to be interested in looking at this psychological syndrome to investigate how this gender dispositional empathy influence mathematics engagement at Atiwa Senior High Schools. This study therefore assessed a qualitative study on the influence of gender dispositional empathy on mathematics engagement among Atiwa SHS students.

1.1 Objective of the study

The main aim of the study was to assess whether there exist a significant association between students mathematical engagement and their emotional dispositional empathy of Atiwa Senior High School students. The specific objectives of the study were to:

1. to investigate whether emotional dispositional empathy affect Atiwa SHS students' mathematical engagement, and
2. to find the extent to which students' emotional dispositional empathy affect their academic performance?

2. Literature Review

The characteristics of students directed towards his dispositions in classroom learning are as complex as the human nerves can interpret. Emotion is a complex subjective experience accompanied by biological and behavioural changes, Spark, (19..) Empathy has many different definitions that encompass a broad range of emotional states, including caring for other people and having a desire to help them; experiencing emotions that match another person's emotions; discerning what another person is thinking or feeling; and making less distinct the differences between the self and the other. It also is the ability to feel and share another person's emotion. Some believe that

empathy involves the ability to match another's emotions, while others believe that empathy involves being tenderhearted toward another person. Compassion and sympathy are two terms that many associate with empathy, but all three of these terms are unique. Compassion is an emotion we feel when others are in need, which motivates us to help them. Sympathy is a feeling of care and understanding for someone in need. It can also be understood as having the separateness of defining oneself and another blur. Empathy necessarily has a "more or less" quality. The paradigm case of an empathic interaction, however, involves a person communicating an accurate recognition of the significance of another person's ongoing intentional actions, associated emotional states, and personal characteristics in a manner that the recognized person can tolerate. Recognitions that are both accurate and tolerable are central features of empathy. The genetic personality of the individual student assumes the emotional state generated towards mathematics engagement and can have advert effect on the mathematical engagement and performance.

The human capacity to recognize the bodily feelings of another is related to one's imitative capacities and seems to be grounded in an innate capacity to associate the bodily movements and facial expressions one sees in another with the proprioceptive feelings of producing those corresponding movements or expressing oneself. Humans seem to make the same immediate connection between the tone of voice and other vocal expressions and inner feeling.

Empathy is distinct from sympathy, pity, and emotional contagion. Sympathy or empathic concern is the feeling of compassion or concern for another, the wish to see them better off or happier. Pity is a feeling that another is in trouble and in need of help as they cannot fix their problems themselves, often described as "feeling sorry" for someone. Emotional contagion is when a person (especially an infant or a member of a mob) imitatively "*the emotions that others are showing without necessarily recognizing this is happening*".

An empathic disposition has been seen as a desirable trait for teachers in diverse settings. This disposition has been identified as key characteristics in being effective in urban diverse schools (Darling Hammond, 2000; Gordon, 1999).

3. The Emotional Theories

The conceptual definition of emotion refers to a feeling or state involving thoughts, physiological changes, and an outward expression or behavior. Emotions can be understood as either states or as processes. When understood as a state (like being angry at the mathematics teacher or afraid of teacher, content, formulas) resulting in

anxiety. Emotion is a type of mental state that interacts with other mental states and causes certain behaviors. These behaviours could put the students in a dispositional empathy in getting along with mathematical engagement.

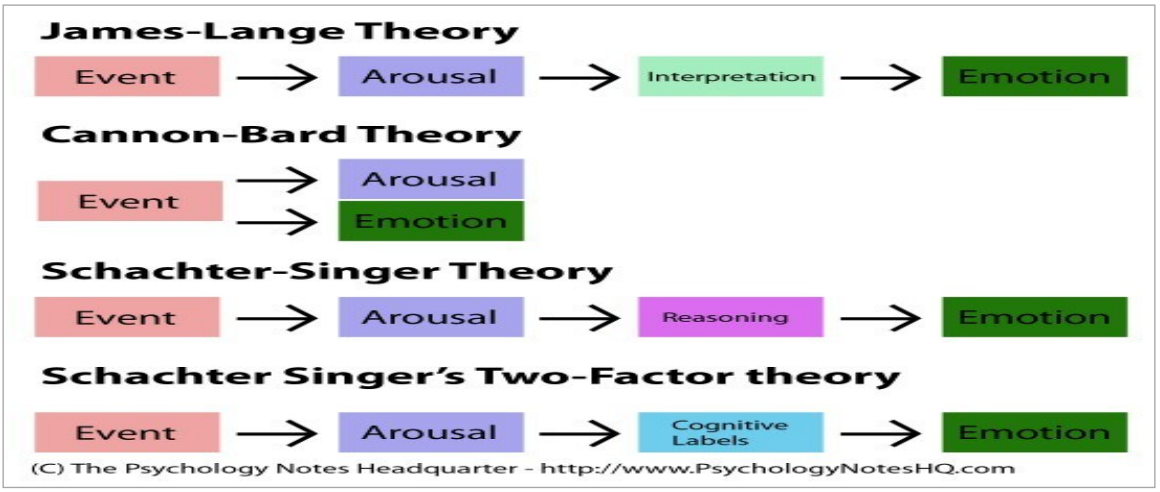
Emotion is seen as a process, it is useful to divide emotion into two parts. The early part of the emotion process is the interval between the perception of the stimulus and the triggering of the bodily response, Gregory, (2011). The later part of the emotion process is a bodily response, for example, changes in heart rate, conductance, and facial expression developed or exhibited towards mathematical learning situation.

The James-Lange theory of emotion argues that an event causes physiological arousal first and then we interpret this arousal. Only after our interpretation of the arousal can we experience emotion. If the arousal is not noticed or is not given any thought, then we will not experience any emotion based on this event. This arousal causal events in this study is specified by student's mathematical engagement in the learning situation where students develop several attitudes towards the mathematics content, the instructor or formative and summative assessment. A few critics, however, is given to James-Lange emotional theory as seen by Paul Redding, (2011). His familiar thought of James that the subjective "feeling" of an emotion is nothing more than an awareness of bodily states and processes, primarily conceived as located "peripherally" within viscera, skeletal muscle, and skin then proceed by addressing the common criticism that such an approach denies any cognitive dimension to the emotions. It should be seen as part of a tradition that aimed at undermining the types of dichotomous conceptions of body and mind that his critics still took for granted. Whatever the misconception is look at in Atiwa District of Ghana SHS, the bodily state, perception and attitudinal clues exhibited by students in mathematical instruction can be positive or negatively directed and can however have significant effect on students' performance.

The Cannon-Bard theory argues that we experience physiological arousal and emotional at the same time, but gives no attention to the role of thoughts or outward behavior, Davitz, (1969). The nature of mathematics engagement of students in the pedagogical development of lessons is physically rigorous and appeals significantly to the psychomotor domain of Bloom's (1957) taxonomy of instructional learning. The stress for which students go through physically in mathematics education initiates some emotional clues to their mathematical engagement demonstrated typically in Ghanaian situations such as Atiwa District.

In Schachter-Singer emotional theory, an event causes physiological arousal first. Similar to Cannon-Bard theory, one must then identify a reason for this arousal and then one is able to experience and label the emotion. The teaching and learning

encounter is specified under this physiological arousal fist directed by manipulatives, especially during mathematical lessons where a lot of teaching aids, activities through demonstrations are made. The curriculum structure of the Ghanaian system for core and elective mathematics is designed to engross students holistically in all paradigms of activities. Does this trigger emotional strand on students' mathematical engagement and under what direction? The chart below shows the various emotional theories from event stimulus arousal to the emotional development.



Source: "Theories of Emotions" by Gregory Johnson, The Internet Encyclopedia of Philosophy

In order to know that a trait is an adaptation, we have to be familiar with the circumstances under which the selection occurred (Brandon, 1990; Richardson, 1996). How a student's adapt himself or herself to the learning environment could results in emotions. The extent to which these emotional results affect mathematical engagement as the students adapt themselves to the learning environment can have adverse effect on academic performance. As Dacher Keltner et al. has stated, "*Emotions have the hallmarks of adaptations: They are efficient, coordinated responses that help organisms to reproduce, to protect offspring, to maintain cooperative alliances, and to avoid physical threats*" (Keltner, Haidt, & Shiota, 2006, p. 117). Teachers who physically threat students to poised them to learn, do assignment and other cohesion means of adapting to the learning situation is very typical of not only Atiwa teachers' but Ghanaian rural communities teachers as a whole. Although the trend when explaining emotions from a historical point of view is to focus on adaptations, an alternative is simply to identify the traits that are present in a certain range of teachers as a means of motivating students to learn.

According to Paul Griffiths, some emotions should be identified and then classified in this way (1997, 2004). This classification creates a psychological category,

which Griffiths terms the *affect program emotions*: surprise, anger, fear, sadness, joy, and disgust. In Griffiths' theory, the other emotions belong to different categories—the higher-cognitive emotions and the socially constructed emotions—and in some cases a single vernacular term, insults, formula proving, more exercises, unavailability of teaching and learning aids etc, for example, can cause students anger, anxiety, stress, dissatisfaction and among others.

3.1 Social and Cultural Theories

The second main approach to explaining the emotions begins with the idea that emotions are social constructions. Gregory, (2011). That is, emotions are the products of societies and cultures, and are acquired or learned by individuals through experience. Virtually everyone who defends this position acknowledges that emotions are to some degree, natural phenomena. Nonetheless, the central claim made in these theories is that the social influence is so significant that emotions are best understood from this perspective. Gregory Johnson, (2011). Emotions typically occur in social settings and during interpersonal transactions—many, if not most, emotions are caused by other people and social relationships. Thus, in many cases emotions may be best understood as interactions between people, rather than simply as one individual's response to a particular stimulus (Parkinson, 1996). The Ghanaian educational systems place students in interactive social and cultural diversity realms from different tribal demographic settings where students from diverse background interact with each other. The class is usually large exceeding the normal teacher-students ratio of 1:25 due to lack of facilities. In Akyem Sekyere SDA SHS and Kwabeng Anglican SHS, a class can contain about 70 students on board and this can create some emotional stress on the students.

3.2 Cognitive Theories

The cognitive theories contend that the early part of the emotion process includes the manipulation of information and so they should be understood as a cognitive process.

As the psychologists Ira Roseman and Craig Smith point out, "*Both individual and temporal variability in reaction to an event are difficult to explain with theories that claim that stimulus events directly cause emotional response*" (2001, p. 4) as cited by Gregory. The cognitive dispositional empathy of students studied by Owusu-Darko, Osei-Boadu and Ansah-Hughes, (2017) of the same demographic settings revealed a significant dependence of students cognitive disposition to their level of mathematical engagement demonstrated. This gradually affects students' academic performance significantly.

3.3 Judgment Theories

Judgment theories are the version of the cognitive position that have been developed by philosophers. The basic idea, as Robert Solomon puts it, is that an emotion is "*a basic judgment about our Selves and our place in our world, the projection of the values and ideals, structures and mythologies, according to which we live and through which we experience our lives*" (1993, p. 126). *Judging* in this context is the mental ability that individuals use when they acknowledge a particular experience or the existence of a particular state of the world; what Martha Nussbaum calls "assenting to an appearance" (2004, p. 191). The judgement teachers, parents, and all stakeholders of the school places on the students even though, could be motivational, but could one way or the other mess-up students emotional disposition in the mathematical engagement during lesson delivery. Judging students learning behavior must be done in a professional way. Placing judgment such as "bad student" "*Wabon papaapa*" [meaning in Akan dialect *very poor or weak students*] and among others disheartens students and put them on emotional stout.

The model below shows the trend of students' perception of mathematics that leads to their emotional status adapted from "Theories of Emotions," by Gregory Johnson, *The Internet Encyclopedia of Philosophy*, ISSN 2161-0002, http://www.iep.utm.edu and modified to suit classroom teaching.

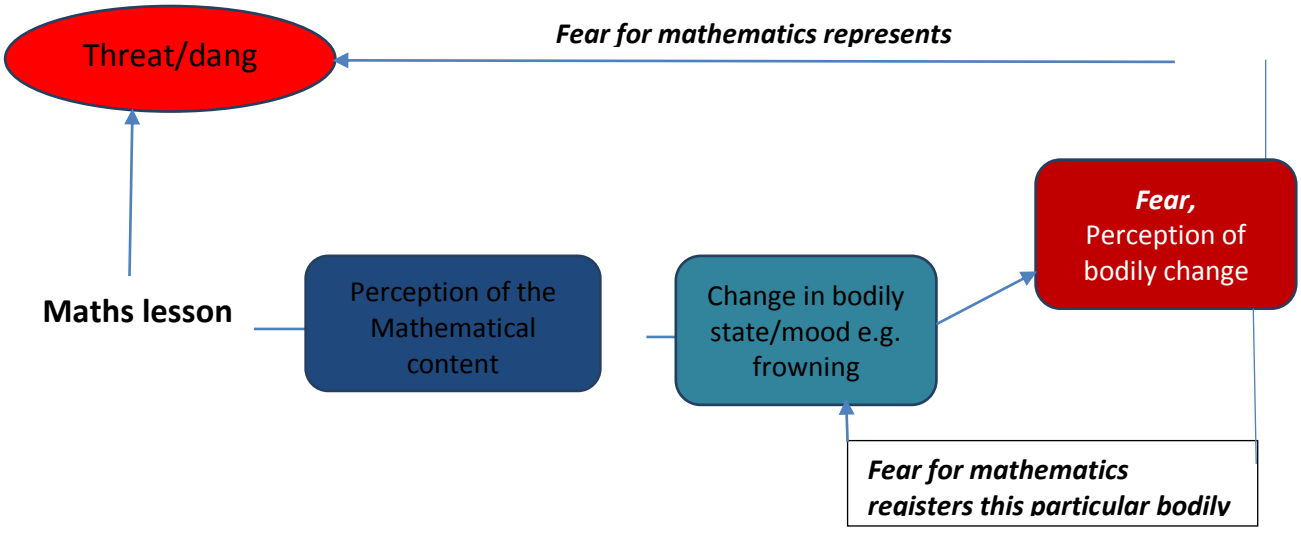


Figure 1: An illustration of Prinz's somatic feedback theory to mathematical lesson perceived by students to trigger fear related emotions

In this example, fear is the mental state caused by feedback from the body (that is, the perception of the bodily changes). This mental state registers the bodily changes, but

represents meaningful, albeit simple, information. In this example, the mental state represents danger. Adapted from Prinz (2004a, p. 69)

4. Method and Materials

The study used a cross sectional source of data with a sample size of 100 respondents across the students randomly selected from the three SHS in Atiwa District of Ghana namely, Kwabeng Anglican SHS, Sekyere SDA SHS and Anyinam Atiwa SHS. The study adopted both descriptive and qualitative methods in analyzing the data. A random sampling method was used to solicit for information about the respondents in the study area per their mathematical engagement relative to their gender disposition in Mathematics lesson. The study used questionnaires and interviews to retrieve all the relevant information needed for the study. The study used both SPSS and STATA software's in the processing and the interpretation of the data gathered from the field. A Pearson chi-square test of independence and Crammer's V test of were used for the analyses

4.1 Conceptual Framework of Pearson Chi-Square and Crammer's V

The chi-square statistic is a sum of terms each of which is a quotient obtained by dividing the square of the difference between the observed and theoretical values of a quantity by the theoretical value defined along the magnitude of categorical counts (qualitative response variables), Owusu-Darko et al, (2017)

In general, the hypothesis of independence between two variables in which one is classified into r classes and the other into c classes gives an $r \times c$ contingency table or r, mutually exclusive cells, where r is the number of rows and c the number of columns. That is, one variables contingent (or dependent) on the other. Table 4.0 is an $r \times c$ contingency table in which variable 1 is classified into r classes and variable 2 into c classes.

Table 1: A $r \times c$ contingency table

Variable 1	1	2	⋯	c	Totals
1	0_{11}	0_{12}	⋯	0_{1c}	R_1
2	0_{21}	0_{22}	⋯	0_{2c}	R_2
⋮	⋮	⋮	⋮	⋮	⋮
r	0_{r1}	⋯	⋯	0_{rc}	R_c
Totals	C_1	C_2	⋯	C_c	n

The observation in each cell is called the **observed cell frequency** representing number of categories defined by total number of respondent in respective nominal study variables**.**

$R_i = \sum_{j=1}^{c} o_{ij}$is the marginal total for row i, whilst

$C_j = \sum_{i=j}^{r} o_{ij}$is the marginal for column j.

Where $\sum_{i=1}^{r} R_i = \sum_{j=1}^{c} C_j = n$ is the total sample size.

We can test the null hypothesis:

H_0: $variables\ \ are\ independent\ against\ the\ alternative$

H_1: $variables\ are\ not\ independent$

The test statistic (Pearson independent chi-square estimator) is given by

$$\chi^2 = \sum_{i=1}^{r} \sum_{j=1}^{c} \frac{\left(o_{ij} - e_{ij}\right)^2}{e_{ij}}, \qquad (4.1)$$

Where e_{ij} is the expected cell frequency for the (ij)th cell. It can be shown that

$$e_{ij} = \frac{R_i \times C_j}{n}$$

The statistic in Equation (4.1) under the null hypothesis has an approximate chi-square distribution with the number of degrees of freedom given by $(r-1)(c-1)$.
The critical region for the test at α% significance level is therefore,

$$\chi^2 \geq \chi^2{}_a[(r-1)(c-1)]$$

In tests for independence, both row and column marginal totals are free to vary although the sample size is fixed. The test for independence or homogeneity is a test of association under consideration.

After we have performed a chi-square test of independence and found the two variables to be dependent, we may want to measure the strength of dependence between the two variables. This may be done by finding a constant$e$. called the contingency coefficient. It is given by

$$c = \sqrt{\frac{\chi^2}{n + \chi^2}}$$

Where

$$\chi^2 = \sum_{i=1}^{r}\sum_{j=1}^{c}\frac{(o_{ij} - eij)}{eij}$$

and n is the sample size. The coefficient, c, is always 0 when the two variables are independent. A disadvantage associated with is that its value is always less than 1, even when the two variables are completely dependent on each other. For this reason, Cramer's V, given by

$$V = \sqrt{\frac{\chi^2}{nt}}$$

Where t is the smallest of the two numbers (r–1) and (c–1), is preferred. The value of V lies in the internal from 0 to 1.

A descriptive response where necessary could be expressed as percentages

$$\frac{X_i}{\sum_{i=1}^{n} F_i} \times 100 = \varphi\%$$

Of students' response on categorical variables defined for SDE

5. Empirical Results

5.1 Descriptive Analysis

This sub-section discusses the nature of relationship existing between students' response variable on gender status and their mathematics engagement in Atiwa SHS. The analyses further elaborate on the dependency of students' Academic Performance (AP) on gender disposition.

5.2 Students Emotional Empathy on Mathematical Content

The study investigates into students' emotional empathy (SEE) on mathematical content in Atiwa District of Ghana Senior High School (SHS), a focus on the research question "*what is the relationship between Students' Emotional empathy (SEE) and their dispositional performance among Atiwa Senior High School"*. Table 4.2 gives a descriptive response expressed as percentages, students response on whether mathematical contents is dull and boring, sometimes find it difficult to see things from other people's point of view in

mathematics, emotional empathy resulting in dislikes in mathematics, and whether students mathematical engagement makes ones feel nervous.

Table 2

Status of students' Emotional Empathy

		Frequency	Percent	Valid Percent	Cumulative Percent
Mathematics is dull and boring					
Valid	Not at all	69	43.7	43.7	43.7
	Some how	48	30.4	30.4	74.1
	Rarely	24	15.2	15.2	89.2
	Not rarely	17	10.8	10.8	100.0
	Total	158	100.0	100.0	
You sometimes find it difficult to see things for other people's point of view in mathematics					
Valid	Not at all	49	31.0	31.0	31.0
	Some how	66	41.8	41.8	72.8
	Rarely	22	13.9	13.9	86.7
	Not rarely	21	13.3	13.3	100.0
	Total	158	100.0	100.0	
Emotional empathy resulting in dislikes in mathematics					
Valid	Not at all	46	29.1	29.1	29.1
	Some how	58	36.7	36.7	65.8
	Rarely	31	19.6	19.6	85.4
	Not rarely	23	14.6	14.6	100.0
	Total	158	100.0	100.0	
Students mathematical engagement makes ones feel nervous					
Valid	Strongly Disagree	44	27.8	27.8	27.8
	Disagree	60	38.0	38.0	65.8
	Agree	20	12.7	12.7	78.5
	Strongly Agree	18	11.4	11.4	89.9
	Undecided	16	10.1	10.1	100.0
	Total	158	100.0	100.0	

Data source: field survey 2016

From Table 2, a varied response of students on whether studying mathematics is dull and boring, those who said *not at all* comprise 43.7%, somehow (30.4%) rarely and not rarely comprise 15.2% and 10.8% respectively. It could be seen that majority of students don't consider mathematics content as dull.

A follow through on SEE table 2 records a relatively high percentages of students reacting to whether they sometimes see things from other peoples' point of view as against *rarely* responses. In the same way, a combined percentage of 65.8% realize SEE resulting in dislike in mathematical content when engaged compared to 34.2% seeing this on the rare cases. Hence, to some extent, SEE can result in dislike in mathematics. Table 3 and 4 would further investigate into the inferential statistics connecting SEE and AP hereafter.

Interestingly, about 65.8% disagreed to the assertion that mathematics engagement makes them feel nervous. A few comprising a combined percentage of 24.1% agreed whilst 10.1% were undecided about this matter.

Table 3: Relationship between Emotional empathy and students interest in solving Mathematical problems (engagement)

		Effect of dispositional empathy on Students Academic Performance							
Emotional empathy resulting in dislikes		Excellent	V. good	Good	Credit	Pass	Fail	Total	Chi-square
	Not at all	8	10	6	12	0	10	46	$\chi^2_{(0.05,15)} = 67.417$
	Some how	0	0	10	15	22	11	58	$P - value = .0.00$
	Rarely	0	0	6	7	8	10	31	
	Not rarely	0	6	0	10	4	3	23	$Df = 15$

Source: field survey 2016-Results are based on nonempty rows and columns in each innermost subtable, *. The Chi-square statistic is significant at the 1%, 5% and 10% level respectively.

Table 3 gives a 4 by 6 contingency Pearson chi-square independence test between whether effect of SDE on AP is dependent on their dislike in studying mathematics. Independent variable on students' response is based on whether the effect is based on *not at all, sometimes, rarely and not rarely* the claim under discussion. Students DE on AP is categorized on the same grade interpretation-Excellent, Very good, good, credit, pass or fail.

The study sought to investigation the hypothesis that

H_0: Dispositional empathy on student Academic Performance (AP) is independent On emotional empathy resulting in engagement in mathematics.

Against

H_1: Dispositional empathy on student Academic Performance (AP) is independent On emotional empathy resulting in engagement in mathematics.

At a significance level of $\alpha = 0.05$, a decision precision level of

$$100(1-\alpha)\% \cong 95\%$$

A Pearson independent chi square is computed using an SPSS output estimator as:

$$\chi^2 = \sum_{i=1}^{r} \sum_{j=1}^{c} \frac{(o_{ij} - e_{ij})^2}{e_{ij}} = 67.417$$

That is:

$$\chi^2{}_{(0.05,\ 15)} = 67.417$$

with the number of degrees of freedom given by

$$(r - 1)(c - 1) = (4 - 1)(6 - 1) = 3 \times 5 = 15\ d.f.$$

The critical region for the test at $\alpha\% = 5\%$ significance level is the probability of rejecting the H_0 . hence the computed chi-square at 15 d.f is given as

$$\chi^2{}_{[(r-1)(c-1)]} = \chi^2{}_{(0.05,\ 15)} = 67.417$$

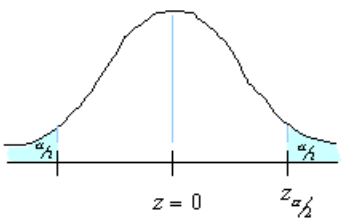
The study realized a significance chi-square test at $\alpha = (0.01), (0.05) and (0.1)$ respectively since SPSS calculated

$$P - value\ of\ 0.000 < (\alpha = 0.05).$$

This is consistent with the traditional critical region defined by α against the degree of freedom 15

$$[\chi^2 = 67.417] \gg [\chi^2{}_{[(r-1)(c-1)]} = \chi^2{}_{(0.05,\ 15)} = 24.996]$$

We fail to reject H_0, hence it is statistically significant. We have insufficient evidence to reject H_0.



$\chi^2{}_{(0.05,\ 5)}$=24.999

It is concluded here however that, Dispositional empathy on student Academic Performance (AP) is independent of students' emotional empathy response. Again, the fact that a student see mathematics as difficult to understand as a result of emotional empathy doesn't mean he or she can't pass mathematics evaluated lesson. That is, a student emotional status doesn't guarantee passing with excellent, very good, good, credit, pass or fail etc.

The graph below is a pictorial representation of the relationship between student's response on the nature of mathematics performance and students' dispositional emotional empathy.

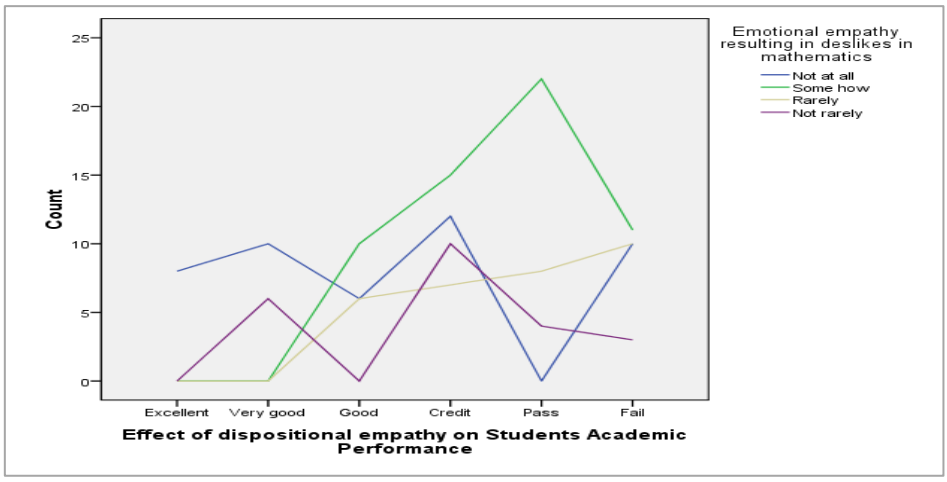


Figure 2: A line graph on effect of SDE and their Academic Performance (AP)

Figure 3 shows a line graph on effect of SDE based on their emotion response and their Academic Performance (AP). Majority of students who responded somehow seem to be dominantly performing relatively high on pass-failure grade.

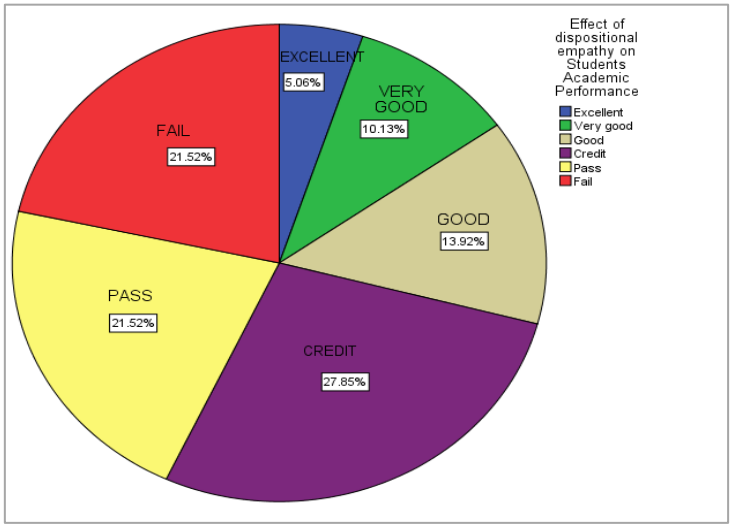


Figure 3: A pie chart showing Effect of SDE on their Academic Performance (AP)

Students' emotional disposition can have adverse effect on their academic performance. The pie chart in figure 2 shows the cross section of the performance of students sampled from Atiwa SHS whose AP were categorized based on their grade interpretations: Fail (below 45%), pass(45%-54%) credit (55%-64%), Good (65%-69%), very good (70%-79%) and excellent (80-100)%. Records of their performance was based on their average terminal grade recorded in end of term exams. Majority of the students fall within the credit range score whiles relatively closed are those passing and failing constituting 21.52% of the total respondents.

6. Conclusion

It is concluded here however that, Mathematics is seen by Atiwa SHS students' as difficult and can have negative emotional disposition about the conceptual engagement of mathematical contents.

The study's hypothetical test of students' emotional empathy (SEE) is independent of students' mathematical engagement reflective of their Academic Performance (AP). It was seen that, the fact that a student see mathematics as difficult to understand as a result of emotional empathy doesn't mean he or she can't pass mathematics evaluated lesson. That is, a student emotional status doesn't guarantee passing with excellent, very good, good, credit, pass or fail etc. The performance is clustered around $F9 - C4$, eventhough, weak. Few had a distinctive grade of good, very good and excellent. Again, the study realized a significance chi-square test at $\alpha = (0.01), (0.05) and (0.1)$ respectively. It is concluded however that, to some extent, students emotional empathy (SEE) can results in dislike in mathematics engagement during mathematical lessons.

7. Recommendations

After careful analyses of the study variables, we recommend the following to Education Services (e.g. GES), mathematics educators, students and future researchers where applicable.

1. Teachers should try as much as possible to satisfy students' affective domain when considering lesson objectives, methodology and evaluation of mathematical lessons as suggested by Bloom et al (1957) taxonomy for instructional learning and supported by the recommendations of Owusu-Darko et al (2017).

2. Students should not be stressed up in the school or in the house with emotional indicative variables that could trigger students' emotions and affection in the classroom especially when students are preparing for mathematical lessons.
3. There exist confounding significant effect of certain performance qualitative indicator variables that can disposition students in Mathematical engagement (such as gender, cognition, perceptions etc) as supported by the findings of Owusu-Darko et al, (2017). Some of these cases could be attributed to their dispositional imbalances that are inherent in the cover of their own sleeves such as emotions, cognitions, perception and psychological status desired to meet mathematical lessons etc and mathematics educators need to be on the lookout.

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