Improving Medical Students' Critical Thinking And Observational Skills For Learning Human Gross Anatomy: A Study At School Of Medicine And Health Sciences Of University For Development Studies, Tamale, Ghana

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Abstract: Background: To investigate students' percept on whether visual art-based interventions would improve their observational skills, as well as to investigate how visual art-based interventions can improve medical students' critical thinking and observational skills for learning of Anatomy.The ability to critically think, observe and analyse physical features of disease conditions on the human body is an essential skill medical students need to develop in order to conduct physical examination of patients effectively. This study aimed at investigating how visual art-based interventions can improve 3rd and 4th Year undergraduate medical students' observational skills to facilitate learning of Anatomy. It was important to conduct this study because the results will trigger a dialogue among experts of Medical education and Art education on how to explore and incorporate visual art-based interventions into the pedagogy of the medical school as an alternative scientific approach to enhance medical students' critical thinking and observational skills for learning of Anatomy as well as for practice. Material and Method: The study employed the post-test only experimental design. The target population was 349 students comprising 211 third year and 138 fourth year students. The study was conducted in the second semester of the 2017-2018 academic years. A randomized sample of 66% on each year group was proportionately chosen for the study. This comprised 139 and 91 third year and fourth year students respectively. The students were divided into two groups: Experimental and Control groups. The experimental group was given specific instructions on how to apply Visual Thinking Strategies (VTS) in analysing visual details of images. Four images of two-dimensionality were distributed to the students to critically observe and analyse its visual details. A scoring scheme was developed to guide in scoring the students' performance. A questionnaire of 23 items with four five-point Likert scale feedback questions and four Visual Thinking Strategies questions were distributed to the participants. It took about 1 hour 30 minutes to complete the exercise. Statistical analysis of responses from the questionnaire and experiment was done using the Software Package for Social Sciences. The results were presented in inferential statistics with mean, standard deviations, p values and Cronbach's Alpha. The study used 99% confidence interval and Cronbach's alpha of .9 reliability coefficient for determining internal consistency of the feedback questions. Results: The experimental group scored significantly with mean and standard deviation of 18.56±8.42 on knowledge score than the control group that scored mean and standard deviation of 11.81±6.70. The overall impact was significant with p = 0.0001. Students' responses via the questionnaire indicated awareness that visual art-based interventions can improve their critical thinking and observational skills for learning of Anatomy. Conclusion: This study concludes that visual art-based interventions with Visual Thinking Strategies used as alternative scientific approach for training medical students would complement the Skills Coordinators' efforts in improving the students' critical thinking and observational skills. [E Mani Natl J Integr Res Med, 2020; 11(2):40-46]

Key Words: Critical thinking, Critical observation, Medical students, Visual images, Visual art-based, Visual thinking strategies.

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Introduction: Critical thinking and observational skills are fundamental to medicine. These skills can be developed through visual art-based interventions. Medical training institutions prepare medical students to become efficient and reflective physicians who will be able to conduct physical examination of disease conditions on the human body. But skills training in physical examination will best be achieved if the School of Medicine and Health Sciences (SMHS) of University for Development Studies (UDS) incorporates Visual Art-Based interventions with VTS into its pedagogy as an alternative scientific approach for students to explore and improve upon their critical thinking and observational skills[1,2]. This will prepare the students holistically to be able to conduct physical examination of patients effectively in future.

Background And Setting: Visual media as learning aid and visual art-based interventions play key

roles in the training of medical students[1] (Mileder, Wegscheider & Dimai 2014;[2] because they have the potential for improving medical students' observational skills for learning Anatomy and for clinical practice[3,4]. However, there was no visual art-based interventions implemented to improve medical students' critical thinking and observational skills at the School of Medicine and Health Sciences (SMHS) of the University for Development Studies (UDS). This may impede students' efforts in developing skills for physical examination. This study was conducted at the Department of Anatomy, School of Medicine and Health Sciences of the University for Development Studies, Ghana. This medical school runs an integrated Problem Based Learning (PBL) curriculum which stresses on student-centered, self-directed learning of basic and clinical sciences[5].

Material and Methods: Research Design: The study employed the Explanatory Sequential Mixed-method research design. The post-test only experimental design was used together with questionnaire for collecting quantitative data on the experiment while observations and focus group discussions were used for collecting qualitative data. The explanatory sequential mixed method was adopted because quantitative data was collected through the use of questionnaire and experiment whiles qualitative data was collected using focus group discussions, interview and observations so that the researcher could generalise the results[6]. This method enabled the researchers to expound results, or decrease flaws emanating from the use of a single method. It also helped "deepen our understanding about teaching and learning of Anatomy in medicine" [7,8].

Sample And Sampling Procedure: The target population was 349 students comprising 211 third year and 138 fourth year students. Selection of participants was randomly done to ensure fairness in the selection process. A randomized sample of 66% on each year group was proportionately chosen for the study. This comprised 139 third year and 91 fourth year students. Permission was obtained from the registry of the medical school to conduct the study. Also, the study obtained the consent of the students and participation was voluntary.

Steps In Conducting The Critical Thinking And Observational Experiment: The students were divided into two groups: Experimental and Control groups. The experimental group was given specific instructions on how to apply Visual Thinking Strategies to analyse visual details of images. Four intriguing images of two-dimensionality were distributed to the students to critically observe and analyse its visual details. A scoring scheme was developed for scoring the students' knowledge and skill level. A questionnaire of 23 items with four five-point Likert scale feedback questions and four Visual Thinking Strategies questions were distributed to the participants. Numeric values of 1 =strongly agree, 2= agree, 3= neutral, 4= strongly disagree, and 5 = disagree were assigned to the Likert scale points.

Data Collection Procedure: Data on the students' perception was collected through questionnaire. Also, focus group discussions were held with the students to seek explanations to some of the issues that emanated from their responses through the questionnaire. A posttest only experimental design was conducted with experimental and control groups to find out whether visual art-based interventions have positive impact in improving medical students' observational skills.

Data Analysis Plan: The first objective was to investigate the medical students' perception on whether visual art-based interventions would improve their critical thinking and observational skills. Data collected on this were entered into Microsoft Excel and Statistical Package for the Social Sciences (SPSS), version 23 (SPSS Inc, IBM, Chicago, IL, USA) and analysed in descriptive statistics and the results presented in percentages in tables. Data collected on the experiment on the students' ability to critically observe and analyse visual images were also entered in SPSS and analysed and the results presented in inferential statistics. Four hypotheses were formulated to test the claims made. The study used 99% confidence interval and Cronbach's alpha of .9 reliability coefficient for the four feedback questions. The results were presented in inferential statistics with mean, standard deviation, p values and Cronbach's Alpha.

Results: Demographic characteristics of respondents: The demographic data of the respondents as shown in Table 1 indicate that 109(60.2%) of them were males and 72(39.8%)

were females. Most, 86(47.5%) of the students fell between 21 and 23 years of age. A total of 95(52.5%) were randomly assigned to control group while 86(47.5%) were in the experimental group.

Table 1: Demographic Data Of Respondents

Variable	Sub-group	Frequency	Percentage
Sex	Male	109	60.2
	Female	72	39.8
Year Of Study	Year 3	112	61.9
	Year 4	69	38.1
Age	18 – 20	50	27.6
	21 – 23	86	47.5
	24 – 26	32	17.7
	>26	13	7.2
Participants	Control	95	52.5
	Experimental	86	47.5

Source: Field Data, 2018

Knowledge Score According To Year Group And Sex: For the students' performance in terms of year level, third-year students obtained a mean and standard deviation of 14.85±7.85 compared with 15.29±8.95 by the fourth-year students. But the difference in their knowledge level to identify and analyse visual images was not significant (p=0.728). In terms of gender, the male students scored a mean and standard deviation of 14.17±7.6 lower than scores obtained by their female counterparts 16.31±9.07. However, p=0.088 indicated the students' gender did not have association with their ability to identify and analyse details of visual images (Table 1).

Table 1: Knowledge Score According To Year Group (N=181)

Variable	Sub group	Knowled--ge Score	Mean percentage	P-value
Year level	Year 3	14.85±7.85	17.47	0.728
	Year 4	15.29±8.95	17.99	
Sex	Male	14.17±7.6	16.67	0.088
	Female	16.31±9.07	19.19	

Source: Field data, 2018

Students' Background Knowledge In Appreciation Of Visual Images: On whether having background knowledge in appreciation of visual images is necessary for learning of Anatomy, Majority 113(62.4%) and 60(33.1%) strong agreed and agreed respectively, that students background knowledge in appreciation of visual images has positive influence on their ability to learn Anatomy effectively (Table 2).

Table 2: Students' Responses On Whether Having Background Knowledge In Appreciation Of Visual Images Is Necessary For Learning Of Anatomy

	Year level		
Item	(Year 3)	(Year 4)	Total
Agree	42(36.5%)	18(27.3%)	60(33.1%)
Disagree	1(0.9%)	1(1.5%)	2(1.1%)
Not Sure Or Neutral	3(2.6%)	2(3.0%)	5(2.8%)
Strongly Agree	68(59.1%)	45(68.2%)	113(62.4%)
Strongly Disagree	1(0.9%)	0(0.0%)	1(0.6%)
Total	115	66	181

Source: Field Data, 2018

Table 3: Students' Responses On Whether Visual Art-Based Intervention When Implemented Will Improve Their Observational Skills Development (N=181)

	Year Level		
Item	(Level300)	(Level 400)	Total
Agree	38(33.0%)	21	59(32.6%)
Disagree	0(0.0%)	1	1(0.6%)
Not Sure Or Neutral	6(5.2%)	0	6(3.3%)
Strongly Agree	71(61.7%)	44	115(63.5%)
Strongly Disagree	0(0.0%)	0(0.0%)	0(0.0%)
Total	115	66	181

Source: Field Data, 2018

Concerning students' agreement on whether Visual Art-Based intervention when implemented will improve medical students' observational skills, 115(63.5%) and 59(32.6%) of the students strongly agreed and agreed, respectively that visual art-based intervention when implemented will improve their observational skill, and will therefore enhance learning of Anatomy (Table 3).

Hypotheses: Four research hypotheses were formulated for this study concerning the experiment and they are as follows:

Ho_1: There is no significant difference between medical students who are guided with VTS and medical students who are not guided in their ability to identify and analyse visual images.

Ho_2: Medical students' background knowledge in visual art does not influence their ability to identify and analyse visual images.

Ho_3: Medical students will not find it easy to identify and analyse visual images.

Ho_4: Visual art-based critical thinking and observational skills training will not improve medical students' ability to observe and analyse visual images more critically.

Results On Visual Art-Based Experiment: With regards to the effectiveness of the visual art-based critical thinking and observational skills experiment, Table 4 shows that the experimental group scored a higher mean of 18.56, and a standard deviation of 8.42 compared with the control group that obtained a mean of 11.81, and standard deviation of 6.70 with p = 0.001. The students' responses with p = 0.197 implied that the students' background knowledge did not have influence on their ability to identify and analyse visual details. Generally, the students' responses with p = 0.0001 indicated that visual art-based critical thinking and observational skills training made a positive impact on improving medical students' ability to identity and analyse visual details more critically than before.

Table 4: Results From Visual Art-Based Experiment

Variable	Sub-Group	M	SD	P-Value
Experimental Group	Control	11.81	6.70	0.001
	Experimental	18.56	8.42	
Age (to the nearest whole)	18 to 20	14.86	7.02	0.165
	21 to 23	16.04	8.62	
	24 to 26	12.22	7.11	
	>26	15.77	11.73	
Background knowledge in visual arts	No	14.47	8.10	0.197
	Yes	16.17	8.55	
Has this observation exercise improved your ability to observe images more critically than before	No	11.20	7.28	
	Yes	16.10	8.23	0.001

Source: Field Data, 2018

Feedback On Whether The Students Found It Easy In Identifying Visual Details Of Images Presented To Them: Table 5 presents Cronbach's Alpha on the students' responses based on a Five-point Likert scale questionnaire items to determine the reliability of responses on whether the students found it easy or not in identifying visual details of images of two-dimensionality presented to them for critical observation and analysis. The scale was, 1 = Agree, 2 = Disagree, 3=Neutral, 4 = Disagree, 5 = Strongly disagree. The Cronbach's Alpha α= .983 indicated a reliable internal consistency in the students' responses that they found it easy in identifying and analysing the visual images, due to Visual Thinking Strategies interventions provided.

Table 5: Reliability Statistics On Whether The Students Found It Easy In Identifying And Analysing The Visual Details Of Images Presented To Them

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.983	.984	4

Source: Field Data, 2018

Item total statistics on students responses on the four images: Reliability analysis carried out on the values scale on all four (4) items using the Cronbach's alpha showed the questionnaire to reach acceptable reliability as shown in Table 6. That is, the reliability coefficient alpha for images one is α = .973; image two is α =978; image three is α = .979, and image four is α = .980 respectively. All items appeared to be worthy of retention, and would result in a decrease in the Cronbach's alpha if any of the items was deleted (Table6)

Table 6: Item-Total Statistics

Items	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Students Found It Easy To Identify Visual Details Of Image One	6.6298	13.979	.973	.947	.973
Students Found It Easy To Identify Visual Details Of Image Two	6.8564	14.090	.955	.912	.978
Students Found It Easy To Identify Visual Details Of Image Three	6.5470	13.471	.957	.921	.979
Students Found It Easy To Identify Visual Details Of Mage Four	6.5691	14.758	.950	.908	.980

Source: Field Data, 2018.

Hypotheses Testing: In order to determine whether the treatment group deferred significantly from the control group in their ability to critically observe and identify details in visual images, four hypotheses were formulated.

H_{o1}: There is no difference between medical students who are guided with VTS and medical students who are not guided in their ability to identify and analyse visual images: The test statistics p = 0.0001 on the experiment provides strong evidence against the null hypothesis. We therefore conclude that there is a difference in the students' ability to identify and analyse details of visual images.

$H_{o2:}$ Medical students' background knowledge in visual art does not influence their ability to identify and analyse visual images: The test statistics of p = 0.197 is not significant and provided evidence in favour of the null hypothesis. We therefore fail to reject the null hypothesis and conclude that the student's ability to identify and analyse visual images was not dependent on their background knowledge in visual art.

H_{o3}: Medical students will not find it easy in identifying and analysing visual details of the images: In all, Cronbach's reliability coefficient alpha, α=.983 for all the four images analysed was highly reliable and provided strong evidence against the null hypothesis. We therefore go for the alternate hypothesis and conclude that the students found it easy in identifying and analysing visual details of all four images presented to them.

H_{o4}: Visual art-based critical thinking and observation skills training will not improve medical students' ability to observe and analyse visual images more critically: The test statistics of p = 0.0001 provides strong evidence against the null hypothesis. We therefore reject the null hypothesis and conclude that the visual art-based critical thinking and observation skills training improved the medical students' observational skills.

Identification And Analogies Of Details Of Visual Images Of Two-Dimensionality: Students were presented with similar images of two-dimensionality to critically observe, identify and analyse visual details embedded in them. The treatment group was guided by Visual Thinking Strategies (VTS) questions adapted from [9] VTS like "What do you see", "What else do you see" "What do you think this means". Hudson's VTS questions adapted promoted aesthetic thinking and cognitive growth in terms of observing, speculating and reasoning on the basis of evidence among the experimental group, resulting in a higher mean and standard deviation score than the control group.

Discussion: Findings from this study support the assertions made by[10 and 11] that visual art-based observational skills training has relevance for improving medical students' critical thinking and observational skills for learning of Anatomy.

Therefore, it will be appropriate if the School of Medicine and Health Sciences of UDS in Tamale integrates Visual Art-Based interventions with its pedagogy to enhance students' learning of Anatomy and critical thinking and observational skills development for practice. Integration is a process in which ideas or teaching approaches from two or more disciplines are synthesized, connected or blended[12] to understand complex phenomena or finding answers to solving perplexing issues[13].

Integration approach in PBL medical schools enhances critical thinking, promotes collaboration among students, and allows for easy integration and organisation of information learned for easy recall[14]. Therefore, the absence of visual art-based interventions at the School of Medicine and Health Sciences, Tamale, to offer students holistic learning opportunities may impede the students' learning of Anatomy. The implication is that, some of the medical students at SMHS, UDS, Tamale, may complete school with limited observational skills needed for physical examination of disease conditions of patients, and this can be dangerous to humanity[15].

Limitations: Although this study confirms the hypothesis, a few limitations have been identified. First, the study only utilised images of two-dimensionality. There was not enough time for the study to utilize images of three-dimensionality.

Implications: In spite of the limitations, the responses of the students through the questionnaire, and their keen participation in the visual art-based interventions imply that efforts made by the medical school to implement visual art-based interventions would provide the students with alternative opportunities to explore various visual media to enhance learning of Anatomy as well as develop their critical thinking and observational skills for practice.

Conclusion: This study concludes that medical students exposed to visual art-based critical thinking and observational skills will do better in identifying and analysing visual details of anatomical objects. This skill can be transferred in conducting physical examination of patients in future. The consistency of response with Cronbach's reliability coefficient alpha, α=.983 is an indication that the visual thinking strategies employed were effective in boosting the students' higher-order thinking. The students' responses on the impact about the Visual Art-Based intervention $p = 0.0001$ shows that visual art-based critical thinking and observational skills training is an appropriate scientific alternative for improving medical students' critical thinking and observational skills.

Recommendations: This study recommends that the SMHS of UDS should review its curriculum to incorporate visual art-based interventions in its pedagogy to augment its existing approaches for training the medical students in the area of critical thinking and observational skills development.

Ethics Approval And Consent To Participate: Approval was obtained from the Registry of the University for Development and the School of Medicine and Health Science. Informed consent was obtained from all the students involved in the study and participation was voluntary.

Availability Of Data: Raw data on this study will not be shared due to restrictions by the University for Development Studies' School of Medicine and Health Sciences.

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