The Impact of Writing on Academic Performance for Medical Students

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Abstract
Background Since the 1970s, writing has been widely used in classroom settings. Writing enhances learning, but there are limited studies that prove its effectiveness, especially in the medical education setting. The purpose of this study, therefore, is to investigate the effect of writing on medical students’ academic performance.

Methods An experiment was conducted with 139 medical students from Seoul National University College of Medicine. They were randomly assigned to three different groups: self-study (SS), expository writing (EW), and argumentative writing (AW) group. Each group studied the given material by the method they were assigned, and they were tested on their understanding and transfer of knowledge. We also tested students’ higher-order thinking ability using Remote Association Test (RAT).

Results The results showed that the writing groups displayed better performance than the SS group in transfer type items, while there was no difference in scores between the EW and AW group. The three groups did not show any difference in rote-memory type items, but RAT scores have a positive correlation with rote-memory scores.

Conclusions This study provides empirical evidence for writing to be adopted in classrooms for greater educational benefits, especially in medical education. These findings indicate that writing can enhance learning and higher-order thinking, which are critical for medical students.

Background
“Writing organizes and clarifies our thoughts. Writing is how we think our way into a subject and make it our own. Writing enables us to find out what we know—and what we don’t know—about whatever we’re trying to learn.”¹ As Zinsser once stated, we can clarify what we know and what we do not know through writing. The process of writing requires writers to have a clear understanding of the subject matter² and makes use of cognitive abilities. For these advantages, since the 1970s, writing has been widely used in classroom settings.³ By adopting writing assignments in the classroom, learning could be promoted. Writing helps students to develop thinking and enhance academic performance; it promotes metacognitive skills⁴ and critical thinking.⁵ However, many teachers avoid
teaching using writing because they argue that the amount of time allotted to writing assignments will only decrease the amount of time available to address the learning content they need to cover.\textsuperscript{6} They also question whether teaching students by writing could enhance academic performance and claim that the impact of writing on student learning could be limited, having reported that writing did not have a differential effect on students’ achievement.\textsuperscript{8}

On the other hand, researchers in educational and psychological fields have tried to prove the effect of writing and in some studies; it turned out that it enhanced learning.\textsuperscript{9, 10} However, there is only limited research in this area to resolve the controversy; writing to learn (WTL) turned out to be effective in some research papers,\textsuperscript{11} while some researchers questioned its effects. In particular, there is little research in medical education settings. However, if there is empirical evidence that writing enhances academic performance more than students’ self-study, there is no reason not to adopt writing as it also has important educational benefits.\textsuperscript{12} One of these educational benefits is that writing helps students to become better thinkers. In particular, writing fosters students’ higher-order thinking: writers need to utilize metacognitive skills and critical thinking abilities when writing.\textsuperscript{4, 5}

Metacognitive skills involve thinking about the process; when writing, writers have to plan, monitor and self-evaluate what has been written.

Likewise, medical professions need metacognitive skills when diagnosing patients.\textsuperscript{13} Metacognition plays a critical role in the process. Doctors need to define the problem of a patient, mentally represent the situation, plan how to proceed with the patient, and evaluate the whole process to check against other possibilities.\textsuperscript{14} When performing medical practice, it is critical to detect what is relevant and what is not between two contradictory sources of information. They also have to contrast the current patient’s status with histories of patients they have diagnosed in the past to increase accuracy of the diagnosis. Thus, revising plans constantly and checking it against other possibilities is the metacognitive ability to achieve successful performance in the medical field.\textsuperscript{13}

During writing processes, critical thinking, one of the higher-order thinking abilities, is promoted.
Critical thinking refers to the ability to analyze and evaluate thinking, and medical practice requires this kind of process. Likewise, writers go through a similar process. Writers should answer tentative response to a problem, look for clues, outline what they will write, and evaluate alternative hypotheses to counter-argue opposing views. One has to judge whether the conclusions are logically drawn, and evaluate arguments to create better pieces of writing. Therefore, writing involves and enables writers to practice metacognitive skills and critical thinking abilities, which are skills critical to becoming proficient health professionals.

For these reasons, medical students should practice metacognitive skills and critical thinking abilities to make precise judgments, which can be cultivated through writing. In this sense, the importance of writing in medical education should not be overlooked. However, there is a lack of emphasis on writing in medical schools due to some of the constraints in the classroom setting. Teaching through writing is still an unfamiliar activity for professors in medical schools where knowledge is taught mainly through listening to lectures and memorizing large volumes of material. What is worse, medical students even do not recognize the importance of writing. If writing can replace the traditional methods of learning, not only could the future medical professionals learn what they need to learn but they can also become better practitioners. For this reason, the need for writing education in medical schools could not be overemphasized.

While what to write also matters in class, how to write can affect the way ideas are organized. Both expository and argumentative essays are frequently dealt with within curriculum that require comprehension and evaluation of the general concepts. However, the two types of writing tasks involve different reasoning skills. Expository writing requires reasoning skills like classification, comparison, definition, and illustration; it requires a structured interpretation of the texts and thus can improve comprehension. On the other hand, argumentative writing deploys more reasoning skills than expository essay writing. Writers need to establish contested claims while formulating an explanation, generating counterarguments and assessing them to support their own opinions. While
both types of writing help students to develop thinking, an argumentative essay depends upon the reasoning skills much more than an expository essay.

In this study, we tried to prove the effects of writing activity in the medical education setting. We used a post-test design to see the effect of writing and devised two kinds of post-test questions: rote-memory and transfer of knowledge, respectively. Transfer is defined as the students’ ability to apply the knowledge they learned to new and/or novel situations and corresponds to the use of critical thinking in a wide variety of contexts. Since both writing tasks demand students to solve problems, those who learned through writing would do better on transfer type items than those who passively memorized the given knowledge. Considering that the ultimate goal of education is to improve thinking and transfer of learning, the implications of this study would be meaningful if participants in the writing group show better performance, especially in transfer type questions. Also, we tested students’ higher-order thinking ability using Remote Association Test (RAT), which assesses students’ cognitive processes and is often linked to students’ academic performance.

We hypothesized that those who study by writing would show better academic performance in transfer type items and the responses to RAT will be correlated with the academic performance. We also hypothesized that the effects of the two types of writing would be different. While all the participants who wrote better essays would be expected to show higher academic performance, those who study by writing an argumentative essay would show higher performance in transfer type items than those who study by writing an expository essay. We assumed argumentative writing would enhance critical thinking more than expository writing because argumentative writing involves more activities that promote critical thinking, like analyzing and synthesizing an argument. Thus, we divided the participants into three groups: those who study by themselves (self-study; SS group), those who study by writing a summary text (expository writing: EW), and those who study by writing an argumentative text (argumentative writing: AW). We tested each group’s academic performance and tried to better differentiate the effect of different types of writing on learning. Also, we tried to see the relationship between the quality of writing and academic performance.

Methods
Participants

Participants were recruited at the Seoul National University College of Medicine. Among 139 individuals, 48 were female. However, we excluded participants who performed the task insincerely or did not complete all the tasks during the experiment. Therefore, 23 were excluded from the experiment and only the data from the remaining 116 participants were analyzed ($\bar{x} = 19.22$, $\sigma = 0.79$).

Learning Material

The participants were instructed to study 4-page-long written material. Their study methods varied depending on their assigned groups. The subject was related to the cognitive development of music skills, dealing with the relationship between music and youth’s cognitive development. The subject matter was chosen because it was less likely to be affected by background knowledge since related courses are not provided to the medical students. It was also convenient to devise post-test items and the writing tasks based on the topic, as the materials covered diverse concepts and theories.

Experiment Procedure

According to our experimental design, participants were assigned to each of the three groups: SS group, EW group, and AW group. For the SS group, participants were instructed to study the written material by themselves for 25 minutes. For the writing group, participants were instructed to write a half-page long essay on the given material for 25 minutes. Specifically, the EW group was instructed to summarize the given text, while the AW group was instructed to make their arguments based on what they learned. Following the study session, participants were given filler tasks for 15 minutes. In this session, participants were asked to solve the Remote Associates Test (RAT). Finally, they were given 20 minutes to complete a post-test.

Measurement of Academic Performance

Post-test questions were comprised of rote-memory type and transfer type items. The ten rote-memory type items asked direct factual information on the given material and were worth 13 points.
There were four transfer type items, which required the students to think a step further and apply what they learned to new situations. These questions required not only an overall comprehension of the given material but also application of it to different situations, which were worth of 16 points. Thus, the maximum score students could achieve was 29 points.

**Remote Associates Test (RAT)**

RAT is a creativity test that measures human's creative potential. It typically tests ten to forty questions each of which consists of three common stimulus words that appear to be unrelated. The person being tested should think of a fourth word that is somehow related to each of the first three words.\(^{33}\) Fifteen questions were devised to meet the time.

**Two Types of Writing Tasks**

Participants were instructed to write two different types of essays: either expository or argumentative essay. The EW group was told to write more than three paragraphs, the total length of over a half-page. The group had to summarize the youth’s cognitive development, which was mainly handled in the learning material. The AW group was instructed to write an argumentative essay. The length of the writing required was identical to the EW group. The participants were required to pretend that they are an elementary school music teacher, and propose a music class based on the cognitive development theories introduced in the given material. There were four theories they could choose from, and they had to explain why the theory they chose was better than the others.

**Writing Scores**

The EW group and the AW group were asked to write an essay within the same amount of time the SS group was given for study. To analyze the effect of writing, we scored their essays according to two criteria: a) how well they constructed their writing and b) how well they covered the content. Three points were given for the first ‘format’ criteria, while seven points were given for the second ‘contents’ criteria.
**Statistical Analysis**

To examine the effect of the treatments on academic performance, analysis of covariance (ANCOVA) and correlation analysis were performed. All statistical analyses were performed using both SPSS 23 software (SPSS, Chicago, L, USA) and R (3.6.2. version; R Foundation, Vienna, Austria). The statistical significance for all tests was set as $\alpha < 0.05$.

**Results**

In traditional medical education, professors simply address knowledge and test students' rote-memory based on how well they memorize the learning content. Recently, it has drawn much criticism because it ultimately does not help students to develop higher-order thinking. Then, we focused on the effect of writing on academic performance and tried to prove how it affects learning. All participants studied the given material and then took a post-test. To test our hypothesis, planned comparison was conducted in order to compare the academic performance of students in the three groups. As shown in Table 1, there was a significant difference in total post-test scores of the three groups ($P = 0.002, \eta^2_p = 0.102$). The difference in scores for transfer type items was also significant ($P < 0.001, \eta^2_p = 0.249$). However, no difference was found in scores for rote-memory type items ($P = 0.899, \eta^2_p = 0.002$).

Looking at each of the groups in detail, the two writing groups showed significantly higher total post-test scores ($P = 0.007, \eta^2_p = 0.064$). The SS group scored significantly lower than the EW group ($P = 0.003, \eta^2_p = 0.077$); however, no significant difference was found between the SS group and the AW group ($P = 0.109, \eta^2_p = 0.023$). The average total score of the AW group was not significantly different from that of the EW group ($P = 0.197, \eta^2_p = 0.015$).

In terms of transfer type items, the writing groups performed significantly better than the SS group ($P < 0.001, \eta^2_p = 0.155$). The SS group scored significantly lower than the EW group ($P < 0.001, \eta^2_p =$
0.171), and the AW group \((P < 0.01, \eta^2_p = 0.067)\). However, the scores of the AW group and the EW group were not significantly different \((P = 0.077, \eta^2_p = 0.028)\).

For rote-memory type items, there were no significant differences between the three groups. The performance of the writing groups was not significantly different from that of the SS group \((P = 0.937, \eta^2_p = 0.000)\). In addition, the score of the SS group for rote-memory type items was not significantly different from those of the EW group or the AW group \((P = 0.858, \eta^2_p = 0.000; P = 0.756, \eta^2_p = 0.001)\). The performance of the AW group was not significantly different from that of the EW group \((P = 0.648, \eta^2_p = 0.002)\) \((Table 2)\).

Data from the filler task and the quality of writing from participants in the writing groups were further analyzed to identify how writing enhances performance. We hypothesized participants’ responses to RAT will be correlated with their academic performance. Overall, correlation analysis including all three groups showed that RAT scores did show a weak positive correlation with only performance in rote-memory items \((r (114) = 0.18, P < 0.05)\). However, for participants in the writing groups RAT scores did not show any significant correlation with the main study variables as demonstrated in Table 3.

Also, as the high quality of writing hints at more active participation in learning, we predicted that participants whose writing had a higher score would show better performance in the post-test. According to Table 3, the quality of writing of participants for all writing conditions combined showed a weak positive correlation with both performances in rote-memory \((r (68) = 0.34, P < 0.01)\) and transfer type items \((r (68) = 0.27, P < 0.05)\). However, a significant linear relationship between the quality of writing and performance in transfer type items were discovered only in the AW condition. Further regression analyses controlled for age and gender variables indicated that the quality of writing explained 26.7% of the variance for participants in the AW group \((R^2 = 0.26, F (3, 31) = 5.123, P < 0.01)\) \((Table 4)\). Thus, the quality of writing significantly predicted performance on transfer type items for students who learned through writing an argumentative essay \((\beta = 1.15, P = \)
Discussion

Writing actually serves to promote metacognitive skills and critical thinking. Writers constantly have to monitor their writing process and judge if they are following their planned outline, and whether there are any logical fallacies that need to be supplemented. In addition, critical thinking is also promoted during writing, another form of problem-solving process that involves analyzing the given information and searching for the task at hand.

We found partial evidence for our first hypothesis that there would be a significant difference in scores of transfer type items between the three groups. Participants in the writing groups performed better in transfer type items than those in the SS condition. The SS group showed significantly lower performance than the AW and the EW group. In other words, the writing exercise stimulated higher-order thinking abilities which increased students’ performance in transfer type items. Compared to students who just read the given material to comprehend and memorize the information, students involved in the writing task had to analyze what they had read and present what they had learned in their own words. Thus, it seems natural that writing which requires higher-order thinking skills such as application, analysis, synthesis, and evaluation, better prepares students for transfer-type items that test more than a basic level of comprehension.

We could only find partial evidence for the second hypothesis that the quality of writing would be correlated with academic performance. There were some different patterns between the two writing groups (Fig 1). In other words, for the EW Group, participants got similar scores on transfer type items regardless of their quality of writing. However, for the AW Group, the higher the quality of writing, the higher the scores on transfer type items. The overall quality of writing in the two conditions showed a weak positive correlation with performance in rote-memory and transfer type items (Table 3). However, such a tendency was only clear in the AW group, which implies that learning may not have effectively taken place for some of the participants in this group. This may have pulled down the average score of the AW group to meet that of the EW group.
Another interpretation of why there was no difference in performance between the two writing groups could be inferred from the results of further regression analysis (Table 4). As the quality of writing showed a weak positive correlation with post-test performance in only the AW condition, participants with poor writing skills in this group may have not benefited enough from the writing task. On the other hand, since participants in the EW group did not show such a tendency, we can probably assume there was no individual variance in the learning effect of expository writing. Such different dynamics between the two different types of writing could have lowered post-test performance in the AW group, or could have raised the scores in the EW group, bringing academic performance within the writing groups to a similar level. Thus, in future experiments not only would we need to control for students’ innate writing skills, we could include steps that could help us understand why and how these different types of writing affect learning.

Moreover, we tried to find the relationships between academic performance and higher-order thinking by measuring students’ RAT scores. Our results showed that RAT scores have a positive correlation with scores on rote-memory type items. This supports recent researchers’ view that RAT measures convergent thinking abilities and that higher RAT scores might reflect greater working memory or general intelligence of the person being tested.\textsuperscript{31, 33} Working memory refers to a brain system providing temporary storage and manipulation of the information needed for cognitive tasks, predicting academic performance along with general intelligence.\textsuperscript{36, 37} In light of this, findings that connect RAT scores with academic performance suggest RAT could be a predictor of academic performance as well. Therefore, those who got higher scores in RAT scores might have shown better academic performance in rote-memory items because of their greater working memory capacities or general intelligence. If these findings are consistent with other studies, RAT might be highly related with working memory and general intelligence, and might be a predictor of academic success.

Although we could not find the differences between the EW and the AW groups, we were able to find evidence that writing can be used as a useful educational tool. In particular, this was evident in performance regarding transfer type items that require application of the given information.
Considering writing also fosters students’ metacognitive skills and critical thinking abilities, writing should be adopted in medical education. They need to practice metacognitive skills to better diagnose patients. Using metacognitive skills, they could take relevant information into account to judge their patients’ status, while ruling out other possibilities. They could also practice making plans and revising them repetitively while being involved in writing task. In addition, critical thinking is developed in the process; they have to be logical and try to find the best solutions for the given situation. Therefore, writing facilitates learning, and improves students’ higher-order thinking.

Currently, most universities offer writing classes, but the number is limited and there is little systematic approach to support it. In this sense, there is a call for a supportive environment where students could learn writing and metacognitive skills while learning their major curricula. A guideline could be provided for successful implementation. For example, the writing tasks should be clear and handed out either before the lecture to help students preview what they will learn or after the lecture to review what they have learned. Also, providing students with a final writing assignment that involves applying what they learned during the semester to novel situations would be an effective way for students to wrap up the whole class. Lastly, providing students with an online writing platform would help facilitate learning through writing. Using an online system, students would be able to turn in their writing assignments at any time they want to, making the writing process easier for digital learners.

Furthermore, assessing students’ learning process through writing is recommended in medical education to facilitate students’ learning and thinking. Traditionally, the process of learning was underestimated as the outcome of learning was more valued and frequently measured. However, recent changes in the educational paradigm have shifted its attention to learning processes as well in the form of summative evaluation. Therefore, rather than testing students’ rote-memory knowledge, evaluating their learning process in the form of portfolio with a set of reflection papers, could be meaningful in recruiting and training better doctors. By way of illustration, students of Maastricht College of Medicine should submit a portfolio that includes reflection papers showing roles and
abilities as medical professionals, scientists, and health care providers, respectively.\textsuperscript{41} While preparing this portfolio, students are required to identify their strengths and weaknesses, and look back on their learning processes. Since these papers have to be written multiple times over a semester or years, students should reflect the whole learning process and look back what and how they have learned. In this way, writing could be used a way of evaluating students’ learning process and promoting thinking.

This study, however, has some limitations. First, we could not differentiate the effect of learning depending on the type of writing. We hypothesized that there would be differences between the two writing groups and that those who wrote argumentative essays would perform better. One of the reasons these differences was not clear could be explained by the instructions in the writing task. The EW group was instructed to simply summarize the cognitive development theories that were introduced in the material. The participants in the AW group had to propose an effective teaching method based on these theories having supposed that they were an elementary school music teacher. While, some verbs in the instruction for the AW group, such as “suppose,” did follow the definitions of higher-order thinking in Bloom’s taxonomy, the writing task did not clearly require the students to have an opinion and argue about it.\textsuperscript{35} Considering we intended for the writing task to be argumentative, a more direct instruction that required the students to take a stance and support his or her perspective was needed. In addition to the unclear expression of the instruction, the scope of knowledge that the task required for each writing condition differed. Participants in the AW group did not need to understand all the details for every cognitive model, while those in the EW group had to mention all four theories as the instruction required them to do so. These factors may be the reasons that lead to the lack of differences between the two groups.

Furthermore, follow-up studies need to be conducted under a more ecologically valid context by providing writing tasks in actual medical classes. We did an experiment involving medical students with a learning material unfamiliar to them. We used an unfamiliar topic as the stimulus to control the effect of prior knowledge on academic performance. Our experiment was meaningful because it took
place in a real classroom, however, it also would have been valuable to test our results using readings on concepts dealt in the actual medical curricula.

Conclusion
This study provides empirical evidence for writing to be adopted in classrooms for greater educational benefits, especially in medical education. Writing promotes metacognitive and critical thinking skills that a prospective doctor should have. As students have to analyze the given information and synthesize it to express their ideas in a compact piece of writing, higher-order thinking is promoted through the process. Writing also enhances students’ academic performance, especially in transfer type questions that require students to apply the knowledge they learned to new and/or novel situations. In order to provide medical students with the opportunity to practice writing in the classroom, teachers need to reorient the current classes into more writing-centered ones. We also suggested ways to incorporate writing in education, such as giving students more chances to write and evaluating their learning process through writing to maximize learning outcomes. By actively using writing assignments in class, medical students could not only gain knowledge but also enhance higher-order thinking skills at the same time.

Abbreviations
Self-Study group (SS); Expository Writing group (EW); Argumentative Writing group (AW); Remote Association Test (RAT); Writing to Learn (WTL)

Declarations

Ethics Approval and Consent to Participate
The study was reviewed and approved by the Institutional Review Board (IRB) of Seoul National University School of Dentistry (approval No. S-D20190016). All participants were aware that they were taking part in this research and gave informed consent in addition to confirming that they would allow us to use their collected data anonymously for publication. All the data were anonymously collected and analyzed.

Competing Interests
All authors have no potential conflicts of interest.

Authors’ contributions
All authors have read and approved the manuscript. Conceptualization: Kim SE; Methodology: Kim SE, Park JY; Formal analysis: Lim JS; Data curation: Yang JW, Lim JS; Investigation: Lim JS, Yang JW, Kim SE; Writing - original draft preparation: Kim SE, Yang JW; Writing - review and editing: Lee SH, Park JY, Ihm JJ

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Availability of data and materials
The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

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Tables
Table 1. Academic Performance by group and type of post-test items
| Group          | SS (n=46) | EW (n=35) | AW (n=35) |
|---------------|-----------|-----------|-----------|
| Total score (29 points) | 15.96 (4.54) | 19.66 (5.51) | 18.74 (4.80) |
| Rote-memory items (13 points) | 9.26 (1.97) | 9.14 (2.40) | 9.57 (1.70) |
| Transfer type items (16 points) | 4.09 (2.03) | 7.97 (3.73) | 6.97 (3.00) |

**Type of items**

|                          | F     | P    | $\eta_p^2$ |
|--------------------------|-------|------|------------|
| Total score (29 points)  | 6.351 | .002 | .102       |
| Rote-memory items (13 points) | 0.106 | .899 | .002       |
| Transfer type items (16 points) | 18.616 | .000 | .249       |

Data are shown as mean (standard deviation). SS: Self-study, EW: Expository writing, AW: Argumentative writing.
For each group, total scores, rote-memory item scores and transfer type item scores are given. Gender and age were adjusted.
|                |    |         |    |          |    |
|----------------|----|---------|----|----------|----|
|                |    |         |    |          |    |
|                |    |         |    |          |    |
|                |    |         |    |          |    |
|                |    |         |    |          |    |
|                |    |         |    |          |    |
|                |    |         |    |          |    |
|                |    |         |    |          |    |
|                |    |         |    |          |    |
|                |    |         |    |          |    |

**Rote-Memory items**

|                |    |         |    |          |    |
|----------------|----|---------|----|----------|----|
| Writing vs. SS | 1  | .025    | .  | .937     | .000|
| SS vs. EW      | 1  | .129    | .  | .858     | .000|
| EW vs. AW      | 1  | .835    | .  | .648     | .002|
| AW vs. SS      | 1  | .386    | .  | .756     | .001|

**Transfer type items**

|                |    |         |    |          |    |
|----------------|----|---------|----|----------|----|
| Writing vs. SS | 1  | 262.310 | 2  | .000     | .155|
| SS vs. EW      | 1  | 295.550 | 2  | .000     | .171|
| EW vs. AW      | 1  | 40.972  | 3  | .077     | .028|
| AW vs. SS      | 1  | 103.261 | 8  | .006     | .067|
Data are shown as mean (standard deviation). SS: Self-study, EW: Expository writing, AW: Argumentative writing. For each group, total scores, rote-memory item scores and transfer type item scores are given. Gender and age were adjusted.

Table 3. Correlations between study variables within the two writing groups

| Variables                        | 1   | 2   | 3   | 4   |
|----------------------------------|-----|-----|-----|-----|
| 1. Quality of Writing            | -   | -   | -   | -   |
| 2. RAT scores                    | 0.14| -   | -   | -   |
| 3. Total post-test score         | 0.35**| 0.16| -   | -   |
| 4. Transfer type item scores    | 0.27*| 0.10| 0.91***| -   |
| 5. Rote-memory type item scores | 0.34**| 0.20| 0.74***| 0.41***| -   |

*P < 0.05, **P < 0.01, ***P < 0.001

Table 4. Multiple regression analysis of quality of writing and performance of transfer type items
| Independent Variables | Expository Writing (EW) group | Argumentative Writing (EW) group |
|-----------------------|-----------------------------|-------------------------------|
|                       | SE  | t   | P    | SE  | t   | P    |
| Age                   | -1.82 | 0.63 | -2.92 | 1.52 | 1.31 | 1.16 |
| Gender                | 1.16 | 1.26 | 0.92  | 1.06 | 1.04 | 1.02 |
| Quality of Writing    | 0.29 | 0.35 | 0.91  | 1.15 | 0.31 | 3.72 |
| Constant              | 39.41| 12.46| 3.16  | -32.65 | 25.6 | -1.28|

*P < 0.05, **P < 0.01, ***P < 0.001

Figures
Figure 1

Linear Regression between quality of writing and academic performance