2017

AP CollegeBoard

AP Research Academic Paper

Sample Student Responses and Scoring Commentary

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AP® RESEARCH 2017 SCORING GUIDELINES
Performance Task Rubric: Academic Paper

Content Area	Performance Levels		
1 Understand and Analyze Context	The paper identifies a broad topic of inquiry and/or a purpose. 2	The paper identifies a focused topic of inquiry and describes the purpose. 4	The paper explains the topic, purpose, and focus of the inquiry and why further investigation of the topic is needed by connecting it to the larger discipline, field, and/or scholarly community. 6
2 Understand and Analyze Argument	The paper identifies or cites previous scholarly works and/or summarizes a single perspective on the student's topic of inquiry. 2	The paper summarizes, individually, previous scholarly works representing multiple perspectives about the student's topic of inquiry. 4	The paper explains the relationships among multiple scholarly works representing multiple perspectives, describing the connection to the student's topic of inquiry. 6
3 Evaluate Sources and Evidence	The paper uses sources/evidence that are unsubstantiated as relevant and/or credible for the purpose of the inquiry. 2	The paper uses credible and relevant sources/evidence suited to the purpose of the inquiry. 4	The paper explains the relevance and significance of the used sources/cited evidence by connecting them to the student's topic of inquiry. 6
4 Research Design	The paper presents a summary of the approach, method, or process, but the summary is oversimplified. 3	The paper describes in detail a replicable approach, method, or process. 5	The paper provides a logical rationale for the research design by explaining the alignment between the chosen approach, method, or process and the research question/project goal. 7
5 Establish Argument	The paper presents an understanding, argument, or conclusion, but it is simplistic or inconsistent, and/or it provides unsupported or illogical links between the evidence and the claim(s). 3	The paper presents a new understanding, argument, or conclusion that the paper justifies by explaining the links between evidence and claims derived from the student's research. 5	The paper presents a new understanding, argument, or conclusion that acknowledges and explains the limitations and implications in context. 7
6 Select and Use Evidence	Evidence is presented, but it is insufficient or sometimes inconsistent in supporting the paper's conclusion or understanding. 2	The paper supports its conclusion by compiling relevant and sufficient evidence generated by the student's research. 4	The paper demonstrates an effective argument through interpretation and synthesis of the evidence generated by the student's research, while describing its relevance and significance. 6
7 Engage Audience	Organizational and design elements are present, but sometimes distract from communication or are superfluous. 1	Organizational and design elements convey the paper's message. 2	Organizational and design elements engage the audience, effectively emphasize the paper's message and demonstrate the credibility of the writer. 3
8 Apply Conventions	The paper cites and attributes the work of others, but does so inconsistently and/or incorrectly. 2	The paper consistently and accurately cites and attributes the work of others. 4	The paper effectively integrates the knowledge and ideas of others and consistently distinguishes between the student's voice and that of others. 6
9 Apply Conventions	The paper's use of grammar, style and mechanics convey the student's ideas; however, errors interfere with communication. 1	The paper's word choice and syntax adheres to established conventions of grammar, usage and mechanics. There may be some errors, but they do not interfere with the author's meaning. 2	The paper's word choice and syntax enhances communication through variety, emphasis, and precision. 3

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Performance Task Rubric: Academic Paper

NOTE: To receive the highest performance level presumes that the student also achieved the preceding performance levels in that row.

ADDITIONAL SCORES: In addition to the scores represented on the rubric, readers can also assign scores of **0** (zero).

- A score of **0** is assigned to a single row of the rubric when the paper displays a below-minimum level of quality as identified in that row of the rubric.

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AP® RESEARCH
2017 SCORING COMMENTARY

Academic Paper

Overview

This performance task was intended to assess students' ability to conduct scholarly and responsible research and articulate an evidence-based argument that clearly communicates the conclusion, solution, or answer to their stated research question. More specifically, this performance task was intended to assess students' ability to:

- Generate a focused research question that is situated within or connected to a larger scholarly context or community;
- Explore relationships between and among multiple works representing multiple perspectives within the scholarly literature related to the topic of inquiry;
- Articulate what approach, method, or process they have chosen to use to address their research question, why they have chosen that approach to answering their question, and how they employed it;
- Develop and present their own argument, conclusion, or new understanding while acknowledging its limitations and discussing implications;
- Support their conclusion through the compilation, use, and synthesis of relevant and significant evidence generated by their research;
- Use organizational and design elements to effectively convey the paper's message;
- Consistently and accurately cite, attribute, and integrate the knowledge and work of others, while distinguishing between the student's voice and that of others;
- Generate a paper in which word choice and syntax enhance communication by adhering to established conventions of grammar, usage, and mechanics.

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The Effects of Running on Adolescents´ Attitudes towards Education

Word Count: 4513

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Context

The United States of America is internationally known for many different icons, trades, and traits. Most of all, in recent years, America has been seen as an obese country compared to the rest of the world, one that is known for their large population of inactivity amongst persons of all age groups. The President's Council on Fitness, Sports & Nutrition reported "only one in three children are physically active each day." Eric Jensen, author of *Teaching with the Brain in Mind,* notes that "an astonishingly high 68 percent of high school students in the United States do not participate in a daily physical education program" (Grunbaum et al., 2002). Along with the low participation rates of physical activity, the United States is ranked among the lower half of the OECD (Organization for Economic Co-operation and Development) countries in education: 27th in mathematics, 20th in science, and 17th in reading (Davidson & Schleicher 2012). Achievement scores in math and science lag for U.S. students compared with those of other countries. In addition, that same year, United States 15-year-olds ranked 26th in math, 21st in science and 17th in reading when compared with peers from 64 other countries in the International Student Assessment tests.

The problem with today's educational environment is student engagement in learning. Nearly half of the of 825,000 fifth- through 12th-grade students in Gallup's 2014 student poll report were being either not engaged (28 percent) or actively disengaged (19 percent) in school. The poll shows a clear slide as children progress in school. A survey conducted by *Education Week*, in 2014, found that only 40 percent of the teachers and administrators (who participated) believed that most of their students were highly engaged and motivated. Jennifer Fredricks, who has PhD and is a Professor in human development at Connecticut College, states "our schools are

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getting worse rather than better in a lot of indicators. Kids are bored and alienated. Too many are just going through the motions". Many different remedies have been explored to combat boredom and increase educational motivation. The one most feasible and accessible to this study was running.

Jensen tries to uncover this connection, speaking directly to the correlation found between movement and learning-- In addition to strengthening muscles, the heart, the lungs, and bones, exercise also "strengthens the basal ganglia, cerebellum, and corpus callosum-- all key areas of the brain." This allows for both the fueling of the brain and neurotrophins which increase the number of connections between neurons and the speed that they grow.

In order to test this relationship, background research on the emotional effects of running on adolescents needed to be done. Hypothetically, it is the student's attitude toward school, caused by a lack of regular physical activity, that is causing them to not be able to perform at a higher level of education. Interest sparks motivation and perseverance in adolescents. Students' level of physical activity has a certain impact on attitude. Research has shown that those who are more physically active have better feelings on an emotional level and further help one think and stay motivated to do better (Jensen 2005).

In an article published by Livescience, a science news website that promotes scientific education, Jeanna Bryner gives statistical analysis about the proportion of high school students that dislike school. Bryner notes that in an Indiana University High School Survey of Student Engagement (HSSSE), "more than 81,000 students in 110 high schools across 26 states" were surveyed in an effort to understand their attitudes towards school. "In the survey, about 20 percent of students said they had considered dropping out of school, giving some of the

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following reasons: 73 percent said, ‘I didn't like the school.’ 61 percent said, ‘I didn't like the teachers.’ 60 percent said, ‘I didn't see the value in the work I was being asked to do.’ About 25 percent said, ‘No adults in the school cared about me.’’’ Research shows that this generation’s high school students are not interested in school on any level, whether that would be because of teachers, the material taught, or the environment of learning.

Much has been studied on how movement increases brain development, as well as high school students and their attitudes towards school; however, the association between the two response variables has yet to be analyzed. Many sources have noted that brain and body have a connection on a molecular level: “Oxygen is essential for brain function, and enhanced blood flow increases the amount of oxygen transported to the brain. Physical activity is a reliable way to increase blood flow, and hence oxygen, to the brain” (Jensen 2005). Due to the connection that physical movement has on one’s brain function, the connection between movement and emotions can be drawn. In an effort to understand the current predicament of our Nation’s youth, the attitudinal effects of cardiovascular movement on adolescents’ attitudes towards school will be experimentally observed.

Literature Review

Emotional Benefits of Running

The benefits of having a physically active lifestyle have been hypothesized and proved scientifically. However, the attitudinal effects of exercise have not been thoroughly explored, and how that affects adolescents’ academic education. The fields of physiology, and neuroscience, offers many explanations on how running directly affects the performance of students in the classroom, both immediately and in the long-term. Implementing more physically

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active teaching styles in today's educational system, ones that get the brain charged before class time, could reveal a stronger learning environment for a student. However, even with this great deal of information, we still see the same trends in this gross academic achievements.

Studies have shown physical activity to prepare students' brains better for education. However, very few sources talk about the student's attitude towards school. With this mindset, I asked the question "How can running alter the adolescent attitude towards learning?" A question that has yet to be answered.

An article published in *Medical Daily* discusses the various mental benefits of jogging and running. Relief of anxiety, depression, pain, and stress, as well as increase in emotional joy and confidence, have been noted to be a result of incorporating a daily run into one's lifestyle (Medical Daily, 2010). This provides some evidence of the benefits of running, regardless of the participant's age.

Berthoud et al. (2006) deal specifically with the neurobiology of exercise in their novel "Obesity." Voluntary physical activity "can favorably influence brain plasticity by facilitating neurodegenerative, neuroadaptive, and neuroprotective processes." This allows for the brain's motor system to increase efficiency and frequency of neuron development. Although this source talks about the causes of obesity, the neurobiological part aids the understanding of how the mind works when engaged in physical activity. Despite the paucity of sources that dealt with the anatomical effects of running on a cognitive level, few sources look at the correlation between exercise and attitude, but rather the emotional responses of the physical stress.

Emotions are regulated on an intermolecular level. Enzymes secrete hormones in an effort to regulate the body's response to stress. These hormones trick the mind into telling the

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body to produce more neurotoxins that help the body recover. The side effects of these neurotoxins cause emotional levels to alter. “Hormone release can be stimulated by both external and internal stresses to the body. Adapting to acute exercise causes an increase in the secretion of many hormones.” (Kravitz & Marks, 2000)

Hershel Thornburg, professor on child development at the University of Arizona, in his academic journal “Early Adolescents' Attitudes toward School” from 1985, writes that the aspect of learning, distinct from “cognitive mode,” known as the “affective mode,” or one’s attitudes and values toward school, is often overlooked, despite its significant role on education. Thornburg put a great deal of emphasis on the teacher, working as a conductor towards his, or her, students’ attitudes. “Attitude learning may be related directly to the material that teachers present to students, or indirectly by the emphasis teachers place on various subjects in their classroom.” Teachers who foster more passion in their students generate passions in them that they use to keep their interest in those respective subjects presented. This simultaneously neglects others who were presented with lesser emphasis.

In a study by Walter Callahan involving 336 eighth graders (180 boys and 186 girls), the attitude towards mathematics in adolescents was assessed. The pupils were asked to rate their liking of math on a scale from 1 to 11; 11 being the extreme for like, 6 being the neutral option, and 1 being the option for extreme dislike. The results of the survey showed a majority of both populations (girls and boys) leaning towards the like option. Some of the speculated reasons behind these results were that the students felt that they would need math in their life and it would have practical application to their future occupations. Another reason behind these results was the quality of the teacher; students noted that they had good teachers who were sympathetic

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and explained the material carefully. This study offered a template to possible similar relationships between students and different academic subjects. In another light, this study does not offer to much depth into the psychology of why kids like or dislike mathematics.

Further psychological research explained why children might not enjoy academic learning. In contrast to the mathematical experiment's results, many adolescents suffer from academic anxiety. Barta (2016) defines academic anxiety and the effects that exercise has on managing unhealthy stress. Barta notes that exercise is one of the most important factors in stimulating the brain and therefore contributes to academic performance. A healthy body means a healthy mind. To put this in perspective, Dr. Wilson (2014), an internationally recognized expert in "brain-based teaching and leading (mind, brain, and education) in both professional development and teacher education," notes that aside from physical developmental, exercise accelerates adolescents' psychological development. He cites a study done by John Ratey, author of *A User's Guide to the Brain,* that concluded "regular physical activity supports healthy child development by improving memory, concentration and positive outlook." The study found that, if a child had an opportunity to run 15 to 45 minutes before class they would be "less distracted and more attentive to schoolwork."

Mental Benefits of Running

Chapter four of the book *Go Wild*, by John J. Ratey and Richard Manning, speaks directly to "building and rebuilding the brain through movement." Ratey offers ample amounts of information on the relationship between mind and body in persons of all ages. In this chapter, Manning and Ratey talk about physical activity being more about one's well-being (particularly in stimulation of the brain) than gain of physical ability, contrary to popular belief. Manning and

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Ratey cite a British scientist named Daniel Wolpert and his discussion of the question, "Why do we have a brain?" Wolpert notes that "our brains are literally built on and inextricably tied to movement of our bodies" (p. 100). Ratey states that "in return, it only makes sense that movement builds our brains."

In addition, Manning and Ratey explain the complementary relationship between our brains and movement. "Movement places demands on the brain, just as it does on muscle, and so the brain releases BDNF [brain-derived neurotrophic factor], which triggers the growth of cells to meet the increased mental demands of movement. But BDNF floods throughout the brain, not just to the parts engaged in movement. It provides the environment that brain cells need to grow and function well," (p. 105). Although Ratey and Manning emphasizes the many benefits granted to our brains through physical activity, he fails to speak towards the specific attitude changes adolescents experience in doing so.

The limbic system is the part of the brain that controls emotions and memory. Due to the having the same control center, these two functions go hand in hand. This offers some reasoning behind why students who have bad attitudes and emotions towards school also do not do as well; they forget what they are learning. The medical team at Healthline (2015) explain the significance of the hippocampus in teaching. "The hippocampus is involved in the storage of long-term memory, which includes all past knowledge and experiences." (The team notes that scientists are still unsure how this occurs, leaving a gap in knowledge.) "In particular, the hippocampus plays a major role in declarative memory, the type of memory involving things that can be purposely recalled, such as facts or events." This portion of the brain's limbic system has close relations to emotions and experiences that people face.

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Essentially, the better the experience a student has with learning material, presented by the teacher, the more likely the knowledge is to stick with him or her for a long period of time that can be called on when needed. As noted by Thornburg (1985), teachers that teach with more enthusiasm create a greater interest in their students for those specific teachings.

Looking at the relationship between the adolescent attitude towards school and running, it is also important to consider if the benefits of recreational running to the brain outweigh the stress put on adolescents from juggling both academic and athletic obligations. Szabo, A., Abraham, J. (2012) provided a detailed description of an experiment that took place involving 50 recreational runners and their emotional feedback after running on an urban terrain. Ultimately their conclusions identified positive changes in all four measures of affect. "Multivariate regressions were performed to examine the contribution of four exercise characteristics (i.e., duration of the current run, weekly running time, weekly running distance, and running experience) to the observed changes in affect." The conclusion was 14 to 30 percent of the variance in was explicable by variance in running characteristics. This explains that there was little to no statistically significant association between the two variables. In addition, they conclude that "psychological benefits of recreational running may be linked to placebo [conditioning and/or expectancy] effects."

Ossola (2015) addresses the chronic stress that many high school students undergo, more so at highly competitive, independent schools. It is because of the dramatic increase of academic and extracurricular programs, as opposed to previous schooling, that so many students report high stress levels. The student will often try to load his, or her, plate with as much opportunity as

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they can possibly handle, ultimately taking on too much. These students are surrounded by the best and brightest peers applying to extremely competitive schools. This forces a mentality of life or death in terms of getting into a highly prestigious school. The student suffers from fear of rejection and very high stress levels.

This dilemma is seen more and more in modern day society. As colleges become more selective, students become more and more pressured to do well, especially since in today's economy a college diploma is essential.

Ultimately, the issues surrounding the adolescent attitude towards school are seen through their lack of interest in learning the material. A possible alternative is using running as a way of stimulating the brain into being more open to learning. This widens the gap in knowledge that has been increasingly opened through each study lack of focus on the student's attitude specifically. Despite the many studies that have been done in an effort to understand the bond between academics and athletics, very few have even thought about the attitudinal aspect of the relationship; this is shown through the most recent such study being done in 1985. Through my research, I hope to unlock a door that will lead these fields of psychology and physiology to the answer of this question.

Method

The best approach to test this hypothesis is the scientific method. An experimental analysis had to be performed. This experiment involved voluntary participation in facilitated runs 3 times a week (Tuesday, Wednesday, Thursday), over the course of 3 weeks. After the runs, a follow-up survey was conducted with various participants in order to measure their attitudes towards school. The trends of how their attitudes would improve over the course of time

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dismissed the need to record the participants initial attitudes; where they started and finished attitudinally was not important as the presence of change was only needed. The survey was formatted based off of Cynthia Gray's master's thesis of the University of North Florida. Gray explains the purpose and procedures behind crafting a survey that blindly and specifically measures students' attitudes towards school. The experiment she performed dealt with 5th graders, which differs from my adolescent subjects; nevertheless, the psychology behind the work does not seem to differ between the two audiences. The survey questions identify three different aspects of attitude towards school. First, the belief that attending school is valuable and important. This objective was weighted so that 37.5 percent of the questions on the survey were designed to measure it. The second objective was for students to enjoy being at school; this objective was weighted 41.67 percent. The third objective was for students to indicate they would choose attending school over other less appropriate activities; the weighting for this objective was 20.83 percent. (Gray 1983)

The survey that was used for this experiment was crafted from a similar pattern. In researching sample questions with the focus on "students' attitudes toward school," the researcher's survey was formatted around questions that dealt with participation, enjoyment, and recognition of priority for school. The formula of this survey was roughly 40 percent of the questions indicated enjoyment, 30 percent indicated the level of participation the student engaged in a regular school day, and the final 30 percent indicated the student's recognition that school is a priority. The reasons behind why enjoyment was focused on more than the other two aspects is because it has been shown that joy enables interest, which further leads to participation and devotion. Hilary Conklin, Associate Professor of Teacher Education at the University of

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Depaul, explained that adolescents, similar to infants, have increased participation and interest in what they're doing with the addition of fun and enjoyment. Those who have fun while learning look forward to class and increase their participation and devotion to what they are learning. Conklin refers to a similar researcher named Sarah Fine who, in her study of high schools across the country, has shown the promise of what she terms "intellectual playfulness." Intellectual playfulness refers to the perfect concoction of fun, but difficult, work that allows students to stay interested but challenged. Conklin states that "giving students occasions to learn through play not only fosters creative thinking, problem solving, independence, and perseverance, but also addresses teenagers' developmental needs for greater independence and ownership in their learning, opportunities for physical activity and creative expression, and the ability to demonstrate competence" (Conklin, H. G. 2015).

The questions given were accompanied by a Likert scale from 1 to 4 (strongly disagree, disagree, agree, strongly agree) so that participants were forced to lean towards agreement or disagreement. Because this survey was given to three different sample groups – those who run 6 times a week (indoor track team) and those who run 3 times a week (volunteers) – a match-pair analysis between the three different data pools will be statistically compared. Each population tested had 10 subjects each.

The indoor track team serves as the control group for the study, running almost every day of the week. Due to expected different ideology, the control sample was blocked by gender. The indoor track sample was made up of 10 subjects (5 girls and 5 boy). Participants from both the girls' and boys' track teams were selected randomly from an alphabetical list. The sample yielded runners of ages from 14 to 18 years old in both gender groups.

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With the results of this three part analysis, further conclusions will be drawn in favor of rejection or failure to reject the hypothesis that increased running will increase adolescents' attitudes toward school. The purpose of this study is not looking at students making the transition of hating to loving school after two weeks of running. The primary objective of this study is to identify any change in attitude towards school after running; this could be small or large, positive or negative. The relationship between running and adolescents' attitude towards school is the main focus of this experiment.

Results

This experiment yielded many different comparisons among the two populations studied. Although the group made up of members of the indoor track team, who ran 6 times a week, already come from a foundation that generally appreciates education and understands the importance of it, trends were still seen in their results. Both subject groups showed increases in all three variables blindly tested: enjoyment, participation, and priority.

The indoor track group had a 100 percent yield of positive results when presented with the question "school has been a pleasant experience." Those results, over the course of 3 weeks showed increase of positive attitude to the enjoyment of school; a 10 percent increase towards the option of "strongly agree" from the "agree". In comparison, something similar was observed when looking at the results of the experimental group of randomly selected participants. When presented with the statement "teachers assign too much work" and "school is boring," both groups showed slight increases of positive attitude over the course of the 3 weeks. For the indoor track group, disagreement in these statements decreased by 10 and increased by 15 percent, respectively.

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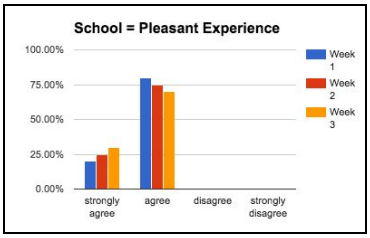
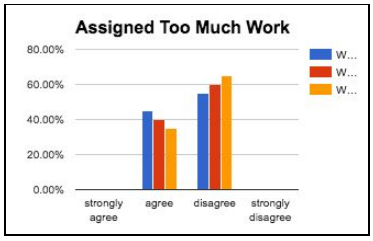
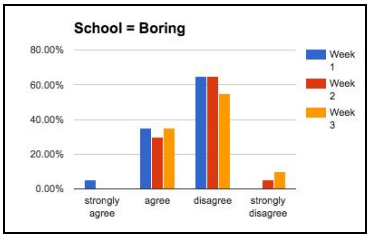
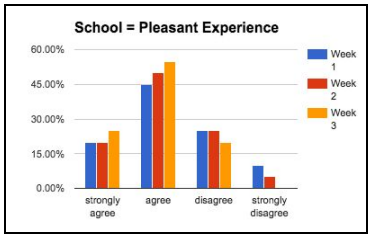
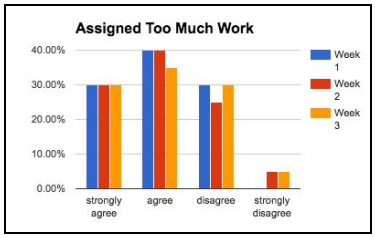


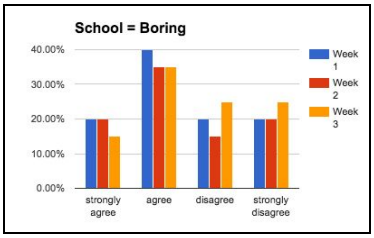




When presented with the same question (school has been a pleasant experience) the experimental group showed a much more normally distributed set of data, with a skew left (towards disagree, strongly disagree); In short, although some disagreed that school is pleasant, the group still ruled a majority towards agreement. Over the course of the 3 weeks, the experimental group showed a 100 percent decrease in those who answered “strongly disagree” and a 15 percent increase in those who agree.On the other hand, the experimental group showed a decrease of 10 percent in the choice of “agree; when asked if “teachers assign too much work”. Also, the experimental group showed a 5 percent decrease in the agreement that “school is boring.” These three questions made up the variable of enjoyment. Ultimately, the results showed that the participants, across the board, showed an increase in positive attitude towards enjoyment of school.







With the variable of participation, its subcategories were analyzed in order to assess the overall trend of attitude within the participants, as enjoyment was. Over the course of the experiment, participants showed increased agreement with the statement “I work hard”. The indoor track group showed persistency in their results, not changing on any level. Their results

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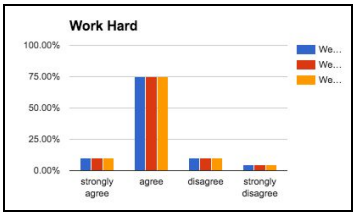
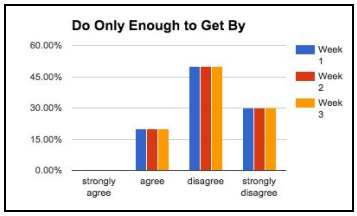
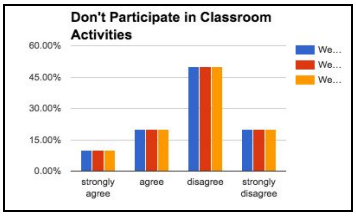
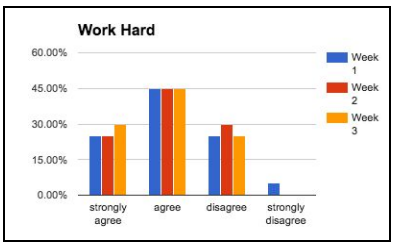
showed a vast majority answering “agree” with a 10 percent capacity in both the “strongly agree” and “disagree,” leaving a 5 percent capacity in the “strongly disagree.” The participants of my experiment showed very different results. The majority went to both the “strongly agree” and “agree” categories, leaving a total 30 percent of those who disagreed. Only significant signs observed were that the 5 percent of participants who answered “strongly disagree” moved towards the “disagree” category.

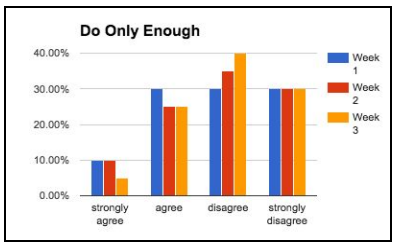


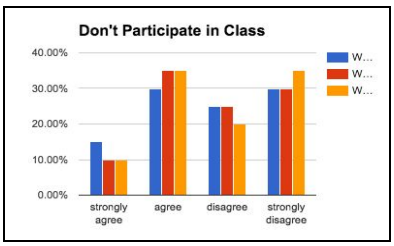




In addition, the statement of “I do only enough work to get by” yielded the same results. Indoor track athletes answered “disagree” and ‘strongly disagree” all three weeks, as the running participants showed a steady level of equality in the categories “agree,” “disagree,” and “strongly disagree.” However, the running subjects showed a transition from strongly agree to agree to disagree over the course of the 3 weeks in the form of 5 - 10 percent . The statement of “I am reluctant to participate in class” showed steady rate of majority saying “disagree” and “strongly disagree,” without any trends over, for the indoor group. The experimental subjects showed a transition of 5 percent from the “strongly agree” category to the “agree,” and a 5 percent transition from “disagree” towards “strongly disagree.”







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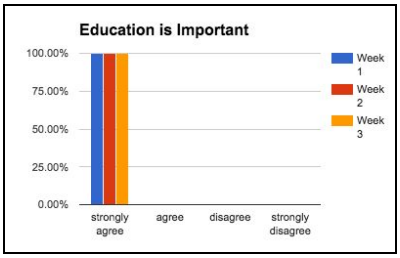
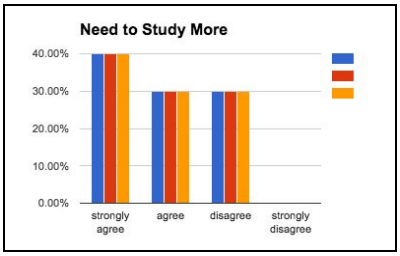
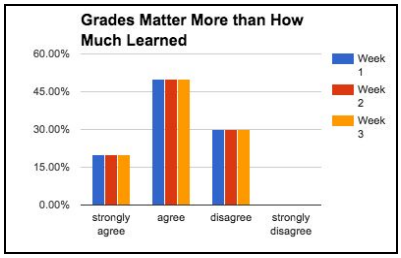
The final variable, priority, showed almost the exact same results as the first two variables. The indoor track group recognized that "getting a good education is important" to them, and answered "strongly agree" 100 percent over the course of the whole experiment. The indoor runners took no change when asked if they think they should be studying more, however the group remained that majority (70 percent) either agreed or strongly agreed that they did need to. This question was designed to recognize the importance of education by noting more time needs to be devoted to it. Lastly, the group noted as a majority that they cared more about their grades in school rather than the material that they learn to take with them. This variable showed no change over the course of the 3 weeks as well.







The experimental group showed 100 percent of the participants recognizing that education is important. A 5 percent increase in certainty was revealed over the course of the experiment, shifted answers from "agree" to "strongly agree". Slight increases in agreement showed when presented with the questions "grades matter more than how much learned" and "more time should be spent studying". The volunteered participants showed a 10 percent shift in certainty over the course of the 3 weeks when asked if they thought they should study more, answering "strongly disagree" instead of "disagree". Although a steady 40 percent of the participants strongly agreed their grades matter more than the knowledge they took with them, 5

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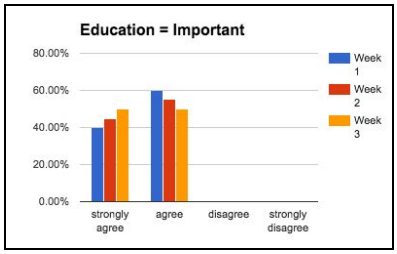
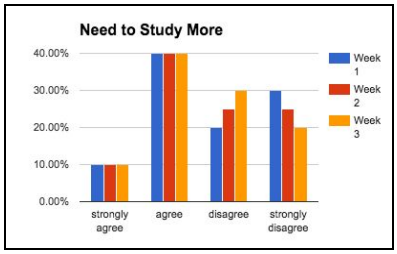
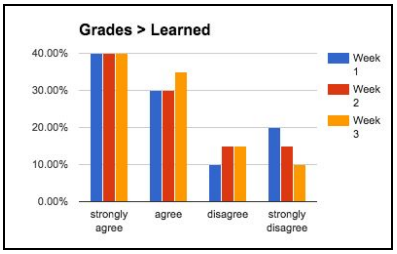
percent increase in certainty showed improvement, moving from “disagree” to “strongly disagree”.







Conclusion

The results found in this experiment support this paper’s hypothesis, showing an increase of positive attitude and a decrease in negative attitude across the board. Nevertheless, some hardships in this experiment leaves the application of these results questionable. The sample size used in this report was 20 participants (10 indoor track members and 10 running subjects). This sample is far too small to generalize the experiments findings. However, the results of this experiment open doors to further research and experiments to be conducted. It is possible that the slight increase in positive attitude on these adolescents towards school could very well be seen in a similar experiment with a sample size of a much larger magnitude.

In addition to a small sample size, the access to a constant running terrain was difficult. The weather faced between the three weeks of the experiment (February 6th to February 27th) caused some lack of feasibility. The projected pleasant experience of the running participants was intervened with the cold and wetness of Vermont winter. Nevertheless, the participants completed the required time of each run and reported back promptly. The indoor track team did not face these hardships, as they completed their runs indoors during practice and meets. Future

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research might take these considerations into account when designing an experiment that further investigates this possible neurobiological advancement.

These results show slight, but gradual, progress towards more positive attitudes toward school among adolescents. Shown in the charts above, the participants indicated a shift, over the course of the three weeks, in their portrayal of school. All age groups showed improvement in all aspects of the experiment. With these results offer is a possibility to a more efficient and inclusive teaching style. One that allows for students to increase their attentiveness, enjoyment, and participation while in the classroom. Implementing more physically active requirements at a given high school may increase the average performance in school.

Through further research and a larger sample-size experiment, sufficient evidence can be found to support this hypothesis' on a more substantial level. A more refined experiment, considering the limitations experienced in this experiment, could reveal results that would enable gateways to learning styles that capture motivating adolescents. Essentially, more physically active teaching styles, such as 20 minute runs between classes, could better the learning environment of a teenager.

Despite the limitations apparent in this experiment, the results found support the hypothesis presented. This means running and increased physical activity can be used to combatant negative adolescent attitude towards school, and further increase the positive outlook towards education, creating a more suitable learning environment for young adults.

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AP® RESEARCH
2017 SCORING COMMENTARY

Academic Paper

Sample: G
1 Understand and Analyze Context Score: 6
2 Understand and Analyze Argument Score: 6
3 Evaluate Sources and Evidence Score: 6
4 Research Design Score: 5
5 Establish Argument Score: 7
6 Select and Use Evidence Score: 4
7 Engage Audience Score: 2
8 Apply Conventions Score: 4
9 Apply Conventions Score: 2

MEDIUM SAMPLE RESPONSE

The Effects of Running on Adolescents' Attitudes towards Education

Content Area: Understand and Analyze Context — Row 1
The response earned 6 points for this row because the paper identifies a focused and narrow topic of inquiry, stating its research question on page 5, paragraph 2: "I asked the question 'how can running alter the adolescent attitude towards learning?' A question that has yet to be answered". The paper also opens with an introductory section that situates the topic of inquiry within a larger context, that of the problem of student engagement in learning, which the student hopes can be ameliorated through increased physical activity.

Content Area: Understand and Analyze Argument — Row 2
The response earned 6 points for this row because the paper summarizes a number of scholarly works representing multiple perspectives on its topic. These perspectives include the mental benefits of running (page 5, paragraph 3), the influence of physical activity on brain plasticity (page 5, paragraph 4), the reasons behind a student's attitude towards school (page 6, paragraphs 2 and 3), and the relationship between physical activity and brain stem stimulation (page 7, paragraph 3). Additionally, the paper is able to contrast the results of the Callahan study with those of the Barta study, demonstrating that multiple perspectives have been put in conversation with each other and with the student's topic of inquiry - see page 7, paragraph 2: "In contrast to the mathematical experiment's results, many adolescents suffer from academic anxiety. Barta [2016] defines academic anxiety and the effects that exercise has on managing unhealthy stress".

Content Area: Evaluate Sources and Evidence — Row 3
The response earned 6 points for this row because the paper uses reasonably relevant and credible sources within its literature review. These include Barta, Berthoud et al, Callahan, Szabo & Abraham, and Thornburg. In addition, on page 10, paragraph 3, the paper explicitly defends its own avenue of inquiry in relation to the previous studies it cites, thus opening a viable research gap: "Despite the many studies that have been done in an effort to understand the bond between academics and athletics, very few have even thought about the attitudinal aspect of the relationship....Through my research, I hope to unlock a door that will lead these fields of psychology and physiology to the answer to this question".

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2017 SCORING COMMENTARY

Academic Paper

Content Area: Research Design — Row 4
The response earned 5 points for this row because the paper provides a detailed description of a replicable method on pages 10 to 13. The method is termed an "experimental analysis" and the student included voluntary track runs along with follow-up surveys modeled on those performed for a 1983 master's thesis at the University of Florida. The response did not earn 7 points because the rationale provided for the choice and construction of the research method remains vague, beyond its similarity to the previous study (that is, investigating adolescent attitudes toward school).

Content Area: Establish Argument — Row 5
The response earned 7 points for this row because the paper mounts a complex, logical argument, linking evidence to claims derived from its original research, concluding that: "The results found in this experiment support this paper's hypothesis, showing an increase of positive attitude and a decrease in negative attitude across the board" (page 17, paragraph 2). Further, the student also includes a discussion of limitations of the research, noting for instance on page 17 that the small sample size made generalizing from findings impossible, and that environmental challenges compromised any constancy in the running terrain being used by the test subjects. Finally, the paper also addresses implications of the research, suggesting on page 18 that: "A more refined experiment...could reveal results that would enable gateways to learning styles that capture motivating adolescents".

Content Area: Select and Use Evidence — Row 6
The response earned 4 points for this row because the paper does provide mostly relevant and sufficient evidence derived from the student's research (see tables on pages 14 to 17). The response did not earn 2 points because evidence from the student's own inquiry is apparent and clearly presented as such. The response did not earn 6 points because the evidence is summarized in tables, question by question, with no subsequent attempt to synthesize its overarching claim to support its conclusion. The only attempt at a summary of the evidence in toto is the first sentence of the "Conclusion" on page 17.

Content Area: Engage Audience — Row 7
The response earned 2 points for this row because organizational and design elements mostly facilitate communication with the reader. These elements include consistent use of section and sub-section headings and six illustrative graphs. The response did not earn 1 point because these elements do not substantially detract from the paper's ideas. The response did not earn 3 points because the paper wanders excessively in certain sections, notably the literature review, and because the graphs provided are too small and are not clearly labelled, making them more difficult to read and understand.

Content Area: Apply Conventions — Row 8
The response earned 4 points for this row because the paper provides mostly accurate and consistent citations and attributions of its sources. The response did not earn 2 points because these citations are present in both the body of the text and the appropriately formatted "References" list at the end. The response did not earn 6 points because there are a few inconsistencies in citations, namely works included in the "References" section, but not in the body of the text (see Anitei, Ekkekakis, Greenwood, and Sparks).

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Academic Paper

Content Area: Apply Conventions — Row 9
The response earned 2 points for this row because the paper uses clear and simple language. The response did not earn 1 point because the use of language does not impede the main idea of the paper. The response did not earn 3 points because the paper's language remains serviceable, but not elegant, with stylistic awkwardness. For example, see how the student uses a table, description, table, description, table, description, etc., on pages 14 to 17, instead of attempting to offer a more interesting synthesis of the evidence that would be more engaging overall. The paper also makes unsubstantiated and vague statements such as in the first line of the paper on page 2: "The United States of America is internationally known for many different icons, trades, and traits".

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