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IMPACTS OF EARLY SELF-STUDY ON MATHEMATIC ACHIEVEMENT OF ADOLESCENTS

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Abstract

Regular and adequate sleep is an important factor that has impact on performance on cognitive tasks. Investigators assumed that through the evolution process for hundreds of thousands years people sleep when it was dark and woke with sunrise. That is why, our daily rhythm programmed according to sun. Therefore, current study assessed the impact of regular sleep cycle and early self-study on mathematic achievement of high school seniors. Thirteen students six in experimental group and seven in control group completed the study. The experimental group was send to bed at 22.00 pm and they were waked up at 06.00 am. They had self-study time between 06.15-07.45 am. Participants' mathematic achievements were measured before the intervention and four weeks after the intervention. While control groups did not show any increase, experimental group showed significant increase in mathematic achievement. However, difference between group's posttest did not reach to statistical significance.

Key Words: Sleeping cycle, self-study time, early study, mathematic achievement.

Introduction

Since the beginning of time there is a daily cycle that is determined by the orbiting of the world around the sun. This daily cycle caused occurrence of so called circadian rhythm (Folkard and Monk, 1980). When we compare with the evolutionary development of human kind invention of light seems like a recent development. Concurrently, invention of electric lamp is even more recent development. Therefore, we think that through evolution process humans' circadian rhythm had been determined by daily cycle of the sun. We assumed that people adjusted their life according to daylight. They went to sleep when it is dark and they woke up with the sunrise. This evolutionary nature of the human kind cannot be reversed in a few thousand or hundred years. Therefore, it is reasonable to think that people would be more productive if they abide this evolutionary cycle of sleep. That is why we think that in different times of day people's learning performance can vary.

Many studies examined impact of time of day on behavior, attention, cognitive performance and learning (Antrop, Roeyers and Baecke, 2005; Lotze, Treutwein & Roenneberg, 2000; May, Hasher, Stoltzfus, 1993; Davis, 1987; Badenhausen, 1990). Studies strived to find which time of the day is better for learning. They could not reach a straightforward linear answer for the question. Impact of time of day showed variety according to the learners' age groups (May, Hasher & Stoltzfus, 1993; Klein, 2001); learners' characteristics (Lawrence, & Stanford, 1999; Natele, & Lorenzetti 1997); nature of task that is being performed (Manly, Lewis, Robertson, Watson, & Datta, 2002; Lorenzetti & Natale, V. 1996; Davis,1987, Folkard & Monk, 1980; Folkard, Monk, Bradbury & Rosenthall, 1977).

Even though there are several factors that are affecting performance level of the learner, generally it has been accepted that beginning from the morning performance level gradually increases and it reaches its' peak afternoon hours. Also, being agreed is people perform better on immediate recall in the morning and elaborative tasks in the afternoon. Lorenzetti and Natale, (1996, 1997) claimed that there are morning and evening type learners. Their findings supported their claim. Both typologies performed better

on elaborative task in the afternoon and immediate recall in the morning. However, morning type learner showed better memory performance in the morning vs. afternoon and vice versa was true for evening type learners. Folkard, Monk, Bradbury and Rosenthall (1977) tested 12-13 years old pupils immediate and delayed recall performance on a listen story that they listened from a tape. One group of children listened the tape in the morning at 9.00 am and other group listened the tape after noon at 3.00 pm. They found that morning group performed better than afternoon group on immediate recall. On contrary afternoon group was superior on delayed recall. In a further study Folkard and Monk (1980) indicated that arousal level of the learner during learning was important for immediate and delayed recall achievement. When we think of arousal we have to consider daily sleeping cycle as an important factor.

Studies revealed that regular and adequate sleep has positive impacts on learning and academic achievement (Kubow, Wahlstrom, & Bemis, 1999; Dahl 1999; Wolfson & Carskadon, Quine, 1992). Wolfson and Carskadon (1998) conducted survey with 3,120 high school students whose ages were ranging from 13 to 18. Their participants reported significant decrease in their daily sleep because they were going bed later than they used to and their rising time was consistent. Academic performance of less and irregularly sleeping students were significantly worse than their regularly and more sleeping peers. Regular and adequate sleep is vital for all age groups. However it has greater importance for adolescents because due to hormonal and social changes, most of the time sleeping cycle of adolescents becomes irregular and they start to sleep less even though they do not have decreased need for sleep (Dahl 1999). Therefore, in this experimental study that we intervened sleeping cycle and self-study time of the participants, we targeted adolescents.

Even though sleeping cycle is of great importance for learning and cognitive performance of any kind none of the studies to the authors' knowledge attempted to intervene sleeping cycle and self-study time of the participants. Therefore, purpose of this study was to examine impacts of regular night sleep (from 22.00 pm to 06.00 am) and early morning self study time (6.15-07.30 am) on high school seniors' mathematic achievement. Accomplishing the purpose of the study required addressing following

research question: Will intervention with students' sleeping cycle and study time increase their mathematic achievement?

Participants

This study's population included Turkish senior high school math and science students residing in Erzurum, Turkey. In this population 42 senior high school math and science students from Erzurum Anatolian high school participated to pretest. High school senior students were targeted in the study because they were preparing for the university entrance examination. The university entrance exam consists of two steps. First one is Entrance to Higher Education Examination (EHEE) and the second one is Entrance to Bachelor Program Examination (EBPE). Student can enter to two years vocational school with EHEE. Students who want to attend to a bachelor program at university have to enter and get required score from EBPE. Therefore participants of this study were chosen among those students who were preparing for EBPE. Of the 42 participating students 18 were boarding students therefore they were assigned to the experimental group. It was not possible to control sleep hours of the daytime students. Eight participants from experimental group quitted the study because they did not want to awake up early in the morning and 4 of them did not come to school at the day of posttest. Control group participants did not want to take the posttest therefore only seven of them respond to posttest. Finally, six participants from experimental group and seven participants from control group total of 13 participants completed the study and responded to the posttest.

All participants in the experimental group were male because there were no female boarding students. Of the seven participants in the control group, 3 of them were girls (43%) and four of them were boys (57%). All participants were science students. Ages of the participants in the experimental group range from 16 to 18 years, with a mean age of 17.4 years (SD=0.8). Concurrently, the ages of participants in the control group ranged from 16 to 18 years, with a mean age of 17.3 years (SD=0.7).

Measure

In this study one measure was used. Mathematic part of the 2009-2010-university examination test was used as a pre and posttest. It is a central standardize test that is prepared by governmental institute so called Measurement, Recruiting and Placing Center (MRPC). This test was the former test that the participant would enter at the end of the semester. The test contained 50 mathematic questions and 30-geometry questions total of 80 questions. Students have 2 hours to complete the test.

Design and Procedures

Study utilized a pretest-posttest control group design. There were no random assignments because study requires the control of sleeping time of the participants in the experimental group. Therefore, boarding students were assigned to the experimental group because it was not possible to control the sleeping hours of the day students.

Investigator visited the classroom and explained the purpose of the study. He told that they would receive 2010 EBPE mathematical test as a pre-test and than for four weeks students in the experimental group would go to sleep at 22.00 pm latest and they will wake up at 06.00 am study for the university entrance exam and at the end of four weeks they would receive posttest. In fact, investigator demanded to send students to their bed at 21.00 am and wake them up at 05.30 however school administration did not authorize it. Investigator did not tell that the pre-test and posttest were the same in order to prevent cheating after the pretest. After the explanation investigator listed the students who wanted to participate the study. Pre-test day and place were arranged with the help of school administration. Forty-two participants received the pre-test at the school library. Participants were given 2 hours from 10.00 am to 12.00 pm to complete the test.

After the pre-test for four weeks (including weekends) investigator monitored sleeping hours of participants in the experimental group. Every morning the investigator went to participants' dormitories and woke them up at 06.00 am. From 06.00 am to 07.45 am, investigator stayed with the participants while they were having their prep time for university entrance exam. Every night investigator went to dormitories to con-

trol bedtime. He made participants went to bed latest at 22.00 pm. After the pre-test no intervention occurred with the control group during the four-week control phase.

At the end of four weeks participants responded to 2010 EBPE mathematical test in the school library. Participants were given 2 hours from 10.00 am to 12.00 pm to complete the test.

Results

In the EBPE test each mistakes were canceling 0.25 points. Therefore, calculations were made over the net scores. Due to small number of participants parametric tests cannot be used in the data analysis. Wilcoxon Signed Rank test, for both groups, compare means of the pre-test and post-test scores within the group. Also applied was Mann-Whitney U in order to discover any differences in post-test scores between the experimental and control groups.

The mean score for the experimental group's pre-test was 35,75, with the mean ranging from 10,00 to 64,75, and an SD of 19,3. The mean score for the experimental group's posttest was 43,7 with the mean ranging from 15,25 to 65,5, and an SD of 18,6. There was 8 points difference between pretest and posttest scores. Wilcoxon Sign Rank revealed that this difference reach to statistical significance ($N=6$, $p<0.05$).

The mean score for the control group's pre-test was 37,3, with the mean ranging from 27,5 to 57, and an SD of 11,8. The mean score for the control group's posttest was 35,5 with the mean ranging from 25,25 to 46,5, and an SD of 7,8. Wilcoxon Sign Rank revealed that the mean difference between pretest and posttest was not significant ($N=7$, $p>0.05$)

Groups' posttest means were compared with Mann-Whitney U. Statistical analysis did not revealed significant difference neither between pretest scores $z=-.143$, $p>0.05$ of the groups nor posttest scores $z=-1.003$, $p>0.05$.

Discussion

Pretests comparison revealed that there were no differences between groups in terms of their EBPE mathematic test achievement at the beginning of the study. Exper-

imental group's EBPE mathematic test performance significantly increased. Contrary control group's EBPE mathematic test performance slightly decreases. This finding is consistent with findings of Pincback (as cited in Klein, 2004, p. 443) where he found college students showed more progress in algebra in the morning than in the afternoon. Our emergence point was human beings natural evolution process. We thought that for hundreds of thousands years people sleep when it was dark and woke up with sunrise. Therefore, we assumed that attention level of the students would be high during early in the morning if students have adequate sleep. Reports from several studies (Klein, 2001; Morthon & Kershner, 1991 as cited in Antrop, Roeyers, & De Baecke, 2005; Biggers, 1980 as cited in Klein, 2001) supported heightened attention assumption. Therefore, while control group could not show any increase in mathematic achievement, regular sleep and early self-study time can be factor in the explanation of the significant increase in experimental groups mathematic achievement. Of course we have to be very careful while we are interpreting these findings because of the limitations that will we address below.

Even though experimental groups performance significantly increased this increase did not reach statistical significance when we compared it with the control group's performance. This fact may be explained with the limitations of the study. First of all sample size was not large enough to apply parametric statistics and many participants did not respond to posttest. Second of all, researcher had to leave the dormitories after experimental students went to their beds. After researchers left because students were not accustom to sleep early they might stay late and this extended adaptation process. Therefore, one month of intervention period may not be adequate for occurrence of significant difference in the performance. Finally, as we mentioned in procedure school administration did not authorize for waking students up at 05.30 am and sending them to sleep at 21.00 pm. This was important because those hours were more compatible with the daily cycle of the sun at the time the study was conducted. That is why we believe that there is need for further research on the issue with the consideration of limitations.

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