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THE EFFECTS OF STUDENT ACHIEVEMENT TEAM-DIVISION (STAD) ON ACHIEVEMENT AND RETENTION IN MATHEMATICS OF THAI STUDENTS

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Abstract:
The study was conducted to examine the students' mathematic achievement and retention when a cooperative learning method of Student Team Achievement Division (STAD) is used in a Thailand primary school. The research design selected for this study was quasi-experimental. A total of 72 students took part in the study and they were selected by fishbowl random sampling technique that divided them into two groups equally (control and treatment group). The 50-items are School-Based Test is formatted in the multiple-choice pattern to examine the equivalence of the academic ability of the participants of 6th grade students in 6 topics**:** area/perimeter, geometry, algebra, graphing, data management and probability. Overall, the participants of this study had undergone 3 tests: pretest, post-test 1 and post-test 2. ANOVA Repeated Measure was used in analysing the data. The result showed that the cooperative learning by STAD technique is most positive effective in the students' mathematic achievement and retention. This study argues that the cooperative learning of STAD technique can facilitate students' achievement and retention in Mathematics. Consequently, this cooperative learning technique is recommended in learning and teaching Mathematics.

Keywords: the STAD technique, cooperative learning, mathematic achievement, mathematic retention, Thailand

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1. Introduction

Education is not acquirement of what happens in the classrooms. Actually, it is important interlacing than that. From these issues prefer dispose child hunger, expanding access healthy to ecumenical will all support educational levels grow up including sustainability of life. Developed countries must supervise these issues are not only the humanity, but it has an effect on the worldwide economy too. For example, in 2012 alone, 31 million primary-school pupils worldwide dropped out of school. According to the United Nations Educational, Scientific and Cultural Organization, "Opportunities lost: the impact of grade repetition and early school leaving" (UNESCO, 2014). This shows that the role of education is a global phenomenon which needs to be upgraded to meet up with that of other countries.

The argument by Masino and Niño-zarazúa (2016) says that "*Education is critical to economic and social development"* captures the gist of the importance of education towards economic and social development of a country. In other words, education has great impacts on individual and social behaviour, besides being the foundation of economic development of building a wealthy nation. According to Khan, Fauzee and Daud (2015), the accomplishment of a nation depends on the quality of the education system where it contributes to the predominant role in developing outstanding society at large. Therefore, this quality education system needs more systematic research in order to fulfil the National objective in educating people.

On the other hand, education holistically will help to facilitate the human development in order to improve health, gender equality, strengthened social cohesion, mitigating inequity and the reduction of poverty. Moreover, multiple dimensions of societal development such as social, cultural, environmental and economic can be addressed through education. The proper educational planning along with humanitarian and development efforts is the key to sustainable development. The educated people will move forward to catch up with more challenging economic constraints, culture, social and intellectual engagement (Yudof, Levin, Moran, Ryan, & Bowman, 2011).

Thailand in the best interest is gearing up their human resource and human capital to meet up with the other Association of South East Asian Nations (ASEAN) community in the year 2015, yet the education system that can play a vital role in meeting this requirement is not up to standard (Sivarnee, 2013). However, Even though the Thai government has allocated great amount of budget on education, the outcome is still unsatisfactory, the Thai education budget allocation constitutes 4% of Gross Domestic Product (GDP). This huge budget is meant to build better educational infrastructure, revamp the curriculum, train teachers, pay adequate remuneration for teachers and promote the importance of learning among the student population (Tangkitvanich, 2013). Despite this, the Thai education system was declined in performance, which diminishes Thailand's competitiveness in the world and puts the country's future at risk. This can be seen in the achievement at the low level of Program

for International Student Assessment (PISA) and Ordinary National Educational Test (O-NET).

The PISA program is a global study organized and conducted by the Organization for Economic Co-operation and Development (OECD), catering for 15-year-old school pupils' educational performance appraisal in mathematics, reading and science. Then, the PISA survey gave attention to mathematics, reading, financial literacy as well as science which includes problem-solving abilities in young people. Thailand took part in 2000, and despite about 4% of Thai national GDP was allocated for educational sector, the decreasing tendency in achievement of the Thai students is shown by PISA from 2003 to 2015 as presented below.

Table 1: Comparison of Thailand's Mathematic PISA scores between the year 2003 to 2015

Year	Mathematic	Mean
2012	427	494
2015	415	490

Source: Mala, (2016). M = mean

Thailand conducts O-NET each year for grade 6th, grade 9th and grade 12th pupil to assess their academic performance. It is comparison of 8 major subject areas according to the national education curriculum: 1) Thai Language 2) Mathematics, 3) Science, 4) Social Science, Religion and Culture, 5) Health and Physical Education, 6) Art, 7) Career and Technology, and 8) Foreign Languages (Wichian, Wongwanich, & Saengsiri, 2014). The result shows that the O-NET mathematic score is lower in 2014.

Table 2: Comparison of mathematic O-NET scores between the year 2013 to 2014

Year	Number of Candidate	Full Mark	Mean
2013	734,622	100	41.95
2014	731,047	100	38.06
2015	716,684	100	43.47

Source: http://www.onetresult.niets.or.th/AnnouncementWeb/Login.aspx

Even worst, it was found that Thai students achieved lower scores even though they spends more hours in the classroom than students in other countries (Tangkitvanich, 2013). Thus, this problem should be solved through systematic research in order to understand the possible contributions to this problem. Furthermore, results also shown that in South East Asia, Thai students are poor in academic scores, with worse mathematics scores (Timss, 2009; Saiyasombut & Voices, 2012). Therefore, further investigation into the teaching styles will possibly help Thai students improve their learning in PISA and O-NET.

Moreover, Thailand was confrontation in education because of many determinants that needed to solve it such as teaching methodology, material or textbook. According to Tangkitvanich (2013), among the factors are the big classes in government schools, where more than 50 students are taught in one class by one teacher without any assistant teacher. This will create a situation whereby teachers will

find it difficult to give individual attention in class. This is partially because most of the students are inactive, and they will escape the teachers' attention more easily. Moreover, books are limited and science equipment does not exist in a lot of schools. It has become worse when less qualified assistant teachers are employed just to make the pupil-teacher ratio more favourable (Krishnaratne, White, & Carpenter, 2013). Another study by Khun-Inkeeree, Omar-Fauzee, and Othman (2016) stated that private schools has better performance when compared to government schools in Southern Thailand; private schools had many characteristics such as small number of students in each classroom, availabilities of teaching facilities, that might not be available in government schools. Being aware of the problems, Thai government realises it is necessary to find any implementation to improve government school students' performance in Thailand.

Finally, the traditional teaching method was employed almost everywhere (Kane & Cantrell, 2010) without any intention from the teachers to apply student centered learning. Zain, Rasidi, and Abidin (2012) stated that adopting a new teaching style, such as the corporative learning, can help to improve students' motivation, performance and retention in mathematics. Therefore, it is a need to conduct this research in order to identify a significant difference of the employed teaching styles between the traditional and cooperative learning styles.

Additionally, Thai educational reforms considered cooperative learning as an effective way to improve skills, promote students' performance in interactive skills (Park & Nuntrakune, 2013; Thinwiangthong, Innprasith & Loipha, 2012 Veenman, Kenter & Post, 2000). The effectiveness of cooperative learning had been identified by many researchers such as Johnson and Johnson, (1999), Slavin, (1995), Tran, (2012), Veenman, Kenter and Post, (2000). Nevertheless, as stated earlier, the problem is that the corporative learning methods had not been widely imposed in southern Thailand. Therefore, how effective is corporative learning from the southern Thailand background, culture, and environment needs to be identified, and this gap is filled by this quasi-experimental study.

Furthermore, the credibility of teacher's competency (Pawattana, Prasarnpanich, & Attanawong, 2014) on cooperative learning for mathematic education is yet to be firmly established in Thai education. What happens in Thailand is that the mathematic teachers have relied on the same routine over and over. It usually starts with the teacher's explanation and followed by exercises from an individual course book or textbook (Sivarnee, 2013). This activity of traditional teaching and learning mathematics has been done over many years. This is a strong and bold claim. If no implementation of other technique of teaching like cooperative learning, the same poor performance in PISA an O-Net test will be likely to repeat.

This study would like to concentrate on cooperative learning intensively to study its efficiency as student-centered strategies to promote students' interest, their problem-solving skills and provide empirical evidence of its effectiveness in learning and teaching mathematics in a Thai primary school.

1.1 Objectives

The study aims to provide a support to implement cooperative learning of Student Team Achievement Division (STAD) in a mathematic classroom that may improve the students' mathematic competency. Therefore, this study is conducted in an attempt to use cooperative learning pedagogical teaching style in order to examine the effects on the students' achievement and retention in mathematics in Thailand when they study mathematic concepts of area/perimeter, geometry, algebra, graphing, data management and probability. It is hoped that the Thailand Government will gain benefit and will consider adopting the technique to enhance the education standard of Thailand in the future.

2. Research Methodology

The quasi-experimental research design was used in this study. It allows comparison of two or more groups. Indeed, the treatment group is a group that receives the treatment while a control group is a group that receives no treatment (Gay & Airasian, 2006). Control of threats is the essence of experimental design. The researcher had to control threat in order to remove influences of external or internal factors in the treatment that might affect the results on dependent variables.

This study were used a quasi-experiment design of cooperative learning by STAD technique is adopted from Slavin (1990). It is also designed on the basis of the knowledge gained from previous studies (Esan 2015; Tran & Lewis 2012; Van Wyk 2011; Zakaria, et al. 2013; Zakaria, Chin et al 2010). Furthermore, the cooperative learning program used in this study has been proved by Thai experts that it measures what is intended to measure. The sample of the study is divided into two groups: control and treatment groups. The quasi-experimental was designed as follows:

Table 3: Experimental Research Design

Group	Pre-test	Treatment	Postest-1	No treatment	Post-test-2
Treatment	Y1	X	Y2	-----	Y3
Control	Y1	-----	Y2	-----	Y3

Quasi-Experimental NEGD Design & Single Subject Design: (Ary, Jacobs, & Razavieh, 2005)
Where:
Y1 Pre-test
Y2 Post-test 1
Y3 Post-test 2
X Treatment (STAD technique)
------ No Treatment

The duration of this cooperative learning using STAD technique program is designed for twelve weeks with the final re-test to be conducted after three weeks. Both treatment and control groups study in the course of the same period of time. The purpose of this STAD program is to enhance their mathematic achievement and

retention. The hypotheses of the study: There is a significant difference of pre-test, post-test1 and post-test2 achievement and retention of Mathematic overall mean scores between the treatment and the control groups toward mathematic.

2.1 Sampling

Random sampling schools were randomly chosen based on big size of schools under a government in Sadao Province, Songkhla Thailand. There is more than one grade 6th classroom with their O-NET test scores lower than mean scores. The student parents have given their permission by signing the informed consent letter for the participation of their children in this study. Then random sampling classroom was used conduct control and treatment group.

2.2 Instrumentation

2.2.1 The School Based Test on Achievement and Retention (In Thailand Language)

The School Based Test had 50 items. The pre-test was conducted at the beginning of the program to examine the consistency of the academic skills of the participants since they receive the treatment. Mathematic knowledge of 6th grade students in topics: rea/perimeter, geometry, algebra, graphing, data management and probability. Fifty items in both tests were developed by the school board by applying Bloom's cognitive domains of taxonomy. As the result, the tests consist of remembering, understanding, applying, analysing, evaluating, and creating. The items are formatted in the multiple-choice pattern. There are four choices in an individual item. The content of the post-test was selected thoroughly based on what were taught to the participants.

The students' identities were not shown on their answer sheets; only the identical number that was listed by the researcher earlier is noted. After collected, the answer sheets of the control group were mixed with those of the treatment group. Two mathematic teachers, besides the researcher, marked the answer sheets to ensure the lease expectancy influence. They marked the sheets without the knowledge of what group the participants were in.

Since the school-based test on achievement was developed by a teacher at this school, the pilot test has been conducted and the alpha Cronbach for this test is 0.78 which is suitable for testing. The same standard test was employed to test the retention of the students three weeks after the experiments for both the treatments and the control groups.

2.2.2 Procedure

The researcher proceeded the program by the steps as follows.

A. A random sampling classroom was used to divide control and treatment group from a big school in Sadao Province, Songkhla Thailand. The school was randomly chosen based on big size of school under government; with the result of mathematics O-NET lower than mean scores.

B. The instruction of the program was described carefully by the researcher to make sure the students in treatment group understand their roles and responsibility. During this period of time, they participated in their groups, i.e. treatment and control group, for a period of 15 weeks. The treatment group used STAD technique procedure five times per week for a period of 15 weeks; the control group went to class that employed the traditional teaching method, also five times per week for 15 weeks.

STAD technique had five steps follow by class presentation by the teacher and students work in a small group (4-5 students) with mix gender and academic ability with variety of activities, then student take individual quiz. After that, the teacher shows improvement individual score, then the last step is team recognition, a group receives recognition for the sum of the improvement score of the group members each week. The reward gives to the group score improvement. Traditional teaching mean the teacher teaches follow the text book and student work individual assignment.

C. Regarding the pre-test, the students in both control and treatment groups will be tested, taking 60 minutes by using the School-Based Test. After the pre-test score obtained, the students in the treatment group were divided into groups with 3 or 4 students of mixing gender and ability per group in order to prepare them for STAD technique. Then, the control and treatment groups will study using the same mathematics lessons but different teaching techniques.

D. The post-test 1 will run on week 12^{th}, in which the students took 60-minute achievement test. After post-test 1, both the control group and treatment group will continue their lessons normally in their own groups until week 15^{th}. In week 15^{th}, three week after their lessons, the post-test 2 test will be conducted to measure the retention of their mathematic knowledge (Abu & Flower, 1997; Van Wyk, 2011).

2.3 Data Analysis

This research collected data from the students' achievement and retention tests. The inferential statistics test and the parametric test was used in this study. The parametric test was used to test the differences in hypothesis testing.

The hypothesis test of the pre-test, post-test 1, and post-test 2 for a test of achievement and retention and result in score of cooperative learning by STAD technique were measured by using Repeated Measure ANOVA to test the mean score differences between and within the groups. Accordingly, this investigation included an intercession time of 15 weeks (week 1, week 12, and week 15). The statistically significant difference was defined at an alpha level of 0.05. The statistic SPSS software program 22 version was used. The effect size tested for a number of small, middle, and large sizes of any significance differences (0.05).

3. Results

This study examines the significant difference of student's overall achievement and retention in mathematics using the One-way ANOVA repeated measures. It is detected from the multivariate scores that there was a significant difference between the pre-test,

post-test 1 and post-test 2 scores of mathematic achievement in their total scores. Adopting Cohen's (1998) postulation for effect size (.01 = small effect, .06 = moderate effect, .14 = large effect size), the analysis appears to signify large effect size, with F (4, 67) = 206.41, ϱ-value = .00 (ϱ< .05) with eta square = .86.

Hence, the result illustrates that 86% of the variability in total score was connected with the treatment after the variability of individual differences eliminated. Overall, the study shows that the result of ϱ value is less than .05 and there is a statistically significant difference in overall score of student's achievement and retention in mathematics from pre-test, post-test 1 and post-test 2 scores of the control and treatment groups.

Moreover, the effect of time was tested on the two groups. Empirically, the result posits that the students' perceived time is an important factor and this is presented by the result of F (1, 70) = 20.69 ϱ-value =.00 (ϱ < .05), with a large effect size of 37%.

Empirical evidence from the graph presented in the Figure 1 presents that the achievement of an overall mathematic scores of the students in the treatment group improves, but was depreciated than that in the control group. While moving to the retention, the estimated mean shows that the intervention of corporative learning provides a significant increase in the mean score of overall mathematic retention.

Furthermore, results from the mathematic effect scores among the control and treatment group illustrate the statistically significant difference with F (4, 67) = 321.80, ϱ-value =.00 (ϱ< .05) with an eta square = .82. Thus, the result between groups was statistically significant, meaning that there was a statistical difference of students' mathematics overall score in achievement and retention from pre-test, post-test 1 and post-test 2 scores of treatment and control group.

Also, the pairwise comparison tables present a statistically significant difference among the students' achievement and retention of mathematic overall score for pre-test, post-test 1 and post-test 2 scores of treatment and control group. With the results generated from the one-way ANOVA repeated measures, it is therefore concluded that there is a statistically significant different in students' overall score of Mathematics. Therefore, this study accepted hypothesis and concludes that there is a significantly difference between the pre-test, post-test 1 and post-test 2 overall scores of the treatment and control group on achievement and retention in overall mathematic score.

Table 4 below presents the three trials and significance differences between groups in the process of multiple follow-up comparisons; however, it does so at the expense of under-claiming. For the time variable, the results at the paired product (control and treatment) of pre-test, post-test 1 indicated that the mean difference (M= -9.78*) is significantly different at (p < .05).

Moreover, the post-test 1 and post-test 2 were compared, it is pointed that the mean difference of M= -.92* has a significant difference at (p < .05). While the comparison between post-test 2 and pre-test indicates a mean difference (M = 10.69*) which is significant (at p < .05). The result implies that there is overall significant difference between the students' overall score of achievement and retention in mathematics. The Table below depicts the results clearly, while Figure 1 provides the

experimental data of effect of time on the overall score of achievement and retention in mathematics.

Table 4: Result of Repeated Measure ANOVA for Students' overall mean scores in Mathematics

Overall Score Effect	**N**	**Mean**	**SD**	**F**	**Sig.**	**Eta sq.**	**Mean Difference**
Time*Group				206.41	.00	.86	
Treatment Group							
Pre-test	36	16.33	4.85	20.69	.00	.37	
Post-test1	36	25.00	4.67				
Post-test2	36	27.44	3.52				
Control Group							
Pre-test	36	16.50	5.23				
Post-test1	36	27.39	2.97				
Post-test2	36	26.78	2.52				
Treatment*Control				321.80	.00	.82	
Pre-test	72	16.41	5.03				
Post-test1	72	26.19	4.06				
Post-test2	72	27.11	3.05				
Pairwise Comparison							
Pre-test*Post-test1	72				.00		-9.78*
Post-test1*Post-test2	72				.00		-.92*
Pre-test *Post-test2	72				.00		-10.69*

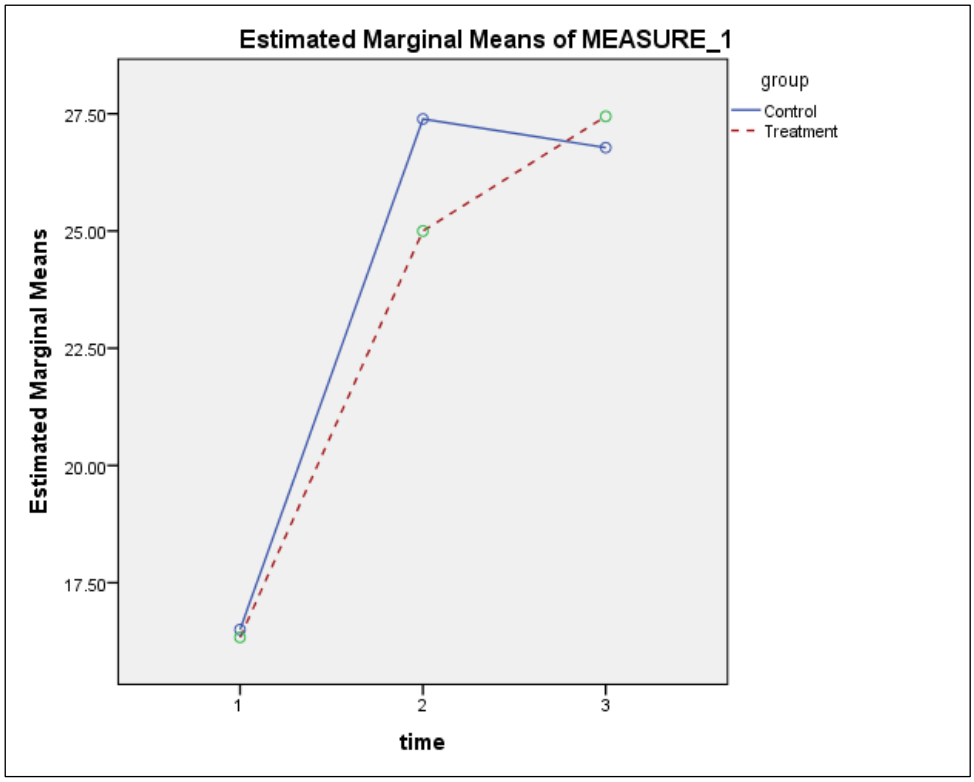

Figure 1: Estimated Marginal of Students' Overall Mean Score in Mathematics

4. Discussion

The students' overall score of achievement and retention of the treatment group were found to increase progressively from pre-test, post-test1 and post-test 2. In contrast, it was found that the control group scores increased regularly for overall mathematic achievement score, but then, decreased constantly for overall retention score. The results show that the technique of cooperative learning helps pupils to achieve a higher overall score in mathematics. Moreover, it also able to retain what had been taught with the even higher mean score. This showed that the module created for cooperative learning had successfully improved students attitudes towards learning mathematics and mathematic achievement over 12 weeks period. On the other hand, it also verifies that the students are able to retain their memory over three weeks without any treatment given. This was found to be true in previous research such as Mentz and Van Zyl (2016); Pierce and Ball (2000) who found that cooperative learning helps the students to improve their achievement as well as their retention ability over time. In conjunction to that, it is suggested that cooperative learning technique should be introduced widely in Thailand education system because it can improve the students' achievement scores and as well as their retention scores. This is because students can work as a team and students may develop social interactions skills that contribute to better achievement especially in learning mathematics (Di Martino & Zan, 2015). Under the corporative learning process, students are free to ask questions from peers and teachers, thus, it is classified as two-way communication which can benefit both parties. Furthermore, cooperative learning also engages with the teaching module (activity and materials) and leads to better grades. The technique imparts critical thinking and social skills, personal growth, positive attitudes towards learning and is easy to implement to achieve group goals (Fini, Zarei & Sardare, 2014; Johnson & Johnson, 1999). On the other hand, the class teachers will also conclude the lesson and re-check student's comprehension, then, after quiz the teacher explained the difficult items to the class (Gubbad, 2010). Moreover, the technique has mobilised the student ability to share knowledge among themselves by teaching the weaker ones (Ismaimuza, 2011). It also improves the interpersonal relationship and activates high retentive abilities (Lasingga, 2011; Tiya & Sufiyana, 2011). In regards to this, Johnson et al (2009); Mentz and Van Zyl (2016) also states that cooperative learning involves learning pedagogy that includes student involvement that creates an atmosphere of academic achievement environments that enhances students' cognitive development relationship.

On the other hand, the control group scored for retention dropped constantly. Perhaps, this is due to the fact that in traditional class the teachers explain and give the students assignments from textbook only; one-way communication style was used, and the students focus on individual commitment (Gubbad, 2010; Tiya & Sufiyana, 2011). This kind of technique may decline the student's attitude in learning mathematics and perhaps, may decrease their overall achievement ability in mathematics. In addition, the one-way communication that exists overwhelmingly in the traditional class teaching did not give much chance to improve their cognitive thinking among students (Johnson

& Johnson, 1999). Likewise, it also did not give room for innovative teaching from teachers' perspective. Perhaps, the traditional teaching style has created boring learning atmosphere which might forbid the retention process (Shimazoe & Aldrich, 2010). Thus, it can be concluded that the intervention of corporative learning STAD in this case does influence the achievement and retention abilities in students (Gillies, 2003a). Of course, without support from the teacher, the cooperative learning might not give positive improvement to the students' mathematic achievement.

4.1 Limitation

The study was conducted only with the students in the region of the southern Thailand and the sample size of the quasi-experiment for this study is suitable for the purpose of this study. However, for the purpose of policy makers for Thai Education System, it is recommended to employ larger sample size over many provinces in Thailand.

4.2 Suggestion and Future Investigation

This study focuses on the cooperative learning of STAD technique, and has provided evidence of effectiveness in students' attitude and achievement in learning mathematics. However, future study should also compare another method of cooperative learning in order to identify the best method. The technique of Jigsaw, Teams-Game-Tournament (TGT) and Team Assisted Individualization (TAI) also should be compared. This will help Thailand authority to choose the best cooperative learning for Thai students.

5. Conclusion

In conclusion, this research argues that a cooperative learning strategy of Student Team Achievement Division (STAD) supports students to improve attitudes, achievement and retention of mathematic skills over three weeks. Consequently, it is recommended that cooperative learning should be executed to other schools in Thailand. Moreover, future research is recommended to examine the students' retention over different periods of time, i.e. five to ten weeks after the intervention.

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