

# The Impact of Self-controlled Attention and Social-comparative Feedback on the Learning of Sandbag Throwing in Adolescents

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## Abstract

**Background:** Recent studies have demonstrated that autonomy support, social-comparative feedback, and attentional factors contribute to performance and motor learning skills. The present study investigated the influence of self-controlled attention and social-comparative feedback on the performance and learning of a throwing task.

**Methods:** 80 healthy students of Shahid Khalaj Azad junior high school from Takestan (mean age=14.12 ±0.752 SD) in 2017 academic year, placed in five groups: internal-experimenter-controlled, external-experimenter-controlled, internal-self-controlled, external-self-controlled, and control. Internal groups practiced based on an internal focus of attention, an external group practiced based on an external focus of attention. Experimenter-controlled groups received only veridical feedback, self-controlled groups in addition to the veridical feedback received social-comparative feedback. We used a four (pre-test; acquisition; retention; transfer) × five (groups) repeated measure analyses of variance (ANOVA) in SPSS software version 25 to analyze data.

**Results:** The results indicated that throwing tasks differed significantly between phases. The retention phase score was higher than the other phases (83.14±0.72, P<0.001). Test of between-subjects effects determined that groups significantly differed from each other. The Internal-self-controlled group score was higher in other groups (81.15±6.15, P=0.041).

**Conclusions:** These findings demonstrated that the self-controlled focus of attention in companion with social-comparative feedback enhances motor learning in the first stage of the learning.

**Keywords:** Internal and external attention, Positive feedback, Motivation, Self-control, Feedback

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## 1. Introduction

Motor learning survives theoretical perspectives that do not satisfy the effects of motivation and attention on performance and learning of the skill. The optimizing performance through intrinsic motivation and attention for learning theory (OPTIMAL) state that intrinsic motivation and attention in learning can make learning as perfect and effective as possible (1). Research indicated that the external focus of attention has different effects on motor tasks. It leads to faster movement times in performance (2, 3) and enhances balance learning (4-6). External focus causes more expressive and organized movement execution (7, 8) and also more automatized movements (7, 9, 10). Also, it facilitates the learning of motor skills in people with Parkinson's disease (11, 12) and causes additive learning advantages combined with autonomy support (13). It leads to an identical result in many areas of motor learning (3, 7, 11,13). However, these studies are inconsiderable in the adolescence. Wulf and Lewthwaite mentioned that an external focus of attention creates direct attention to the task goal, increases goal-action coupling, and causes

lower attention to herself/himself rather than an internal focus of attention (1).

Various studies revealed that if experimenters/coaches allow learners to control some aspects of practice conditions, the effects on motor skill learning increase significantly (14-16). Chance of choice can be motivating in practice conditions and influencing learning. The claim is that autonomy effect on the individual motivational situation is direct. Learner's perception of competence enhances the self-controlled practice resulting in a positive effect on motor learning (17, 18). A study with four groups, based on the age, including; self-young, yoked-young, self-old, and yoked-old examined the push and released task of a low-friction slider along a horizontal rail to a goal distance. Researchers found that the self-young group had better retention and more accurate estimating of motor performance than the rest of the groups. The authors suggested that older adult's benefits of self-controlled knowledge of result are less than young people (19). Regardless of which factor is controlled by the learner and the relation of that factor with learning the task, it

is clear that self-control has very strong advantages for learning and these advantages can be generalized to other tasks, it means that apply of autonomy support effects may be in various ways (1). In this study, we applied self-controlled strategy in choosing internal and external attention to throwing task.

Motivational factors have a facilitator influence on motor learning skills (20, 21). The athlete who experiment success probably gain positive expectations that may lead to improvement in skill learning. Therefore, factors that increase learner expectancies in skill performance, presumably simplify motor learning. Autonomy support has indirect influences on learning such as the chance of increasing expectations for performance. Many types of research indicated the effectiveness of practice circumstances on increasing performance expectancies of athletes, some of these researches investigated social-comparative feedback effects (1). One way that evaluates learners' ability to do something efficiently, is by comparing their performance with scores of other people. Actually, social-comparative feedback is the information, which is different from objective feedback that the experimenter provides for learners. Here, the experimenter provides false scores perhaps more or less than average (1, 22). Search in social-comparative feedback displayed the enhance of motor learning via positive false feedback (1, 22). A study examined autonomy support and enhanced expectancies factors as a facilitator of motor learning of throwing skill in the adolescents. Experimental groups received positive social-comparative feedback in addition to veridical feedback in the practice time; it was found that autonomy support/enhanced expectancies group had higher throwing accuracy and self-efficacy than the C group in retention test (23). One research on adults in the task of balance on a Stabilometer between the normative and control group, showed that normative group demonstrated more effective performance and longer time in balance than the control group. In addition, their satisfaction performance was more than the control group. Also, they had less concern about the performance and little nervousness than the control group (24). In a research, the same as on the task of the previous study, conducted by Lewthwaite and Wulf indicated that normative feedback influenced the learning of balance tasks and the positive comparative

group (better group) displayed better performance in balance (20). Wulf and co-workers in a computer-based task on university students with two groups, better and worse, found that the learning of better group was more effective than worse group, it means that the group with positive social comparative feedback performed better than the group that was convinced their performance was lower than the average (24). None of the above studies investigated the effects of social-comparative feedback and attentional aspect according to the self-control on secondary school students.

The aim of the present study was comparing the effects of the experimenter and self-controlled attention and motivational (social-comparative feedback) factor on the learning of sandbags throwing skill. Avila and co-workers in a study on 10-year-old children with the task of throwing beanbags showed that the group of children with positive feedback had greater throwing accuracy than the control group in the retention test (22). In addition, the results displayed that positive feedback group had higher scores than the control group in perceived competence. The authors just measured the effects of a motivational factor on throwing skill learning. We extended the quest that whether self-controlled condition as a combination of the self-controlled direction of attention and social comparative feedback rather than experimenter-controlled condition may have an influence on throwing learning.

2. Method

The present research was a quasi-experimental study. The sample size was based on optimal sample size calculations (ANOVA: Repeated measure, within-between interaction test; effect size=0.19, power (1-β)=0.90, α=0.05, Number of groups=5, Repetitions=4), comprised of 80 students(13). The participants were healthy junior high school boys in Takestan city, Shahid Khalaj Azad School, in 2017 academic year. Table 1 shows the demographic characteristics of the subjects. The participants' ages ranged from 13 to 16 years (mean age=14.12, SD=0.752). Their weight ranged from 46 to 64 (mean weight=52.06, SD=3.76 SD). The participants' height ranged from 156 to 170 (mean height=162.15, SD=3.15). The school review board of ethics committee approved the study.

Table 1: The mean and standard deviation of age, height, and weight of the participants

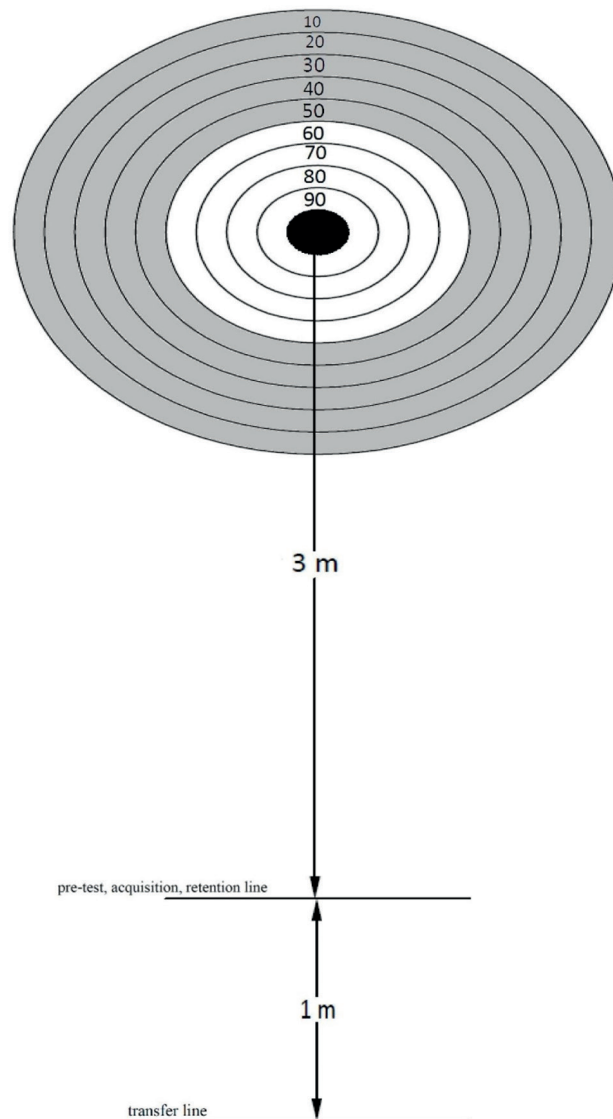
Groups	No	Age	Height	Weight
Internal-self-controlled	10	14.60±.69	163±2.40	51.20±3.19
External-self-controlled	22	13.86±.63	161.22±3.25	53.90±4.23
Internal-experimenter-controlled	16	14.06±.77	162.06±3.08	51.43±3.89
External-experimenter-controlled	16	14.25±.68	162.37±4.03	51.50±3.20
Control	16	14.12±.88	162.75±2.48	51.25±3.35

The analysis of pre-test data with One-Way ANOVA showed that there were no significant differences in demographic variables between the groups. All of them were the male students in grades 7 and 8. All the students in the school-based health records were in perfect health. The participants had no previous experience with the experimental task and all were right-handed. They were not aware of the purpose of the study. All the students can participate in this study. The participants could withdraw the study whenever they want. No participant withdrew the study. Informed consent was obtained from all the participants.

The target was a bull's eye. The participants were asked to practice and throw sandbags (100 g) at a circular target placed on the floor with their right-handed arm. The target was placed at a distance of 3 m from the participant for pre-test, acquisition, and retention tests. The participants threw in a line 4-meter far away from bull's eye for transfer test. The inner-circle had a radius of 10 cm and was surrounded by 9 concentric circles with 90,80,70,60,50,40,30,20,10. If the sandbag was landed on the bull's eye, 100 points were recorded and outside of this circle, 90,80,70,60,50,40,30,20,10, or 0 points, respectively, were registered (Figure 1). This was a similar task mentioned in a study conducted by Chiviawosky and co-workers (25).

This study was semi-experimental research, which included a pre-test, acquisition, retention, and transfer test (24 hours after the last session of acquisition (Figure 2)).

The participants learned how to perform the task by the experimenters who instructed to throw the sandbag overhand with the dominant hand while standing with both feet behind a line on the floor. They were sorted based on their 10-trials pre-test practice scores. Then the groups assigned numbers from one to four randomly. The participants were assigned to one of the four homogeneous groups according to their sorted scores: internal-experimenter-controlled (IE) (n=16), external-experimenter-controlled (EE) (n=16), control(C) (n=16), self-controlled groups. It is noteworthy that the researchers had already designed the self-controlled group to be divided into internal-self-controlled (n=10) and external-self-controlled (n=22) groups. So, compared with other groups, the participants were assigned to the group twice. The self-controlled group participants were categorized into internal-self-controlled (IS), and external-self-controlled (ES) subgroups based on their choice of attention. This caused the number of participants in these two groups to be unequal; however, the pre-test analysis by one-way ANOVA revealed that all five groups are homogenous. The participants practiced 60 throws (6 blocks of 10 trials) in a line 3-meter far away from



**Figure 1:** The figure shows a schematic of circles with a radius of ten centimeters and the score of each circle in the sandbag throwing task.

the bull's eye in the acquisition phase. There were 2-minute break between each block. Attentional instructions were taught to the participants. The participants repeated them just before each block for external & internal attention. The external group focused on the bull's eye (center of circles with radius; 100 score), which designed on the earth (Figure 1). The internal group focused on their hand when they were throwing the sandbag. After each block, the students were aware of the mean of throwing as the veridical feedback. In the groups that included the experimenter controlled (IE, EE), the participants could not have the choice type of attention (experimenter randomly placed them in external and internal attention groups) and received only veridical feedback (average accuracy score) after each block of attempts. However, in the groups that included self-controlled (IS, ES), the participants could

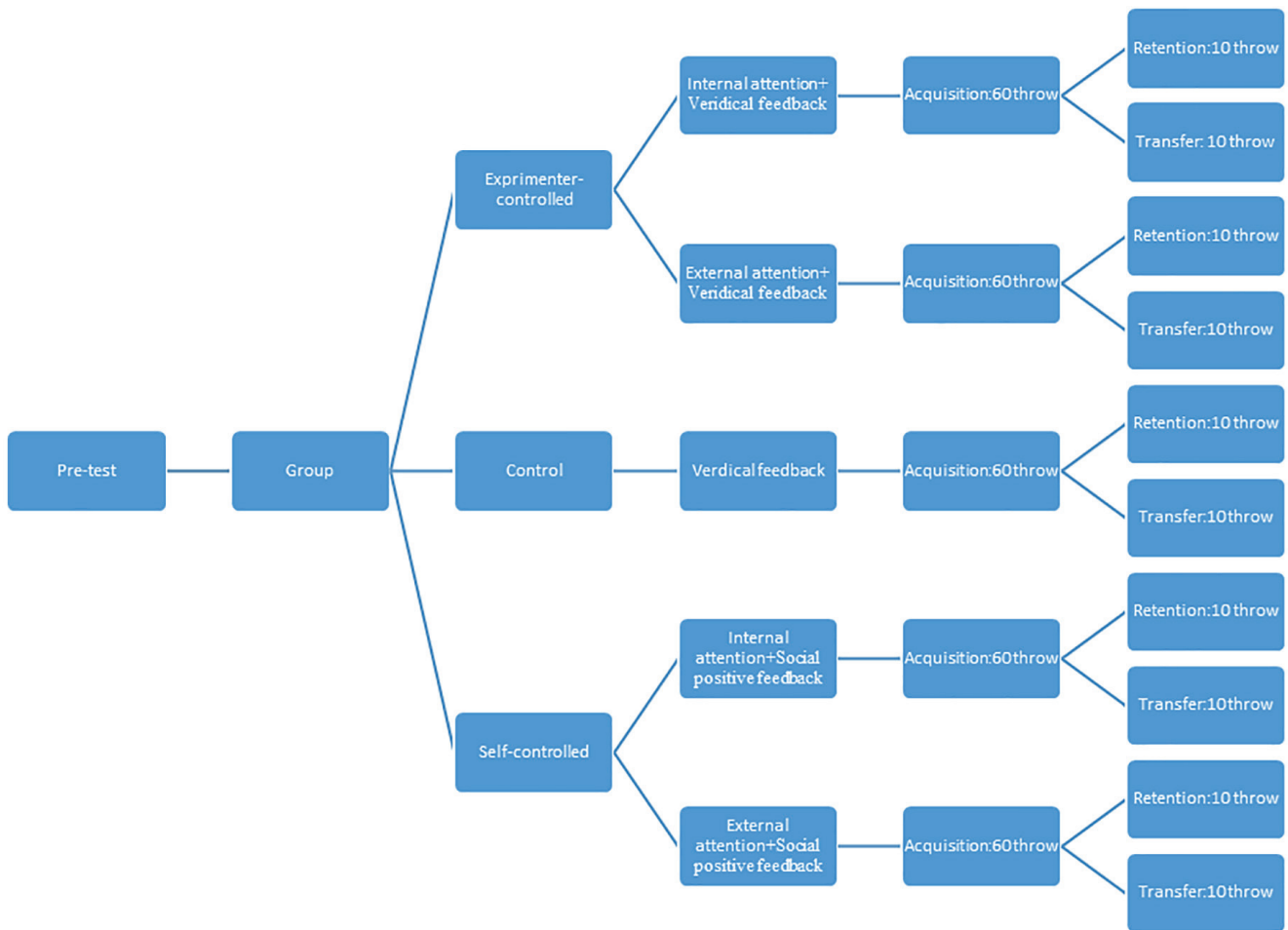


Figure 2: This diagram shows the design of the research in detail.

choose the type of attention. In addition, they received positive social-comparative feedback in addition to veridical feedback. The positive social-comparative feedback was a positive false score, unrealistically the mean of throwing skill scores of other school students. The experimenters and their assistances calculated these scores after each 10-trail block, which was %20 lower than the participants' score and presented it to each participant after each 10-trail block. Group C only received veridical feedback by average after each 10-trail block. Twenty-four hours later retention and transfer test with 10-trails without feedback was performed. The participants threw in a line 4-meter far away from bull's eye for the transfer test.

Data was analyzed for outliers and standard parametric assumptions. Shapiro-Wilk test of normality showed that distribution is normal. We used descriptive statistics to present the study population. The task in sandbag throw was analyzed in a four (pre-test; acquisition; retention; transfer) × five (groups) repeated measure analyses of variance (ANOVA). Alpha was set at 0.05 for all analyses. The researchers used SPSS software version 25 for analyzing data.

### 3. Result

Statistical analysis of the study was presented in Table 2 and 3. A repeated-measures ANOVA with a Greenhouse-Geisser correction determined that throwing tasks differed significantly between the time points, (P<0.001). Post hoc tests using the LSD correction revealed that acquisition score mean was increased to 80.65, which was significantly different from pre-test(73.48; P<0.001) and transfer mean (73.30; P<0.001). In addition, LSD correction revealed a significant difference between retention score mean (82.83), pretest (73.48, P<0.001), acquisition (80.65, P=0.008), and transfer (75.30, P<0.001). There was no significant difference between pre-test and transfer (73.48 and 75.30, respectively). Test of between-subjects effects determined that the groups significantly differed from each other, (P=0.041). LSD tests revealed that the mean score of the self-internal group was significantly higher than self-external (P=0.006), experimental-internal (P=0.041), experimental-external (P=0.007), and control (P=0.006) groups. There was no significant interaction between the test and groups (P=0.737).

**Table 2:** Descriptive analysis of groups in four-time points

Groups	Condition	Mean	Std. D
Internal-self-controlled	Pre-test	76.10	7.09
	Acquisition	83.60	2.83
	Retention	85.50	4.99
	Transfer	79.40	4.59
External-self-controlled	Pre-test	72.36	7.29
	Acquisition	80.45	3.58
	Retention	81.36	6.09
	Transfer	75.77	8.20
Internal-experimenter-controlled	Pre-test	73.50	7.05
	Acquisition	80.37	3.70
	Retention	83.75	6.88
	Transfer	75.68	5.89
External-experimenter-controlled	Pre-test	73.56	7.08
	Acquisition	81.56	4.11
	Retention	82.50	6.50
	Transfer	72.06	7.01
Control	Pre-test	73.31	7.12
	Acquisition	78.43	3.22
	Retention	82.62	6.15
	Transfer	74.93	5.37

**Table 3:** The effects of the test times, groups and interaction between the groups

Effects	df	Mean Square	F	Sig	Partial Eta
Time	2.61	1670.13	43	0.001	0.364
Time* Groups	10.46	26.91	0.693	0.737	0.036
Groups	4	118.89	2.63	0.041	0.123

#### 4. Discussion

The current study examined the effect of an internal and external focus of attention and comparative positive feedback on the sandbag throwing of fourteen-year-old novice children. The results of this study indicated that within-subject and between-subjects differences were significant. The subjects in the retention time performed better than in pre-test, acquisition, and transfer time. In addition, the combination of the self-controlled internal focus of attention and social comparative feedback, as the internal-self-controlled group, enhanced sandbag throwing motor skills more than other groups.

Wulf and Lewthwaite proposed the social-cognitive-affective-motor nature of motor behavior as a theory of motor learning. Optimizing performance through intrinsic motivation and attention for learning theory (OPTIMAL theory) is based on the premise that to understand motor learning, one should consider the social-cognitive and effective (motivational), and attentional effects. Therefore, this theory states that motivation and attention are contributing factors for performance and

learning of tasks. Since the external focus of attention directs attention to the goal of the task and reduces the focus on self. Thus, external attention is a significant contributor in coupling goals and actions (1). Hence, a large number of studies on different participants, with a variety of approaches, claimed that an external focus of attention enhances motor skills learning (2, 3, 7, 11, 13, 27). Our findings were not in consistent with these studies. We found the internal focus of attention enhances the sandbag throwing task rather than the external focus of attention. Considering that, they chose internal attention themselves.

Tasks type is an essential component to determine the amount of attentional factors effects. A comprehensive study examined age, gender, and task difficulty as the moderators of the focus of attention effects. Researchers found that there were no significant time differences between attentional groups in the double pedals with handles (simple) task. However, in the complex task, external focus groups of men had faster time in the retention phase than internal focus groups. This study finding showed task complexity and sex moderate effects of the focus of

attention (27). A study considered the effect of the focus of attention and age on dart throwing tasks in acquisition, retention, and transfer condition. This study revealed that children and adults focus on attention differ from each other at the accuracy factor and variability of dart throwing task in the acquisition and transfer conditions. They concluded that people, as physical therapists who work with children, should direct their attention internally (28). Both of these studies used a simple task to determine the effects of attentional focus. They confirmed that the internal focus of attention could be more effective than the external focus of attention for children. Our task was a simple task as the task used in these studies. Additionally, there were sample similarities between the studies. Our study is on the line with these studies.

Providing the opportunity to choose practice conditions for learners may be the motivating factor. According to this, self-controlling of the practice conditions promote task learning. Giving the opportunity for patients to choose using an assistive device may improve rehabilitation (29). Research on patients with Parkinson and children with cerebral palsy (CP) revealed that a self-controlled group showed more effective learning of the task (14, 30). Other studies with self-controlled protocols result in greater self-efficacy for self-controlled experimental groups (17, 18). In addition, it has a positive effect on the motor learning (16, 18). Therefore, a study on timing task found that a self-controlled group was better in the accuracy (17). Moreover, autonomy of learners in tasks closely depends on their enhanced expectancy. Motor learning literature states that feedback influence the learner's motivational state. Feedback enhances perceptions of competence through presenting after good trails. The effect of practice conditions promotes individuals' performance expectancies. Some of these effects demonstrate social-comparative feedback as positive feedback. Positive feedback (false feedback) improves motor learning. Studies on throwing and aiming tasks revealed that social-comparative feedback enhances motor learning (22, 23, 31), increases perceived competence (22), and also enhances balance control (20). One of the factors that may create positive expectations and lead to further contribution to learning is the experience of success. Factors that increase learners' performance expectancies facilitate motor learning (1). Our results indicated that internal-self-controlled group with social-comparative feedback outcomes was better than the others groups that are in line with these studies.

In the early stage of Newell's learning model, novice players try to acquire movement patterns. They are looking for applying a stable movement pattern for specific motor skills as their tendency to solve the movement problems.

Newell's motor learning model supports this notion that different attentional focus affects task learning based on skill levels (32). According to this model, the internal focus of attention may be appropriate for novices at the first stage of learning for constructing a basic functional coordination pattern from different movement patterns that the human motor system offers to him/her. Since the goal of the athlete is to produce a specific pattern for the movement of the task, an internal focus of attention seems to be more effective. According to this notion, our novice players, without any experience, in the task were in the coordination stage of learning. Thus, the internal focus of attention was appropriate and effective attentional factors for our learners in the first stage of motor learning. Of course, researchers should exactly define the novice players and the novelty of the task for him/her. Therefore, to minimize the effect of the experience of the learner on the task, researchers should apply the novel tasks (33). We did not determine if the internal-self-controlled group had the experience of success more than the other groups previously. From another perspective, the challenge point framework states that learning a task depends on the functional difficulty of the task. The amount of information presented in the task is the potential of learning. The optimal amount information of learning depends on the learner's skill level and the difficulty of the task. According to contextual interference and knowledge of results, which are based on nominal difficulty of the task (throwing on the constant distance) and functional difficulty of the task (no different levels of participants, no special variety of throwing condition), it is expected that in a very low nominal task conditions, the beginner performance outcomes increase. While, with increasing functional task difficulty, the certainty of the potential success of a movement and potential feedback decrease (34). Therefore, low nominal difficulty and no different levels of participants contribute to enhancing the performance outcome of our participants. In addition, the effectiveness of the internal focus of attention for the coordination stage of learning because of only acquiring movement patterns and less complexity of this stage. Also, the influence of autonomy support on motor learning skills confirm using the self-controlled approach of the internal focus of attention for simple throwing tasks.

## 5. Conclusion

We concluded that the self-controlled focus of attention in companion with social-comparative feedback enhances motor learning in the first stage of the learning. Future research on kinematic changes with the different focus of attention and autonomy support would contribute to determining effective attentional focus in the coordination

stage of learning.

**Ethical Approval:** Ethics committee of school board approved this study

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**Conflict of interests:** All authors of this research disclose any financial and personal relationships with participants or school boards that could inappropriately influence the work.

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