



The effect of the color of educational tools and teaching aids on learning futsal inside kick skills: The role of trait anxiety

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Article Info	Abstract
<p>Article type: Original Article</p> <p>Article history: Received: 23 April 2024 Revised: 15 June 2024 Accepted: 22 June 2024 Published: 01 July 2024</p> <p>Keywords: cool color, futsal inside kick skill, trait anxiety, warm color.</p>	<p>Background: Colors can play an effective role in the level of attention, arousal, anxiety, and motivation of learners in learning.</p> <p>Aim: The purpose of this study was to investigate the effect of the color of educational tools and teaching aids and the role of trait anxiety on learning futsal inside kick skills.</p> <p>Materials and Methods: Sixty football school participants aged 10-12 years, who, had no experience in futsal matches, according to the type of color (warm and cool) and the level of anxiety (high and low) in four groups were selected. The participants performed 135 trials during three acquisition sessions including 3 blocks of 15 and they rested for 5 sec between each attempt and 2 min between each block. At the end of the last session, the acquisition test and after 48 hours, the retention test, and after 15 min, the transfer test were performed in the same session in the presence of the spectators. To analysis the data, from variance analysis tests with repeated measurements were used. For the effectiveness of color in the acquisition phase, the two-way variance analysis test was used to compare the groups at the significant level of $P < 0.05$.</p> <p>Results: The effect of training sessions ($P < 0.001$) and the interactive effect of color and anxiety ($P < 0.028$) and test stages ($P < 0.001$) are significant and the changes in the progress of the groups did not take place in the same way. In subjects with high anxiety, the cool color group had better progress than the warm color group, and in low anxiety subjects, the warm color group had better progress than the cool color group. Therefore, in learning futsal side kick skill in subjects with high and low trait anxiety, the color of the tool is known as an effective factor.</p> <p>Conclusion: The use of a variety of training programs along with the color of the tool can improve the learning of futsal inside kick in teenagers with high and low trait anxiety.</p>

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1. Introduction

Identifying the training conditions is one of the important goals of research in motor learning, as it improves the learning of motor skills to the optimum level. Cognitive abilities are one of the effective factors in learning for learners, and they are related to the methods of perception, attention, memory, thinking, and understanding. In the early stages, strategies are needed to facilitate the learning process. In addition to training, some variables, such as color, can play an effective role in motivation and capturing the attention of learners [1]. Colors are important in various aesthetic, cognitive and functional aspects [2]. Human life is influenced by color and all environments and the tools used are somehow color [3]. Human in receive of information from the world around. It relies on the sense of sight more than other senses [4]. It has been shown that the sight receptors in the eyes have different sensitivity to different colors [5].

Color improves processing vision and reduced stress by stimulating vision. Also, searching for patterns and textures helps brain growth can be visual stimulation actually strengthens the brain. It creates stronger connections in the brain than visual perception improves problem solving [6]. According to the theory of symptom identification, color can increase or decrease the recognition of a factor and as a factor to reduce the error in symptom identification [7].

Color can enhance the encoding and retrieval of cognitive maps and also reduce the processing resources they require [8]. In the psychological context of the environment, color is important as environmental factors and has a significant impact on human perception and behavior [9].

They have different colors, warm colors stimulate subjects, while cool colors have a relaxing effect. The use of appropriate colors in the learning environment creates a relaxing atmosphere for the learner and improves visual processing, reduces stress, and promotes brain growth. Furthermore, visual stimulation strengthens the brain, establishes stronger connections in the brain, and enhances visual perception, problem-solving, and creativity. According to the symptom recognition theory, color can be utilized as a factor to reduce errors in symptom recognition [10].

In examining color and its effect on reaction time, as well as recognizing color and its effect on peripheral vision, the researchers concluded that different colors produce different effects. In investigating the effect of color on reaction time, researchers observed the use of blue and being in a blue environment significantly reduces reaction time [7]. Additionally, color recognition in peripheral vision can be effective for athletes in various sports fields, with red and blue colors being more recognizable than green and white. It is suggested that wearing red or blue clothes during a match can help identify group members [1]. Furthermore, the findings indicate that the tools used in education play an important role in people's functioning and learning. The presence of blue color in tools can improve alertness, mental health, reduce fatigue, and enhance overall function [11]. Blue color can also induce relaxation and reduce stress during tests [12].

Studies show that providing the right color of tools can have positive effects on people's learning. For instance, 7 and 8-year-old children demonstrated better performance in receiving a ball when it was presented in their preferred color [1]. On the

other hand, the use of warm, cool, neutral, and preferred colors in educational tools for training and games did not show a significant difference in post-test performance and short and long-term retention of fundamental manipulation skills in first-grade students, despite pre-test to post-test effects [13].

Additionally, the use of markers in education is also important. The findings suggest that the ability to use markers is a crucial aspect in finding ways to successfully perform a task or skill [14]. The results showed that using markers can alter the three-step movement pattern in participants, but no significant difference was found between colored and black and white markers [15]. Overall, the use of warm and cool colors is associated with emotional reactions and specific behaviors in an environment. Understanding how color affects human perception and behavior is necessary for creating an efficient educational environment [16, 17]. Therefore, it is expected that the compatibility between the colors used and educational aids can lead to optimal learning for individuals.

On the other hand, individual characteristics should be considered important factors in learning skills. Individual and psychological characteristics, such as personality traits, motivation, progress motivation, and anxiety about acquiring and learning skills, play a decisive role [4]. Color and its use in the environment and tools can also affect characteristics such as motivation, emotions, attention, and functional memory [1]. Considering that differences in people's characteristics cause different reactions in similar situations, it seems necessary to investigate the interaction between individual characteristics and

environmental characteristics. Trait anxiety is a relatively stable and acquired behavioral tendency and is described as a personality trait. It is considered a predictor of sports function due to its role in the occurrence of state anxiety [18]. Anxiety and its control play a significant role in learning, and environmental factors also play a valuable role in reducing anxiety [19]. Accordingly, the environment should be designed in such a way that it is attractive, relaxing, and free of any nervous and psychological pressure for people [10]. In the field of environmental psychology, color is one of the environmental factors that has a great effect on human perception and behavior [2, 20].

In general, it appears that investigating the interaction between the color of the tool (as an environmental factor) and individual and psychological characteristics, such as anxiety, in learning skills is necessary. Based on a few studies in this field, this research aims to examine how the color of the tool and trait anxiety interact and affect the learning of futsal inside kick skills. Therefore, the main question of this research is whether warm and cool colors in educational tools and aids (such as futsal gate, futsal ball, and colored markers) have different effects on the acquisition and learning of futsal inside kicks among individuals with high and low trait anxiety levels. The warm (red) and cool (blue) color groups were distinguished by the color of the ball, the goals, the scoreboard inside the goal, and the educational aid tool, colored markers. The scoring was based on the gate areas with dimensions of 70x110 cm, using average scores. The average minimum score was 0, and the average maximum score was 3.

2. Materials and Methods

The participants in this research were 10-

12-year-old boys who were enrolled in football schools located in Bojnord, Iran. The participants were 60 football school students who took part in the study. Based on their responses to a personal information questionnaire, they were in good physical condition, had no experience participating in futsal matches, and exhibited high or low trait anxiety levels. The participants were randomly divided into four groups, each consisting of 15 individuals, and underwent training based on their assigned research group, high trait anxiety-warm color, high trait anxiety-cool color, low trait anxiety-warm color and low trait anxiety-cool color. The Ethics Committee of Hakim Sabzevari University also approved the ethical conduct of this research (IR.HSU.REC.1 high trait anxiety-warm color 402.007).

2.1. Procedure

At the beginning of the research, the State-Trait Anxiety Inventory (STAI) by Spielberger was administered to the beginner students of football schools in the province to select participants with high and low trait anxiety. After the participants completed the STAI and the researcher recorded the scores, the scores were divided into two categories. Scores ranging from 29-42 were classified as low trait anxiety, while scores ranging from 49-69 were classified as high trait anxiety.

In the next stage, 60 participants from football school beginners in the province, who exhibited both high and low trait anxiety, were randomly assigned to two groups: warm colors and cool colors. The research groups consisted of the high trait anxiety group with warm colors, high trait anxiety group with cool colors, low trait anxiety group with warm colors, and low trait anxiety group with cool colors.

To reduce potential errors and assess the number of attempts leading to progress

during the acquisition session, a preliminary study was conducted. Prior to the task and training, participants completed a block of learning principles (15 attempts) as part of a pre-test. Following this, all participants completed the pre-test from a distance of 6 m to the futsal goal. Each group practiced a total of 135 attempts in three blocks of 15 attempts across three sessions. There was a 5 sec rest between each attempt and a 2 min rest between each block.

The training conditions were the same for all four groups and included a warm-up section, 10 min of light running, 5 min of stretching, and training exercises related to inside kicking followed by a cool-down. The warm (red) and cool (blue) color groups were distinguished by the color of the ball, the goals, the scoreboard inside the goal, and the educational aid tool, colored markers. The scoring was based on the gate areas with dimensions of 70x110 cm, using average scores. The average minimum score was 0, and the average maximum score was 3.

At the end of the final session, an acquisition test was performed, followed by a retention test after 48 hours at a distance of 6 m. Additionally, a transfer test was conducted after 15 min at a distance of 6 m in the presence of a spectator, and another transfer test was performed after 15 min at a distance of 5 m, also in the presence of a spectator. Figure 1 depicts the use of warm and cool colors in the futsal inside kicking skill.

2.2. Statistic

Descriptive and inferential statistics were used for the statistical analysis of the raw data. Descriptive statistics were used to calculate central indices, dispersion, draw graphs and tables. In the inferential statistics section, the Shapiro-Wilk test was

used to study the normal distribution of the data. Two-way variance analysis tests were conducted: 2 (anxiety) x 2 (color) x 4 (pre-test and acquisition sessions) with repeated measurements in the acquisition stage; and 2 (anxiety) * 2 (color) in retention tests at a distance of 5 m, as well as in the transfer test at distances of 5 and 6 m in the presence of the spectator. The level of statistical

significance was set at $P<0.05$, and the calculations were performed using SPSS 24 software.

3. Results

In this section, the descriptive statistics of research variables using mean and standard deviation indicators are presented in Table 1.



Warm color of the tool



Cool color of the tool

Figure 1. Warm and cool colors of the tool

Table 1. Mean and standard deviation of futsal inside kick skill scores in research groups in pre-test, acquisition, retention, and transfer sessions

		M±SD						
Groups		Pre-test	Acquisition (1st session)	Acquisition (2nd session)	Acquisition (3rd session)	Retention	Transfer distance of 5 m (with the spectator)	Transfer distance of 6 m
High anxiety	Cool color	1.48±0.204	1.76±0.217	2.15±0.203	2.52±0.201	2.52±0.185	2.67±0.147	2.53±0.157
	Warm color	1.56±0.183	1.70±0.190	1.93±0.214	2.20±0.211	2.20±0.212	2.36±0.228	2.21±0.230
Low anxiety	Cool color	1.59±0.219	1.76±0.232	2.03±0.240	2.28±0.262	2.26±0.245	2.41±0.224	2.30±0.219
	Warm color	1.55±0.185	1.77±0.176	2.18±0.175	2.55±0.183	2.53±0.179	2.65±0.171	2.46±0.197

In the acquisition stage, the results of intragroup effects in the investigation of the effect of color showed that the main effect of the test stages (pre-test and acquisition sessions) was significant in the acquisition sessions ($F=2288.244$, $P<0.001$), and the

main effect of color ($F= 0.095$, $P<0.759$), and the interaction of color and test stages ($F=1.710$, $P<0.185$) were not significant. In the acquisition stage, the results of intragroup effects in the investigation of the effect of anxiety showed that the main

effect of the test stages (pre-test and acquisition sessions) was significant in the acquisition sessions ($F=2288.244$, $P<0.001$), and the main effect of anxiety ($F= 0.900$, $P<0.347$), and the interaction of anxiety and test stages ($F=1.098$, $P<0.338$) were not significant. This means that there is no significant difference between the

groups of warm and cool colors and high and low trait anxiety in the acquisition stage, and both groups have progressed in the futsal inside kick skill in a similar way. The graph shown in the Figure 2, represents the average scores of training groups in futsal inside kick skills in different stages.

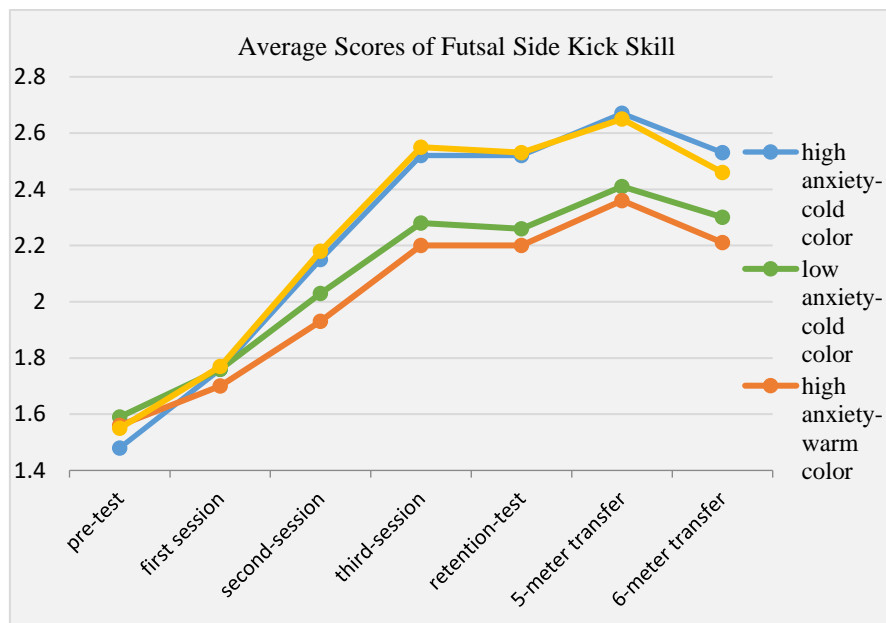


Figure 2. The average scores of training groups in futsal inside kick skills in different stages

Also, the results of the two-way variance analysis test in the retention and transfer tests showed that the main effect of the color of the tool in the retention tests ($F=0.101$, $P<0.752$), the 5 m transfer with the spectator ($F=0.584$, $P<0.448$) and the 6 m transfer with spectators ($F=2.248$, $P<0.139$) were not significant. Also, the main effect of trait anxiety in retention ($F=0.101$, $P<0.752$) and trait anxiety in the 5 m transfer with the spectator ($F=0.084$, $P<0.773$) and trait anxiety in the 6 m transfer with the spectator ($F=0.036$, $P<0.850$) were not significant. In other words, there is no significant difference between the warm and cool color groups and the high trait anxiety and low trait anxiety groups in the retention and transfer stages.

The effect of the interaction of the color of the tool with the trait anxiety of the learners in learning futsal inside kick skill showed a significant difference in the acquisition stage ($F=2288.244$, $P<0.001$) and the interaction of color and anxiety ($F=5.100$, $P<0.028$) and the interaction of acquisition sessions, color, and anxiety ($F=93.574$, $P<0.001$). Also, the results of the two-way variance analysis test in the retention and transfer tests showed that the main effect of the color of the tool in the retention tests ($F=32.191$, $P<0.001$), the 5 m transfer with the spectator ($F=29.457$, $P<0.001$) and the 6 m transfer with spectators ($F=19.667$, $P<0.001$) were significant. In retention and transfer tests, people with low trait anxiety in warm colors and people with high trait anxiety in cool

colors showed better learning in futsal inside kick skills. The graph shown in the Figure 3, represents the average scores of futsal inside kick skill in people with high

and low anxiety in cool and warm color groups in retention tests and the 5 m transfer and the 6 m transfer with the presence of spectators.

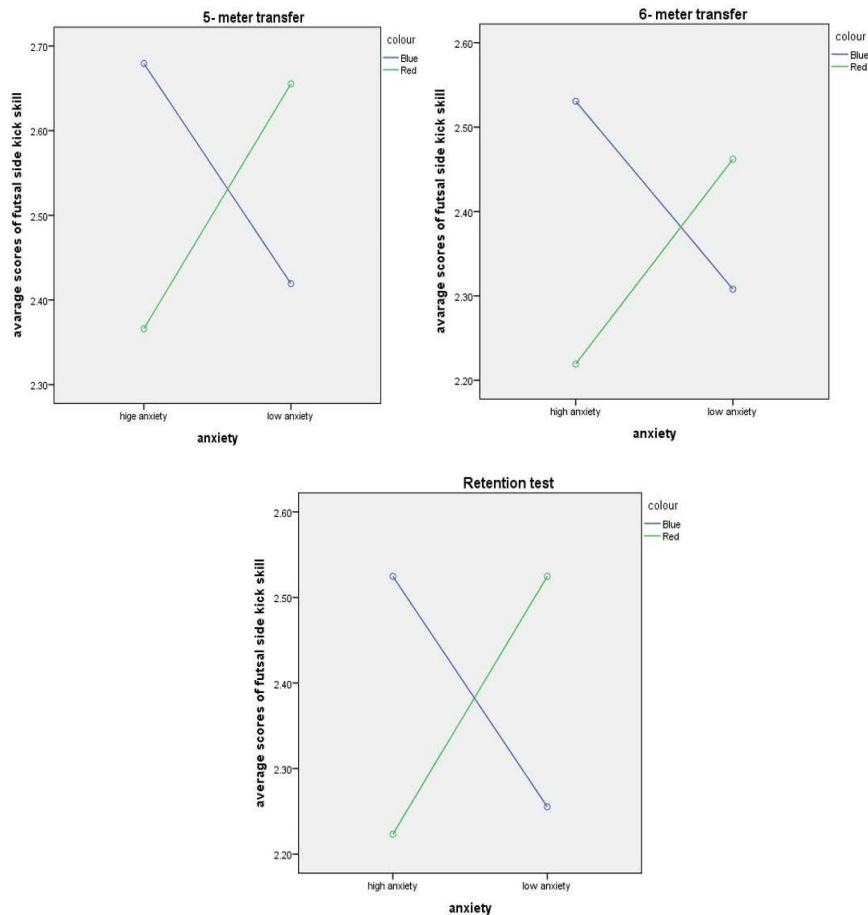


Figure 3. The average scores of futsal inside kick skill in people with high and low anxiety in cool and warm color groups in retention tests and the 5 m transfer and the 6 m transfer with the presence of spectators

4. Discussion

The purpose of this research was to investigate the interaction between the color of educational tools and warm and cool educational aids, and participants' trait anxiety, on futsal inside kick skills. The results showed that the main effects of color and anxiety were not significant, but the interaction effects of color and anxiety were significant. Previous studies have shown that the effect of color alone as a variable may not have an impact on learning. The results of studies on basic skills such as

manipulation skills [13] demonstrated no difference between groups in terms of the color variable, which is consistent with the present research.

The findings of the mentioned research also showed that the effect of training sessions is significant. This means that the use of warm, cool, neutral, and preferred colors in educational tools for training and games did not show a significant difference in the post-test stages and short- and long-term retention. Additionally, the findings of the present research showed that the main

effect of ball color on futsal shot function and retention is not significant. However, the results of [5, 7, 21] regarding the effect of color on learning are inconsistent with the findings of the main effect of color on learning futsal inside kick skills. It is important to note that in this research, only the color variable was investigated without interaction with other variables.

Based on the findings, there is no significant difference in the characteristics of anxiety as the main effect between groups with high and low anxiety in different stages. However, since these findings are reported in the interaction with color, they cannot be considered significant. In fact, the interactive effect yields more accurate results. Some researches [22, 23, 24] have also not reported the effect of anxiety as a separate variable on learning to be significant. Although in this research, the personality characteristic of people (trait anxiety) was not a factor affecting people's function without considering the color factor, many studies point to the fact that high trait anxiety can impact people's motor efficiency and function [25].

In the investigation of the interactive effect of the color with the trait anxiety, the results of a two-way variance analysis test with repeated measurements in the acquisition stage of the training sessions and the interactive effect of color and anxiety in the test stages were reported to be significant. In other words, there is a significant difference between the four research groups in the test stages. In subjects with high anxiety, the cool color group had better progress than the warm color group, and in low anxiety people, the warm color group had better progress than the cool color group. Also, the results of the two-way variance analysis test in retention

and transfer tests showed that the interactive effect of color and anxiety in retention and transfer tests is significant. In other words, in both the retention and transfer tests, subjects who had low trait anxiety in warm colors and subjects who had high trait anxiety in cool colors significantly showed more learning in futsal inside kick skills than other groups.

It seems the participants with high trait anxiety, after receiving the visual information and observing the cool color have reduced their anxiety and arousal, and it has been maintained at the optimal level, and this condition has created optimal learning. The participants with high trait anxiety in the other group, after receiving the visual information and observing the warm color, would have likely experienced more anxiety and arousal and had a lower performance than the cool color group. On the other hand, these conditions were different in participants with low trait anxiety. For these participants, more learning was created when the participants increased their anxiety and arousal (effect of warm color). While the participants with low trait anxiety in the other group, after receiving visual information and observing the cool color the anxiety, and arousal decreased in a way that probably caused a lack of motivation in the individual and reduced learning in this group compared to their corresponding group. The obtained results confirm with the results of previous studies. In previous studies, the efficiency of the therapeutic coloring method has been confirmed. Findings concluded that mandala coloring has significantly reduced anxiety in students [26].

Also, the arousal-function hypotheses (inverted-U and IZOF¹) to explain the interaction between trait anxiety and the

1. Individual Zone of Optimal Function

effect of cool and warm colors in retention and transfer tests [27]. These hypotheses suggest that optimal function occurs at an optimal level of arousal. Therefore, it is important to pay attention to the type of skill and individual characteristics of the learner. The participants of this research were divided into two groups with high and low trait anxiety. So, it seems logical that in order to creation or maintain an optimal level of arousal, the different solutions and methods have been taken. Probably, for participants with low trait anxiety who have low arousal in themselves, observing cool color will cause excessive reduction of arousal and departure from the IZOF, so that the learner loses the necessary motivation to improve his or her performance. However, observing warm colors by these subjects will probably increase the arousal of participants with low trait anxiety and place them in the IZOF, and as a result, it will cause them to learn better. But for the participants with high trait anxiety, the situation will be the opposite, so the observing cool color probably causes the arousal and high anxiety of these people to be reduced, and by entering the IZOF, they have better performance and thus more learning than the group with high trait anxiety who observed the warm color. These participants with high trait anxiety are likely to become more anxious and experience excessive arousal upon observing the warm color, and this condition probably causes the learner to leave the IZOF and, as a result, reduce performance and learning.

Encoding information in any learning process can be related to physical features (such as color, form, size, etc.) or semantic features (such as concept, categorization, and organization) [28]. It seems that the

signs used in this study, such as the colored path and the foot placement marker, help people to encode the input information in their memory and lead to better function in colored groups. It is also possible that the available signs may lead people to receive an accurate meaning from the instructor. According to perceptual learning, perceptual information is likely to be encoded nonverbally, and the acquired information is complex, nonverbal, or learned under high workload. Therefore, it seems that signs reduced the verbal information load and made it easier for participants to remember other instructions [14, 15].

5. Conclusions

The findings showed that the color of the educational tool and educational aid interacts with the trait anxiety of learners in learning futsal inside kick skills. Accordingly, in the present research, when the participant was placed in an environment suitable to his personality characteristics, the level of challenge created for the participant was optimal, and optimal conditions were provided for skill acquisition and especially learning. These results showed that when learning futsal inside kick skills, it is necessary to pay attention to the anxiety level of learners to achieve better results.

Conflict of interest

The authors declared no conflicts of interest.

Authors' contributions

All authors contributed to the original idea, study design.

Ethical considerations

The authors have completely considered ethical issues, including informed consent,

plagiarism, data fabrication, misconduct, and/or falsification, double publication and/or redundancy, submission, etc.

The present study was conducted following ethical principles. The Ethics Committee of Hakim Sabzevari University also approved the conduct of this research from an ethical point of view (IR.HSU.REC.1402.007).

Data availability

The dataset generated and analyzed during the current study is available from the corresponding author on reasonable request.

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