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The Effect of Plickers Implementation on 6th Grade Students' Locus of Control (LoC) and Misconceptions

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Abstract

The purpose of this survey is to define the effect of Plickers implementation applied in science lessons on students' locus of control (LoC) and misconceptions. The experimental design was determined as the single-group pre-test and post-test. Fifty-one students studying in the 6th grade participated in the survey. The Nowicki-Strickland Locus of Control Scale (LoC) for Children and the word association test (WAT) is utilized to identify misconceptions at the beginning and end of the lesson. As a result, it was observed that some of the misconceptions of the students changed after the Plickers implementation, but some of the misconceptions did not change. However, after Plickers, it was defined that the LoC points of girls decreased, and the points of boys increased. When the students were examined in general, it was defined that the post-test points they got from the scale were lower than the pre-test points. Although this result does not show any distinction, it is an indication that students' LoC levels are visibly inclined towards inner LoC. In the results of the survey, it can be suggested that the Plickers implementation be used actively in eliminating students' misconceptions and developing their LoC.

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Introduction

Problem-solving and scientific process skills in science provide many benefits to students when faced with a new situation. In addition, science courses provide students with science literacy, mental and hand skills and

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form the basis of vocational education in the fields of science or technology. The teacher's content knowledge and professional formation are important elements that make up an effective science lesson. The science teacher should be a helper who reveals the essence of the students, explains the love of nature and the environment to individuals, follows and maintains scientific developments, does not make mistakes in basic concepts, principles, and generalizations, encourages learning, and always continues to learn (Kaptan & Korkmaz, 1999). Science course is based on observation, learning, and teaching processes. Due to the processes which it contains, this course supports the freedom of the student with activities and experiments. Everyone's actions of understanding, observing, analyzing, and making inferences are distinct from each other, and this creates individual distinctions among students. It is obvious that there are individual distinctions in learning environments and in the process of each lesson. While individual distinctions do not make a lesson inaccessible or incomprehensible, it ensures that the lesson is effective and productive (Yesilyaprak, 2017).

One of the distinctions in individuals, which makes the course meaningful and effective for the student, and influences the academic success of the student, is the LoC. LoC can be explained as individuals assuming the consequences and responsibilities of their own choices or as the realization of choices and events independently of individuals (internally and externally). The place where the forces determining rewards and punishments are concentrated is called the LoC. Individuals develop an outer or inner personality structure according to the situations they are connected to. Individuals who attribute responsibility to the events that happen to them, while individuals who take responsibility for the consequences of events and behavior develop an "inner" personality structure (Rotter, 1966).

According to the results of the research (Carton & Nowicki, 1994; Joe, 1971; Jonassen & Grabowski, 1993; Lefcourt, 1982; Mountain, 1992; Phares, 1976; Rouse & Cashin, 2000; Yuksel, 1991), individuals with inner LoC, intellectual and academic achievement in high awareness of the high social events, resistant against negative influences safe, effective, and independent with respect to the concept of self, capable of taking responsibility, enterprise, entrepreneur, and individuals are emotionally healthier; individuals with an outer focus of control, further, are passive, practical, skeptical and dogmatic individuals with a low level of competence, high depressive characteristics, low level of self-esteem.

When the meta-analytical studies are examined (Cassidiy & Eachus, 2000; Kalechstein & Nowicki, 1997; Nunn & Nunn, 1993), it is determined that there is a critical and high affair among LoC and academic accomplishment. While there is a positive and high correlation between inner control and academic achievement, there is a negatory and high relation between outer control and academic achievement. Age and puberty were the determining factors among these two factors. For example, the relationship between LoC and school performance in primary and university years is higher and more crucial than in secondary education.

When it comes to academic success, teachers have important responsibilities to students in terms of developing inner control in education (Yesilyaprak, 2017). Therefore, it is necessary for teachers to make practices for students to be internally controlled in lessons.

When the literature is examined, the subject of LoC; controlling epistemological beliefs, burnout in primary school teachers, the aggression of students in secondary education institutions, problem-solving perceptions of primary school students, job satisfaction and burnout of guidance and psychological counselors, occupational saturation levels of senior high school students, and stress levels of university students were discussed together (Akbag, Sayiner & Sozen, 2005; Deryakulu, 2002; Efilti, 2006; Kulaksizoglu & Cakar, 1997; Serin & Derin, 2008; Tumkaya, 2000; Uslu, 1999).

When the studies are examined, there is only one study (Mertoglu & Kacar, 2017) in which the portfolio and LoC are studies collectively as a measurement and evaluation implementation, and another study (Mertoglu & Babayigit, 2018) in which the impact of the Plickers implementation on the motivation of middle school students for learning science. However, no study was found in which Plickers measurement and evaluation implementation, and LoC were studied collectively. In this study, it is estimated that the word association test given before the lesson and the measurements and evaluations made after it can change the students' LoC. In this context, the effect of Plickers implementation on 6th grade students' LoC and misconceptions was investigated in this survey.

The problem of this research was defined as follows:

- What are the students' misconceptions about force and motion in the 6th grade science course?
- How does the Plickers implementation in the 6th grade science lesson affect students' misconceptions about force and motion?
- After the Plickers implementation in the 6th grade science lesson, is there a crucial distinction among the pre-test and post-test LoC points of the students?
- After the Plickers implementation in the 6th grade science lesson, is there a crucial distinction between the gender of the students and their LoC?

Method

Research Design

The design of this survey was determined as a quasi-experimental single-group of the quantitative survey methods. The quantitative survey is a kind of survey that presents facts and incidents in an objective,

observable, measurable, and quantifiable way (Fraenkel & Wallen, 2009) in the pre-test / post-test model with the experimental group. Before the experiment, the study group is given a pre-test, and after the implementation, the group is given a post-test. The same measurement tools are used in the pre-test and post-test. If it is detected that there is a crucial distinction between the post-test and the pre-test, it is accepted that this distinction arises from the implementation (Basturk, 2009). In this survey, a quasi-experimental single group model is utilized since it was aimed to examine the effects of Plickers implementation and word association test on 6th grade students' LoC and misconceptions.

Study Group

The study group of the survey is formed of 51 students being educated in the 6th grade in a public school in Zonguldak in the 2021-2022 academic year.

Data Collection Tools

The data collection tools of the survey, the Word Association Test (WAT), and the Nowicki-Strickland LoC Scale for Children were utilized.

Nowicki-Strickland LoC Scale for Children

In this study, the Nowicki-Strickland LoC Scale for Children was enforced on the students as a pre-test and post-test. The scale is formed 40 items. The scale was created in a 2-point Likert type (Yes and No). It can be obtained from a scale between 0 and 40 points. A high score specified a high outer LoC in the individual (Nowicki & Strickland, 1973). In the study conducted by Yesilyaprak (1988), the reliability coefficient was found to be .81. This value is close to the value found in the survey, so it makes the study meaningful. In this survey, Cronbach's alpha value was determined as .74.

Word Association Test (WAT)

In this research, WAT was utilized to detect the misconceptions of the students about force and motion and the words that came to life in their minds. Before the unit was taught, the concepts of "force", "speed" and "balanced force" were given to the students in the WAT. For each concept, they were appealed to write 5 distinct words that came to life in their minds. After writing the words, they were asked to write a meaningful sentence about a given concept related to science. 1 point is given for each correct word given, and 2 points are given for each correct sentence. Words not related to the concept were not scored. Misconceptions that emerged

within the sentences were noted separately and were not included in the scoring. Before the post-test, the same WAT was presented to the students and scored by the researcher.

Plickers

Plickers assessment and evaluation implementation is an evaluation method presented to students in an interactive way. The questions prepared by the researcher are reflected on the smart board in the classrooms. Creating the code system for students, Plickers prepares a card for each student. These cards are printed out and distributed to the students. A, B, C, and D options are given to each corner of the figure on the card (Figure 1). According to the question reflected on the board, the students turned the card in the way he/she wanted. Thanks to the Plickers implementation on the phone, the teacher reads the answer, and the choice is reflected on the blackboard correctly or incorrectly. The evaluation is completed by answering the questions in this way (Plickers, 2021).

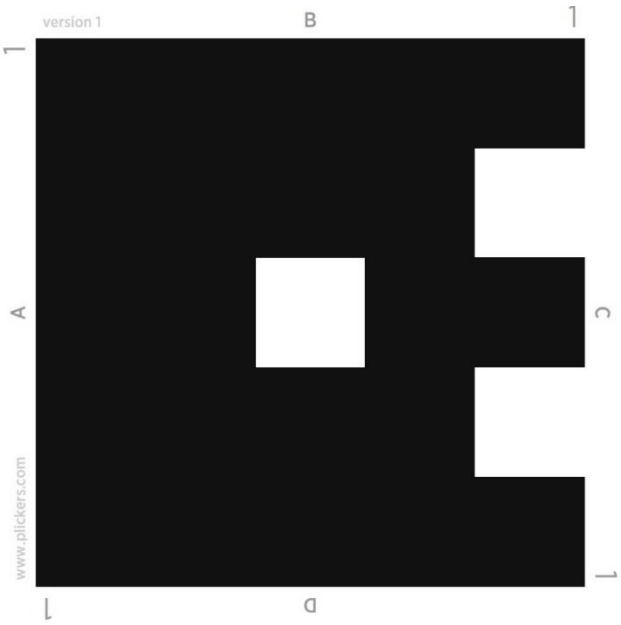

Figure 1. An example of Plickers cards (Plickers, 2021)

Data Analysis

The quantitative data of the survey were analyzed in the SPSS Package Program. The level of importance in the study was determined as 0.05. Since the study group consisted of 51 people, Kolmogorov-Smirnov values were checked in the normality test. It was defined that the variances in the data were normally distributed ($p>.05$). For this reason, the dependent samples t-test, which is a parametric test, was utilized in the pretest-posttest search of the data, and independent samples t-test was used to examine the distinction among pre-test and post-test points and gender. Content analysis was utilized for qualitative data in the survey. Content analysis

is used to interpret content from text data. Content analysis can be divided into three groups: traditional, directed, and summative. In this study, a summative content analysis was managed. Summative content analysis usually includes calculation and equating keywords or contents and then evaluating the elemental context (Hsieh & Shannon, 2005).

Procedure

The Nowicki-Strickland LoC Scale for Children was applied as a pre-test to the study group, which was the participant of the research. Then, WAT was given on force and motion. In the word association test, there are 3 concepts related to the subject in total. Students are asked to write a total of 15 words corresponding to 3 concepts. However, at the end of the concepts, they are expected to write a sentence about the concepts. After the pre-tests were applied, the unit of force and motion was taught by the teacher of the course. In the word association test, Plickers questions were prepared according to the answers given by the students and the sentences they wrote. At the end of the unit, the Plickers assessment and evaluation implementation was applied to the students in the classroom environment. After the Plickers implementation, the WAT was presented to the students again. After the word association test, the LoC scale, which was given as a pre-test, was enforced to the students once again as a post-test. After the LoC scale is done by the students, the implementation ends.

Results

Findings for WAT

In the study, WAT was given to the students before and after the Plickers implementation. The total point of the students from the test was calculated, and their misconceptions were stated below.

Table 1. Points from the WAT

Students	Pre-test's total point	Post-test's total point
51	446	492

When Table 1 was investigated, it was determined that the students got 446 points on the pre-test and 492 points on the post-test.

Table 2. Students Written Words for the Concepts

Concepts	Words Written in the Pre-test	Blanks in Pre-test	Words Written in the Post-test	Blanks in Post-test
Force	Newton, force, N, Dynamometer, power, resultant, resultant force, R, balanced, unbalanced, car, clock, forceful, standing, strong	57	Resultant force, standing clock, moving car, force, Newton, N, dynamometer, strong man, power, unbalanced force, balanced force, unbalanced, balanced	46
Speed	Velocity, car, fast car, km/s, meter, kilometer, hour, second, truck, stationary car, fast car, power, energy, road, distance	38	Fast, lorry, truck, m/s, I'm fast, balanced force, unbalanced force, constant speed, balanced force	39
Balanced Force	Stationary car, stationary clock, stationary house, classroom, desk, board, stationary, resultant force, force	27	Clock on the wall, stationary car, stationary desk, constant speed, constant velocity, stationary, little moving, not moving, standing flower, stopped thing	3

According to the results of the WAT, it was determined that the words noted by the students in the post-test were more accurate and meaningful. It was determined that there was a total of 112 blank expressions in the pre-test, and a total of 88 blank expressions in the post-test. In particular, the reduction in the number of blanks by the students in the post-test shows that the Plickers implementation is instructive. It is noteworthy that the students used to expression "constant velocity" against the concept of "balanced force" in the post-test.

Table 3. Students' Misconceptions in Pre-Test and Post-Test WAT

Pre-test WAT Misconceptions	**f**
Speed is the velocity of an object.	3
Forces are divided into two (resultant force and force).	1
Speeds are divided into two (total distance and minute).	1
Speed is the acceleration of an object over time.	1
When a force is applied to an object, it causes its motion.	1
If the brake is applied, there will be a balanced force.	1
It is divided into two as balanced clock and unbalanced car.	1
The resultant force is an example of speed.	1
We measure the weight of the force with a dynamometer.	1
A car that exceeds its speed is fast.	1
Speed is used in ms/km.	1
A balanced force is that which does not move.	1
The balanced forces always remain the same.	1
Balanced force is to equalize and balance the directions of an object.	1
A balanced force is called a stationary object.	1
Balanced force is moving at an equal.	1
Force is the unit of Newton.	1
There are 42 empty sentences in total.	
Post-test WAT Misconceptions	**f**
Speed is the velocity of an object. (Repeat)	1
If we weigh something and it's equal, it's a balanced force.	1
A car that exceeds is speed is fast. (Repeat)	1
Speed indicates the distance travelled at any given time.	1
Balanced force is the movement of an object at a certain velocity without both accelerating and decelerating.	1
Force is applied in a particular direction or directions.	1
A balanced force is an equal amount of applied force and equality.	1
We measure the weight of the force with a dynamometer. (Repeat)	1
Speed is balanced velocity.	1
If the brake is applied, there will be a balanced force. (Repeat)	1
There are 27 empty sentences in total.	

When the misconceptions table above is examined, the statement "speed is the velocity of an object" in the WAT pre-test and post-test attracts attention. In the post-test, it was defined that the number of empty sentences of the students decreased. This is a positive result for research. However, it is detected that some misconceptions are still repeated in the post-test.

When the table was examined, it was defined that the misconceptions of the students emerged from the confused concepts (Balanced force – constant velocity, force – Newton, balanced force – stopping, force – weight).

Findings for Locus of Control (LoC) Scale

In the study, LoC scale was given to the students before and after the Plickers implementation. The points obtained from the scale were analyzed with the dependent and independent samples t-test.

Table 4. Diagnostic Table for LoC Scale Pre-test and Post-test Points

	N	Total Point	Mean
Pre-test	51	703,00	13,78
Post-test	51	671,00	13,15

According to Table 4, there is a distinction between the pre-test and post-test total points of the students. In accordance with the table, the students got low points on the LoC Scale after the Plickers implementation. This is an indication that students' inner LoC has increased.

Table 5. Dependent Samples t-test Results of LoC Points

	N	Mean	Std.	df	t	p
Pre-test	51	13,78	5,05	50	.882	.382
Post-test	51	13,15	6,30			

It is detected that there is no crucial distinction between the pre-test LoC and post-test LoC of the students. This result is an indication that Plickers implementation did not make a change in students' LoC.

Table 6. Independent Samples t-test Results

	Gender	N	Mean	Std.	df	t	p
Pre-test	Female	25	13,72	5,63	50	.088	.930
	Male	26	13,84	4,53			
Post-test	Female	25	11,92	5,11	50	1.38	.172
	Male	26	14,34	7,16			

There was no crucial distinction among the pre-test and post-test LoC points before the implementation of Plickers and the gender of the colleague.

When Table 6 is investigated, it is detected that the sum of the post-test points of the female students is lower than the sum of the pre-test points, and the sum of the post-test points of the male students is higher than the sum of the pre-test points. This finding shows that the Plickers implementation caused a desired decrease in female students' LoC points, especially since their inner LoC levels increased. However, it was detected that male students' outer LoC increased after the implementation of Plickers, unlike female students.

Discussion and Conclusion

Plickers implementation in the literature (Civitci, 2007; Korkmaz, Vergili, Cakır & Ugur Erdogmus, 2019; Mertoglu & Babayigit, 2018; Mshayisa, 2020; Serin & Derin, 2008; Wiyaka & Praskawayi, 2021) and, WAT on Force and Motion (Balbag, 2018; Sadoglu & Durukan, 2018) there is an insufficient number of studies.

In this study, Plickers implementation did not make a crucial distinction in students' LoC. Similarly, in a study conducted by Korkmaz et al. (2019), it was found that the Plickers implementation did not make a crucial distinction in students' test anxiety. There is a short period of time between the pre-test and the post-test. This may be an indication that students' LoC will not change in a short duration of time.

In the pre-test conducted before the Plickers implementation, the points of the students in the WAT were lower than in the post-test. After the Plickers implementation, the students were able to associate the correct words and reduce the number of blank words. In addition, the misconceptions of the students visibly decreased after the Plickers implementation. Similarly, in studies conducted by Mshayisa (2020), Wiyaka & Praskawati (2021), and Mertoglu & Babayigit (2018), it was defined that Plickers implementation had a positive influence on students' participation in the lesson, their motivation towards science and their learning. The Plickers implementation had a positive effect on correcting students' misconceptions and associating the correct words related to the topic.

In this study, the misconception that "speed and velocity are the same concept" for some of the students in both the pre-test and the post-test was included in the answer sheets. Similarly, there are misconceptions about "speed, and velocity are the same concept" and "speed is almost the same term as velocity" used in a study by Sadoglu & Durukan (2018) and Balbag (2018). Students' learning environments are often informal outside of school. They may have witnessed that the concepts of speed and velocity are used for the same meaning by other individuals in the society, and they may have experienced learning in this way. Because, in terms of physics, there are only displacement and distance distinctions between speed and velocity. However, the concept of travel and displacement in real life is not known to most individuals.

In all tests, it was determined that the outer LoC of female students was lower than male students. Similarly, in the research managed by Civitci (2007) and Serin & Derin (2008), it was defined that male students' outer LoC was higher than that of female students. Men associate their lives with fate, God, destiny, or fortune, while girls are aware that they can direct their own lives.

Recommendation

In this study, although the Plickers implementation did not make a crucial distinction, it can be said that female students increased their inner LoC, while male students increased their outer LoC according to the post-test performed after the implementation. Depending on the results, it can be proposed that teacher candidates should actively use the Plickers implementation, which is an alternative assessment and evaluation method, in their science lessons. When all tests are examined together, it is detected that some misconceptions have not changed. Based on this result, other teaching methods and techniques can be suggested for teachers and teacher candidates (ex., conceptual change texts) to correct misconceptions. This research was conducted with 6th grade students. However, the LoC of students at distinct levels can be measured based on distinct measurement and evaluation tools. This study, which is carried out in parallel with the science, force, and motion unit, can be examined in other courses and subjects.

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