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The Effect of Common Knowledge Construction Model-based Teaching on the Cognitive and Psychomotor Learning of 7th Grade Students

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ABSTRACT This study aimed to investigate the effect of science teaching, based on the Common Knowledge Construction Model (CKCM), on cognitive and psychomotor learning in 7th-grade students. The study group consisted of 29 students from two public schools affiliated with the Ministry of National Education in the 2018-2019 academic year. The study was carried out following a semi-experimental pre-test post-test control group research design. The data were collected with a "*Scientific Inquiry Skills Test,*" and a "*Psychomotor Skills Rubric*" (PSR) developed by the researchers. The PSR was used to evaluate the practice exam results of both groups. Data were analyzed with a standard statistics package. It was determined that the scientific inquiry skills post-test scores of the experimental group (X=15.87) were higher than the control group (X=10.92). The difference was observed to be significant. Also, a comparison of the total post-test PSR scores showed a statistically significant difference between the experimental (X=15.44) and control groups (X=13.30).

Keywords Common Knowledge Construction Model, Force and Energy Unit, Psychomotor Skills, Scientific Inquiry Skills

1. INTRODUCTION

Today's societies aim to raise science literacy individuals through science education of students. Science literacy individual is not only in cognitive and affective domains; it can also be defined as the person who is expected to develop himself in the psychomotor domain (MONE, 2018). Therefore, to raise science-literate individuals through science education, it can be said that there is a need for approaches and models that allow developing themselves in cognitive, affective, and psychomotor domains of students. One of these models is the "*Common Knowledge Construction Model (CKCM)*"(Demircioğlu & Vural, 2016).

Ebenezer and Connor developed the Common Knowledge Construction Model (CKCM), a philosophically meaningful teaching model in 1998. Phenomenography constitutes the philosophical and theoretical foundations of the Common Knowledge Construction Model. However, CKCM's learning strategies and materials are designed by Piaget's conceptual change theory. CKCM, a philosophically cognitive teaching model, aims to create beliefs about the universe by realizing personal and social interaction between the student's natural phenomenon (Bakırcı & Çepni, 2012; Biernacka, 2006). The Common Knowledge Construction Model has four interconnected phases. These phases are: "*Exploring and Categorizing*", "*Constructing and Negotiating*", "*Translating and Extending*", and "*Reflecting and Assessing*". This model is thought that every step of the standard knowledge construction model will enable students to acquire sophisticated skills and simultaneously realize students' cognitive, affective, and psychomotor learning. Therefore, it can be said that revealing the effect of the model on students' psychomotor skills in this study is to bring novelty to the model. One of the crucial points in the science course teaching program is to gain students' scientific inquiry skills. Scientific inquiry skills, which are within 21st-century skills, are taking among the features that science literacy individuals should have, and it plays an essential role in the training of qualified individuals. Scientific inquiry is expressed as a way of thinking in producing scientific knowledge of a scientist. At the same time, scientific inquiry is the inquiry realized by the scientist in this process. The scientist also realizes their inquiries in line with scientific process skills. Therefore, the inquiry

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skills that the student should have are the inquiry skills of a scientist, namely, scientific processes in classical meaning (Harlen, 2014). Wenning (2007) defined scientific inquiry skills as a component of scientific literacy and stated that the skills consist of nine stages. These skills are defined by Wenning (2007) as follows: "*Identify a problem to be investigated; Using induction, formulate a hypothesis or model incorporating logic and evidence; Using deduction, generate a prediction from the hypothesis or model; Design experimental procedures to test the prediction; Conduct a scientific experiment, observation or simulation to test the hypothesis or model; Collect meaningful data, organize, and analyze data accurately and precisely; Apply numerical and statistical methods to numerical data to reach and support conclusions; Explain any unexpected results; Using available technology, report, display, and defend the results of an investigation to audiences that might include professionals and technical expert*".

When the science course teaching program is examined, scientific process skills expected to be gained by the students in the program include skills such as "Observing, Measuring, Classifying, Saving Data, Establishing Hypothesis, Using Data and Modeling, Changing and Controlling Variables, Experimenting" that scientists exhibit during their studies. Therefore, students are expected to acquire scientific inquiry skills through science teaching. Benli Özdemir (2014) stated that CKCM was influential in developing students' scientific inquiry skills. In this context, science teaching based on CKCM can help students gain and develop their scientific inquiry skills.

Another critical point in the science course teaching program is developing the students' psychomotor skills and their cognitive and affective learning. The psychomotor domain is a field where skills requiring mind and muscle cooperation are dominant. This domain keeps physical skills in the foreground (Demirel, 2003). In the process of psychomotor behavior, the individual realizes behaviors using his muscles and one, several, or all of his body organs. In every behavior, cognitive and affective domain competencies also affect. Therefore, the psychomotor domain is intertwined with other domains (Sönmez, 1997; Sözer, 2003). The psychomotor domain was classified by Sönmez (2017) in five steps as "*Excitement*", "*Making Manuel Control*", "*Skill*", "*Fitting situation*" and "*Creating*". considering the necessity of actively using students' psychomotor skills during the application process of CKCM, it can be said that science teaching based on CKCM can be useful in gaining the psychomotor domain skills of students. Also, it can be said that examining the effect of science teaching based on CKCM on the development of psychomotor skills of students will make an essential contribution in filling the gap in the literature.

When the literature on CKCM is examined, it is seen that there are a limited number of studies investigating the effectiveness of this model in terms of different variables. In these studies, it was concluded that the CKCM has positive effects on students' academic achievement (Akgün, Duruk, & Gülmez-Güngörmez, 2016; Bakırcı, 2014; Bakırcı & Ensari, 2018; Bakırcı, Çepni, & Yıldız, 2015; Bayar, 2019; Benli Özdemir, 2014; Caymaz & Aydın, 2019a; Ebenezer, Chacko, Kaya, Koya, & Ebenezer, 2010; Ertuğrul, 2015; İyibil, 2011; Taşkın & Yıldız, 2011; Wood, 2012; Vural, Demircioğlu, & Demircioğlu, 2012; Yıldızbaş, 2017; Sütlüoğlu Dursun, 2019; Atayeter, 2019), Awareness of STSE (Biernacka, 2006), Attitude towards science (Akgün, Duruk, & Gülmez-Güngörmez, 2016; Benli Özdemir, 2014; Ebenzer, Chacko, & Immanuel, 2004; Atayeter, 2019), Attitudes towards chemistry (Demircioğlu & Vural, 2016), conceptual change and understanding levels (Bakırcı, 2014; Bakırcı, Artun, & Şenel, 2016; Bakırcı & Yıldırım, 2017; Bakırcı & Ensari, 2018; Bakırcı, Artun, Kırıcı & Mutlu, 2018; Benli Özdemir, 2014; Caymaz & Aydın, 2019b; Ebenezer, Chacko, Kaya, Koya, & Ebenezer, 2010; Ertuğrul, 2015; İyibil, 2011; Kıryak, 2013; Wood, 2012; Vural, Demircioğlu, & Demircioğlu, 2012; Yıldızbaş, 2017), entrepreneurship skills (Yıldırım & Bakırcı, 2019), Science Process Skills (Bayar, 2019) and their views on the nature of science (Bakırcı, 2014; Bakırcı & Çiçek, 2017; Benli Özdemir, 2014; Çavuş Güngören, 2015; Ertuğrul, 2015; Uzunkaya, 2019; Yıldırım, 2018; Yıldızbaş, 2017). However, more studies are needed to see the effect of the model on the mentioned variables and other variables (scientific inquiry skills etc.) more clearly. At the same time, when the studies conducted were examined, it was not coincided a study investigating the effect of the common knowledge construction model in the teaching of the "*Force and Energy*" unit. Besides, in studies are seen that the effect of the model on the cognitive and affective learning of the students is investigated. In this research, in addition to cognitive and affective learning domains; it was aimed to examine the psychomotor learning domain of students. Therefore, it could be said that this research will contribute greatly to science teaching literature and fill a gap in the literature.

This study aimed to investigate the effect of science teaching based on the Common Knowledge Construction Model (CKCM) on the cognitive and psychomotor learning of 7th-grade students. For this purpose, answers were sought for the following sub-problems: Is there a statistically significant difference between the pre-test and post-test scientific inquiry skills of the experimental and control group students?. Is there a statistically significant difference between the post-test psychomotor skills of the experimental and control group students?

2. METHOD

2.1 Research Design

The research was carried out using a semi-experimental design with a pre-test-post-test control group, one of the experimental research methods (Karasar, 2010). The experimental design was a pattern used to test cause-effect relationships between dependent and independent

Table 1 Distribution of the students in the study group by gender

Groups	Female		Male		Total	
	N	%	N	%	N	%
Experimental Group	9	56.0	7	44.0	16	100
Control Group	6	46.0	7	54.0	13	100
Total	15	52.0	14	48.0	29	100

variables (Cohen & Manion, 1997; Fraenkel & Wallen, 1996; Gay, 1996). A semi-experimental design with a pre-test-post-test control group was defined as a two-factor experimental. While the first of these factors is repeated measurements (pre-test and post-test); the other factor refers to the subjects (experiment and control group) in different categories (Büyüköztürk, 2011).

2.2 Participants

The study group of the research consisted of students studying in the 7th grade of two public schools affiliated to the Ministry of Education in the central district of Afyonkarahisar province in the 2018-2019 academic years. Since there is a 7th-grade branch in both schools; One of the schools was determined as the experimental group (N = 16) and the other as the control group (N = 13). In this determination process, the selection of the experimental and control groups was carried out by random assignment. In the selection of the stated schools, the criteria that the researcher is in the schools he is working in and the researcher can conduct his study comfortably have been taken into consideration (Yıldırım & Şimşek, 2011). The distribution of students in the study group by gender is given in Table 1. When Table 1 is examined, 56 % of the experimental group students participating in the research are female, and 44 % are male students; 46 % of the control group students are female, and 54 % are male students.

2.3 Data Collection Tools

In the research, quantitative data were collected with the "*Scientific Inquiry Skills Test*" and "*Psychomotor Skills Rubric*". Moreover, the qualitative data, on the other hand, was obtained through video recordings in the classroom and practice exam process. Before the study, necessary permissions were obtained from Afyonkarahisar Provincial Directorate of National Education to practice in secondary schools in the central district. A report that the study has ethical principles were received from the Aydın Adnan Menderes University Education Research Ethics Committee on 04/09/2018.

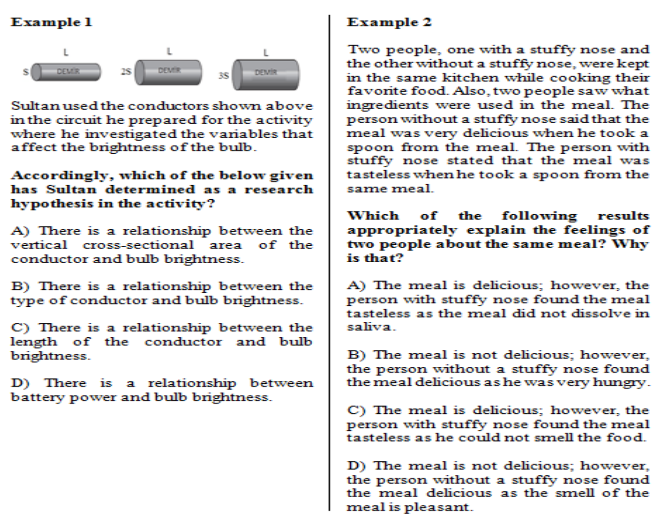
2.4 Scientific Inquiry Skills Test

The Scientific Inquiry Skills Test (SIST) developed by the researchers was used to determine the experimental and control group students' scientific inquiry skills. SIST that consists of 22 items, is a multiple-choice test that measures the skills that arise by matching the scientific process skills based on the science course teaching program (2017) with the inquiry skills put forward by Wenning (2007). Two examples of questions in the test are seen in Figure 1.

The content and construct validity of the test were provided with an indicator table and expert opinion. Kuder Richardson-20 (KR-20) reliability method was used for the reliability of the test. The fact that the KR-20 reliability coefficient of the test has been determined as .82 can be considered as an indicator that the measurement tool is reliable (Büyüköztürk, 2011).

2.5 Psychomotor Skills Rubric (PSR)

In order to determine the status of the experimental and control group students to display the psychomotor domain steps, the "*Psychomotor Skills Rubric (PSR)*" developed by the researchers based on the classification of the psychomotor domain steps of Sönmez (2017) was used in the evaluation of the practice exam conducted at the end of the application to both groups. The PSR, which consists of five steps, was prepared by taking into account the skills that can be revealed in gaining acquires related to the psychomotor domain from acquires within the content of the Force and Energy unit. The third step of the rubric, which is the step of "*Preparing the Experiment Setup under the Supervision of the Teachers*", was removed from the rubric since the students performed it during the application process. Because during the implementation process, students carried out activities by actively working under the guidance of teachers in the "*Configuration and Negotiation*" phase, which is the second phase of CKCM. Therefore, it was thought by the researchers at this stage that the students gained the skill of "*Preparing the Experiment Setup under the Supervision of the Teachers,*" and it was decided to remove this step from the rubric. While rating the behaviors in the steps of the rubric was used evaluation in terms of the process, and the behaviors were rated as "Observed (G) (3)", "Partially Observed (K) (2)" and "Not observed (GM) (1)". For the validity and reliability study of the psychomotor skills rubric developed by the researcher, two science education experts and one education program



Example 1

Sultan used the conductors shown above in the circuit he prepared for the activity where he investigated the variables that affect the brightness of the bulb.

Accordingly, which of the below given has Sultan determined as a research hypothesis in the activity?

A) There is a relationship between the vertical cross-sectional area of the conductor and bulb brightness.

B) There is a relationship between the type of conductor and bulb brightness.

C) There is a relationship between the length of the conductor and bulb brightness.

D) There is a relationship between battery power and bulb brightness.

Example 2

Two people, one with a stuffy nose and the other without a stuffy nose, were kept in the same kitchen while cooking their favorite food. Also, two people saw what ingredients were used in the meal. The person without a stuffy nose said that the meal was very delicious when he took a spoon from the meal. The person with stuffy nose stated that the meal was tasteless when he took a spoon from the same meal.

Which of the following results appropriately explain the feelings of two people about the same meal? Why is that?

A) The meal is delicious; however, the person with stuffy nose found the meal tasteless as the meal did not dissolve in saliva.

B) The meal is not delicious; however, the person without a stuffy nose found the meal delicious as he was very hungry.

C) The meal is delicious; however, the person with stuffy nose found the meal tasteless as he could not smell the food.

D) The meal is not delicious; however, the person without a stuffy nose found the meal delicious as the smell of the meal is pleasant.

Figure 1 Two examples of questions in the SIST

Table 2 Practice exam activities performed in experimental and control groups

Activities
1. Let's Measure Weight
2. Does Kinetic Energy Depend on Mass?
3. Does Kinetic Energy Depend on speed?
4. Does Gravity Potential Energy Depend on Mass?
5. Does Gravity Potential Energy Depend on Height?
6. Friction Force and Kinetic Energy

and teaching expert opinion were consulted. "*Psychomotor Skills Rubric*" used in the research is given in Appendix 1.

2.6 Practice Exam

In the research, it is quite challenging to determine using paper-pencil test the gains specific to the psychomotor domain from the "*Force and Energy*" unit acquisitions. For this reason, both students in the experimental and control groups were carried out a practice exam by the researcher at the end of the application process. However, since the students in both groups did not know the concepts related to the "*Force and Energy*" unit, the practice exam was not performed as a pre-test. The steps followed related to how the practice exam was carried out are given respectively below:

1. Firstly, the psychomotor domain steps and their properties were examined in detail by the researcher.
2. From the gains within the content of the Force and Energy unit, the gains related to the psychomotor domain have been determined.
3. Six of the everyday activities carried out in both the experimental and control groups were selected, taking into account the psychomotor domain gains within the Force and Energy unit's content. The selected activities are presented in Table 2
4. Firstly, students in both experimental and control groups randomly have chosen one of the activities given in Table 2, which was placed in a bag.
5. The students have filled the activity form given to them by the researcher according to the experiment they chose within 15 minutes. The student who completed the activity form was taken into a class with many activity tools, considering what they wrote in the activity form, and they were expected to select the appropriate tools necessary for their activity. Finally, the student who chose the necessary equipment for the activity was asked to perform the activity. In realizing the activity, the researcher was in the position of a guide with questions to the student. In the process of realizing the activity, the researcher has included in the guide position his questions to the student. Besides, while the researcher helps students remember the tools and equipment they forgot during the activity, he has allowed students to get equipment if they remembered the equipment they forgot.
6. The student's application exam process was recorded on the video in line with the required permissions. The video recordings, the activity form filled out by the student, and the researcher's observation notes were examined in detail at the end of the practice exam and were evaluated students according to the psychomotor skills rubric.

2.7 Experimental Process (Application Process)

The research was carried out in 7 weeks in total as a pre-test, application process, and post-test in November and December of 2018. The application process was carried out in a total of five weeks in the experimental and control groups. While the teaching of the "*Force and Energy*" unit was carried out under the science course teaching program in the control group, it was carried out according to the experimental group's standard knowledge construction model. Also, while the activities used in the control group during the application process were the activities which are placed in the science textbook taught in schools affiliated with the Ministry of National Education; in the experimental group, activities and worksheets based on the standard knowledge construction model developed by the researcher were used. Student materials developed by the phases of CKCM were developed based on the issue of "*Mass and Weight*", "*Force, Work and Energy,*" and "*Energy Conversions*" within the content of the force and energy unit. Student materials prepared for each subject were combined to form integrity, and it was turned into an activity set. The lesson plans developed for the teacher were prepared, following the four phases of the standard knowledge construction model, in the form of a guide material that shows how student material is used and how the subject

Table 3 The application process of the research

	Applications	Date	Time (Course Hours)	Groups: Experimental Group	Groups: Control Group
Pre test	SIST Pre test	14.11.2018	2	√	√
Application	Teaching Based on CKCM	19.11.2018	20	√	-
	Teaching Based on Science Course Curriculum	19.11.2018 20.12.2018	20	-	√
Post-test	SIST Post-test	27.12.2018	2	√	√
	PSR Post-test	29.12.2018 30.12.2018	15	√	√

will be handled. The application plan for the experimental process carried out in the experimental group in the research is given in Appendix 2. Moreover, the application process related to "Mass and "Weight "for the experiment and the control group is given an example in Appendix 3. The application process of the research and the application times of the data collection tools are given in Table 3.

2.8 Data Analysis

Within the research context, the scientific inquiry skills test applied to both experimental and control groups and data obtained from the rubric of the psychomotor skills used to evaluate the practice exam carried out in both groups were analyzed with the help of the SPSS 23TM package program. Students are given 1 point for each correct answer and 0 points for each wrong answer in the scientific Inquiry skills test. Therefore, while the maximum score of the students is 22, the minimum score is 0. The behaviors exhibited by the students were scored by using the psychomotor skills rubric with a detailed examination of the video recordings, observation notes held by the researcher, and student activity forms. The student's scores were calculated by scoring the students' behaviors in the activities determined by taking into account the psychomotor domain steps. In this calculation, the behaviors were scored as "Observed (G)" (3 points), "Partially (K)" (2 points), and "Not Observed (GM)" (1 point). Therefore, if the students display all behaviors from this rubric, the maximum score they will get is 18; if they fail to display all behaviors, the minimum score is 6. "*Establishing the Experiment Setup under the Supervision of the Teachers*" sub-skill data in the psychomotor skills rubric was excluded from the analysis since all students were assumed to exhibit this skill during the application process. Besides, in the course of the application exam, analyzes were made considering that students had the skills to "set up the experimental setup without help", in case students performed "partial" the skill of choosing the tools suitable for the experimental setup.

In the analysis of the data in the scientific inquiry skills test and the psychomotor skills rubric, the histogram graphs, skewness, and kurtosis coefficients of each measurement were examined. It was then checked whether the data obtained by the D'Agostino Pearson Omnibus test provides a normality assumption. D'Agostino Pearson Omnibus test is a normality test that combines skewness and kurtosis tests (D'Agostino, Belanger, Ralph, & D'Agostino, 1990). In this normality test, the critical value for the significance level of $p=.05$ was determined as 5.991. In this context, according to the normality test conducted, the data with $DP \geq 5.991$, $p <.05$ did not exhibit normal distribution, Data with $DP \leq 5.991$, $p>.05$ were expressed to exhibit normal distribution (Kim, 2015). D'Agostino Pearson Omnibus test results of the data obtained from SIST and PSR are given in Table 4.

When Table 4 is examined, it is seen that the scientific questioning skills pre-test and post-test scores and the psychomotor skills total rubric scores exhibit normal distribution in the experimental and control groups ($p>.05$). Therefore, a comparison of scientific inquiry skills pre-test and post-test scores and psychomotor skills rubric total scores in the experimental and control groups was used t-test for independent samples. It was also determined that the differences between the pre and post-test scores of the experimental and control groups showed normal distribution. It was also determined that the differences between the pre-test and post-test scores of the experimental and control groups exhibited normal distribution ($p>.05$). Therefore, to compare experimental

Table 4 Results of D'Agostino-Pearson Omnibus test

Group		D'Agostino-Pearson			
		DP	Skewness	Kurtosis	P
SIST	Experimental Group	.12	.07	-.35	.94*
Pre test	Control Group	5.61	1.24	1.49	.06*
SIST	Experimental Group	.64	-.22	-.77	.72*
Post-test	Control Group	.62	-.49	.08	.73*
Experimental Group	Difference (Post-Pre test)	3.34	-1.03	.17	.18*
Control Group	Difference (Post- Pre test)	.14	-.20	-.21	.93*
Total	Experimental Group	2.47	-.83	-.60	.29*
	Control Group	.09	.17	.14	.95*

Table 5 Results concerning the experimental and control groups of SIST pre test and post-test scores

Test	Groups	N	X	SD	df	t	P
SIST	Experimental Group	16	9.25	2.97	27	-.623	.538
Pre test	Control Group	13	8.53	3.15			
SIST	Experimental Group	16	15.87	3.79	27	-3.680	.001*
Post-test	Control Group	13	10.92	3.35			

*p<.05

Table 6 Results concerning SIST pre-test and post-test scores of experimental and control groups

Group	Test	N	X	SD	df	t	P
Experimental Group	**Pre test**	16	9.25	2.97	15	-8.070	.000*
	Post test	16	15.87	3.79			
Control Group	**Pre test**	13	8.53	3.15	12	-3.055	.010*
	Post test	13	10.92	3.35			

*p<.05

Table 7 Results concerning the experimental and control groups of psychomotor skills rubric total post-test scores

Test	Group	N	X	SD	df	t	P
PSR Total	**Experimental Group**	16	15.44	2.80	27	-2.169	.039*
	Control Group	13	13.30	2.39			

*p<.05

and control groups within themselves was used to t-test for dependent samples.

3. RESULT AND DISCUSSION

3.1 Results Related to Scientific Inquiry Skills

The results of the t-test for independent samples made for determining whether there is a statistically significant difference between the scientific inquiry skills test pre-test and post-test scores of the experimental and control groups are given in Table 5. When Table 5 is examined, it is seen that there is no statistically significant difference in terms of skill levels between the scientific inquiry skills test for pre-test scores of the experimental and control group students ($t_{(27)}$= -.623, p>.05). The average pre-test score (Xexperimental=9.25) of the experimental group students is close to the average pre-test score ($X_{control}$=8.53) of the control group students.

As seen in Table 5, it was determined that there is a statistically significant difference in terms of skill levels between the scientific inquiry skills test post-test scores of the experimental and control students ($t_{(27)}$= -3.680, p<.05). This significant difference seems to be in favor of the experimental group. The post-test average score ($X_{experimental}$=15.87) of the experimental group students is higher than the post-test average score ($X_{control}$=10.92) of the control group students.

Comparison of the SIST pre-test and post-test scores of the experimental and control groups with the t-test for dependent samples are given in Table 6. It was determined that there is a statistically significant difference in terms of scientific inquiry skills between the pre-test and post-test scores of the experimental group in favor of the post-test ($t_{(15)}$= -8.070, p<.05).

It was determined that there is a statistically significant difference in terms of scientific inquiry skills between the pre-test and post-test scores of the control group in favor of the post-test. ($t_{(12)}$= -3.055, p<.05).

3.2 Findings Related to Psychomotor Skills

"*Psychomotor Skills Rubric*" was used to evaluate the practice exam conducted to determine the psychomotor skills exhibited of the students in the experimental and control groups. According to the psychomotor domain steps, the rankings of the skills in the rubric is "*Perception*", "*Choosing the Tools Suitable for the Experimental Setup*", *"Establishing the Experimental Setup under the Supervision of the Teachers"*, "*Establishing the Experimental Setup Without Help", "Designing the Experimental Setup to Respond to Another Hypothesis" and "Designing the Experiment Using Different Tools*". By considering this skill ranking, observing the change in the whole of psychomotor domain skills displayed by students in the practice exam was given the graphic in figure 2.

When Figure 2 is examined, it is seen that the scores obtained from all the sub-skills which are placed in the psychomotor skills rubric by the experimental group students are higher than the scores obtained by the control group students. It was determined that the skill with the highest score difference between experiment and control group was the *"Designing the Experimental Setup to Respond to another Hypothesis"* sub-skill. Also, it is seen that both experimental and control group students *"Establishing the Experimental Setup under the Supervision of the Teachers"* skill points are the highest. This situation may be since students have gained the *"Establishing the Experimental Setup under the Supervision of the Teachers"* skill in the application process. It was also determined that the students in both groups obtained the lowest scores in the *"Designing the Experiment Using Different Tools*" sub-skill related to the "*Creating*" step, which is the last step of the psychomotor domain skills.

The results of the t-test for independent samples made for determining whether there is a statistically significant difference between the psychomotor skills rubric total post-test scores of the experimental and control groups are given in Table 7.

It was determined that there is a statistically significant difference in terms of psychomotor domain skills between the psychomotor skills rubric total post-test scores of the experimental and control group students ($t_{(27)}$= -2.169, p<.05). This significant difference seems to be in favor of the experimental group. The post-test average score ($X_{experimental}$=15.44) of the experimental group students is higher than the post-test average score ($X_{control}$=13.30) of the control group students.

Discussion

As a result of the research, it was determined that there was no statistically significant difference between the pre-test scores of the experimental and control groups in terms of skill levels. This result can be considered an indicator that the students' scientific inquiry skills in both groups are similar to each other. This situation may have resulted from students starting to learn their scientific inquiry skills from 3rd grade. When the scientific inquiry skills test post-test scores of the experimental and control groups were examined, it was determined that there was a statistically significant difference in favor of the experimental group in terms of skill levels. This result can be considered an indication that CKCM applied in the experimental group is more effective in acquiring scientific inquiry skills than the teaching based on the current curriculum applied in the control group. As the reason for this result, it can be given that the standard knowledge construction model includes the concept of scientific inquiry on a theoretical basis. Also, the fact that POE activities applied in the second phase of the model are useful in gaining scientific inquiry skills may be another reason for this result. POE activities constitute an excellent learning environment for students to use and develop scientific process skills. Besides, POE activities enable that student's benefit from the theoretical knowledge given to them while writing their predictions, and it allows them to construct a hypothesis about the outcome of the experiment and comment on the variables (Güngör & Özkan, 2017). As a matter of fact, in his study with 5th-grade students, Kara (2017) concluded that activities based on the POE technique contributed positively to students' scientific process skills. In the study conducted by Sağırekmekçi (2016), it was determined that the teaching of science and nature subjects supported by POE had a positive effect on preschool students' scientific process skills.

It was determined that there was a statistically significant difference between the pre-test and post-test scores of the control group students who receive teaching based on science course teaching program in favor of the post-test scores in terms of skill levels. This finding can be interpreted that teaching in the control group helps develop students' scientific inquiry skills. Besides, it was determined that the findings obtained from examining the skills exhibited by students during the practice exam support this result. Because during the practice exam, it has been observed that students exhibit skills such as experimenting, measuring, hypothesizing, identifying variables, observing, and making inferences. As a reason for this result, it can be given that the few activities in the science textbook are written based on some of the skills that the curriculum aims to acquire. Also, the fact that students come to the application process with some skills may be another reason. In studies with secondary school students based on the science course teaching program, it is concluded that teaching based on the current curriculum is effective in students' acquiring scientific process skills (Aydoğdu, 2009; Kara, 2017). It was determined that there was a statistically significant difference between the pre-test and post-test scores of the experimental group students in favor of the post-test scores in terms of skill levels. This finding can be interpreted that teaching based on CKCM

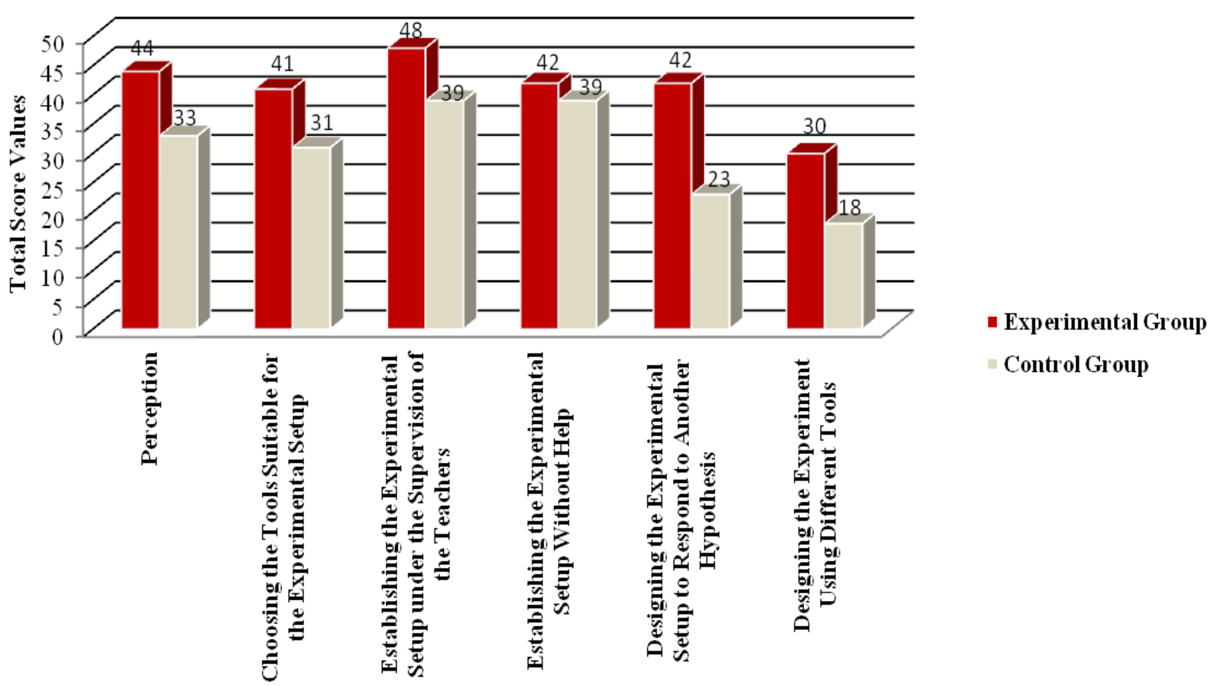


Figure 2 Total score values obtained according to sub-skills in the psychomotor skills rubric

in the experimental group helps develop students' scientific inquiry skills. This situation can be explained by using different methods and techniques (POE activity, worksheets) in the phases of CKCM applied in the experimental group. When the related literature is examined, it was reached that a limited number of studies in which the effect of CKCM on scientific inquiry skills is investigated. In his study, Bayar (2019) concluded that the lessons conducted with CKCM provided a positive increase in students' scientific process skills. Therefore, it can be seen that the result obtained from the mentioned study supports the current research result.

In research, "*Psychomotor Skills Rubric*" was used to evaluate the practice exam conducted to determine the students' psychomotor skills exhibited in the experimental and control groups. According to the psychomotor domain steps, the rankings of the skills in the rubric is "*Perception*", "*Choosing the Tools Suitable for the Experimental Setup*", *"Establishing the Experimental Setup under the Supervision of the Teachers"*, "*Establishing the Experimental Setup Without Help", "Designing the Experimental Setup to Respond to Another Hypothesis" and "Designing the Experiment Using Different Tools*". The result of the analysis made considering this skill ranking; it is seen that the scores obtained from all the sub-skills which are placed in the psychomotor skills rubric by the experimental group students are higher than the scores obtained by the control group students. It was determined that the skill with the highest score difference between experiment and control group was the *"Designing the Experimental Setup to Respond to another Hypothesis"* sub-skill. Also, it is seen that both experimental and control group students *"Establishing the Experimental Setup under the Supervision of the Teachers"* skill points are the highest. This situation may be because students have gained the *"Establishing the Experimental Setup under the Supervision of the Teachers"* skill in the application process. It was also determined that the students in both groups obtained the lowest scores in the *"Designing the Experiment Using Different Tools*" sub-skill related to the "*Creating*" step, which is the last step of the psychomotor domain skills. It was determined that there was a statistically significant difference between the psychomotor skills rubric total post-test scores of the experimental and control group students in favor of the experimental group in terms of psychomotor domain skills. This result can indicate that CKCM applied in the experimental group is more effective on students' acquiring psychomotor domain skills than the teaching based on the current curriculum applied in the control group. This situation can be explained by the fact that the psychomotor skills are increased repeatedly depending on the use of various activities in all phases of CKCM (Sönmez, 2017).

When the relevant literature is examined, Sarıgöz (2008) determined that a program created according to the constructivist approach is more effective on students' acquiring psychomotor domain skills than a program created according to the traditional approach. Gülen (2016) revealed that activities and practices based on STEM integrated argumentation-based inquiry approach effectively developed students' psychomotor skills. Similarly, Atlı (2007) determined that the readiness training program prepared for the "*Force and Motion*" unit caused a significant change in the students' psychomotor skills. Ulutaş (2011) determined that activities within the classroom provided an increase in students' psychomotor skills in his study, which he examined the major games affecting the psychomotor development of 6-year-old students. Yüksel (2010) found that activities within the classroom increased the effect of students' psychomotor skills. In his research, Özcan (2009) reached similar findings to these findings. According to Özcan, active learning develops psychomotor skills more effectively than classical learning. However, in their study, Kuru and Köksalan (2012) determined that there was no relationship between classroom activities and the development of students' psychomotor skills. When the studies mentioned above are examined, it is seen that different teaching methods and models are used in the studies. In the literature, it was not reached that a study investigating the effects of CKCM on psychomotor domain skills. In this context, since the effects of the model on this variable are investigated for the first time, it can be said that the findings and results obtained from the study will contribute to filling the gap in the literature.

4. CONCLUSION

This study investigates the effect of science teaching based on Common Knowledge Construction Model (CKCM) on students' cognitive and psychomotor learning. As a result of the research, it was determined that the scientific inquiry skills post-test scores of the experimental group (X=15.87) were seen to be higher than the control group (X=10.92). The difference was observed to be significant. The result of the analysis made considering skill ranking; it is seen that the scores obtained from all the sub-skills which are placed in the psychomotor skills rubric by the experimental group students are higher than the scores obtained by the control group students. It was determined that the skill with the highest score difference between experiment and control group was the *"Designing the Experimental Setup to Respond to another Hypothesis"* sub-skill. It was determined that the students in both groups obtained the lowest scores in the *"Designing the Experiment Using Different Tools*" sub-skill related to the "*Creating*" step, which is the last step of the psychomotor domain skills. Also, when the psychomotor skills rubric's total post-test scores were compared, a statistically significant difference was found between the experimental (X=15.44) and control group (X=13.30). According to this result, it can be said that science teaching based on CKCM is more effective in developing the mentioned skills than teaching based on the current curriculum.

In the light of the results obtained from the research, the following suggestions are presented: Student materials developed based on CKCM can be used to develop the features mentioned by teachers and students during the teaching process. In other science courses, activities based on CKCM can be prepared, and activities can be enriched with different complementary measurement and evaluation techniques. By increasing the number of activities in the textbooks, these features can be improved more in control group students. Also, by extending the research's application time, longitudinal studies can be conducted in which the effect of CKCM on the psychomotor field skills can be revealed more clearly.

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