Kocaeli Üniversitesi Eğitim Dergisi
E-ISSN: 2636-8846
2024 | Cilt 7 | Sayı 1
Sayfa: 361-385

Kocaeli University Journal of Education
E-ISSN: 2636-8846
2024 | Volume 7 | Issue 1
Page: 361-385

Sorgulayıcı öğretim yaklaşımının zihin yetersizliği olan öğrencilerin bilimsel süreç becerilerine etkisi

The effect of inquiry teaching approach on scientific process skills of students with intellectual disabilities

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Bu çalışma, Sedat KARAÇAM ve Hakan ÖZAK danışmanlığında, Saadet BAYRAK (2021) tarafından hazırlanan "Sorgulayıcı yaklaşımın zihin yetersizliği olan öğrencilerin bilimsel süreç becerileri ve fen dersine karşı tutumları üzerine etkisi" başlıklı yüksek lisans tezinden üretilmiştir.

ARAŞTIRMA MAKALESİ

Gönderim Tarihi	Düzeltme Tarihi	Kabul Tarihi
31 Ocak 2024	*2 Nisan 2024*	*14 Mayıs 2024*

Önerilen Atıf

Recommended Citation

Bayrak, S., Karaçam, S., & Özak, H. (2024). Sorgulayıcı öğretim yaklaşımının zihin yetersizliği olan öğrencilerin bilimsel süreç becerilerine etkisi. *Kocaeli Üniversitesi Eğitim Dergisi, 7*(1), 361-385. http://doi.org/10.33400/kuje.1429004

ÖZ

Bu çalışmada sorgulayıcı öğretim yaklaşımının zihin yetersizliği olan öğrencilerin bilimsel süreç becerilerine etkisi incelenmiştir. Çalışma 2019-2020 eğitim öğretim yılında tamamlanmıştır. Bu çalışmada nitel araştırma yöntemlerinden çoklu durum çalışması deseni kullanılmıştır. Çalışma grubu özel eğitim sınıfına devam eden zihin yetersizliği olan 5 ve 6. Sınıf düzeyindeki dokuz ortaokul öğrencisinden oluşmaktadır. Çalışma süreci ön test, etkinliklerin uygulanması, son test ve genelleme uygulamalarından oluşmaktadır. Araştırmanın verilerini toplamak amacıyla Özkan (2015) tarafından geliştirilen bilimsel süreç becerileri envanteri, gözlem ve alan notları ile araştırmacı tarafından geliştirilen etkinlik gözlem formu kullanılmıştır. Elde edilen veriler betimsel analiz yöntemi ile analiz edilmiştir. Veri analizi zihin yetersizliğinden etkilenmiş öğrencilerin bilimsel süreç becerilerine ait veriler ön test-son test ve süreç içerisinde yapılan gözlemlerden elde edilen verilerin ayrı ayrı analiz edilip bütünleştirilmesini içermektedir. Uygulama sürecinin tamamı video kayıt altına alınarak sonrasında izlenmiştir. Video kayıtlar yazıya dökülmüş öğrencilerin uygulama öncesinde, sürecinde ve sonrasıda gösterdikleri performans farklılıkları üzerinden değerlendirme yapılmış ve gerekli notlar alınmıştır. Analiz sürecinde ilk olarak öğrencilerin ön test-son testte gösterdikleri performans davranışlarının karşılaştırılması yapılmıştır. Ardından etkinliklerin uygulanma sürecinde öğrencilerin bilimsel süreç becerilerinin gelişimi, yapılan gözlemler, alınan alan notları, öğrenci çalışmaları ve etkinliklere dair video kayıtları üzerinden incelenmiştir. Bu kodlama işlemi sırasında, öğrencilerin etkinliğin ilgili kısımlarında sergiledikleri performans davranışları özellikle dikkate alınmıştır. Araştırma sonucunda sorgulayıcı öğretim yaklaşımının zihin yetersizliği olan öğrencilerin bilimsel süreç becerilerinin gelişmesinde etkili olduğu tespit edilmiştir. Araştırmada uygulanan etkinliklerin öğrencilerin bilimsel süreç becerilerinden gözlem, tahmin etme ve bilimsel iletişim kurma becerilerini olumlu yönde etkilemesine rağmen, öğrencilerin çıkarım yapma becerisini üzerine etkisinin diğer beceriler kadar olmadığı tespit edilmiştir. diğer becerilere göre daha düşük performans sergiledikleri görülmektedir. Ayrıca zihin yetersizliği olan öğrencilerin kazandıkları bilimsel süreç becerilerini farklı konu alanlarına genelleyebildikleri tespit edilmiştir. Sonuç olarak sorgulayıcı öğretim yaklaşımının zihin yetersizliği olan öğrencilerin bilimsel süreç becerilerini geliştirmede etkili olduğu görülmüştür.

Anahtar Sözcükler: bilimsel süreç becerileri, fen bilgisi, özel eğitim, sorgulayıcı yaklaşım, zihin yetersizliği

ABSTRACT

In this study, the effect of the inquiry teaching approach on the scientific process skills of students with intellectual disabilities was examined. The study was completed in the 2019-2020 academic year. In this study, multiple case study design from qualitative research methods was used. The study group consisted of nine middle school students with intellectual disabilities attending a special education class. The study process consisted of pre-tests, implementation of activities, post-tests and generalization practices. In order to collect the data of the study, the scientific process skills inventory developed by Özkan (2015), observation and field notes, and the activity observation form developed by the researcher were used. Data analysis includes the process of analyzing and integrating the data obtained from the pre-test, post-test and observations made during the process of the scientific process skills of students affected by intellectual disability. The pre-test-post-test application of the scientific process skills inventory and all of the activities were videotaped and then observed. During the analysis process, performance differences exhibited by students before, during, and after the implementation of activities were evaluated based on transcriptions of video recordings, and necessary notes were taken. Initially, comparisons were made between students' performance behaviors in pre-test and post-test assessments. Subsequently, the development of students' scientific process skills during the implementation of activities was examined through observations, field notes, student work, and video recordings of the activities. Throughout this coding process, particular attention was given to students' performance behaviors in relevant sections of the activities.Video recordings were transcribed and necessary notes were taken. As a result of the research, it was found that the inquiry teaching approach was effective in the development of observation, estimation and scientific communication skills of students with intellectual disabilities except inference skills. In addition, it was observed that students with intellectual disabilities were able to generalize the science process skills they acquired to different subject areas. As a result, it was seen that the inquiry teaching approach was effective in developing the science process skills of students with intellectual disabilities.

Keywords: scientific process skills, science, special education, inquiry approach, intellectual disability

INTRODUCTION

The main feature of our age is its rapid change. As a result of this change, the information produced and the information that has lost its validity are also increasing very rapidly (Meder, 2001). This situation has transformed the knowledge development that changes education systems from the purpose of raising knowledge to raising something that can produce knowledge and apply it to new situations that can access and use knowledge (Parlar 2012). This change in the understanding of education also includes individuals with intellectual disabilities who share the same age. Intellectual disability is a condition characterized by significant limitations in both intellectual functioning and adaptive behavior that originates before the age of 22 (Schalock et al., 2021). It is seen that the rate of individuals with intellectual disabilities in the society is between 1% and 3% (Görmez, 2019). Various concepts and skills are taught in schools so that individuals with intellectual disabilities can live independently in society. In this process, different teaching methods should used.

Due to the cognitive difficulties experienced by students with intellectual disabilities in learning, numerous special teaching methods have been developed in accordance with the characteristics of the students. When the educational processes of students with intellectual disabilities are examined, it is seen that the studies are on concept teaching based on the student's frequent repetition (Batu, 2006; Çapraz, 2016; Çıkılı, 2016; Demir, 2008; İlik, 2009; Kaya, 2016; Mete, 2016; Vayiç, 2008). It is seen that concept teaching is emphasized in different teaching methods with students with intellectual disabilities (Biber, 2009; Çevik, 2016; Karasu, 2019; Kocadağ, 2009; Öner, 2018; Tezcan, 2012). In a study in which concept teaching was carried out, it was stated that students with mild intellectual disabilities had problems in storing what they learned in memory, generalizing and transferring to another subject, concentrating on a point and providing motivation. However, it is also claimed that these students do not have problems in using the information stored in long-term memory (Özsoy et al.,1998). The student in the concrete operational period can make classifications according to different criteria, taking into account the properties of the objects given to him/her (Busbridge & Özçelik, 1997). When given the opportunity to work with tangible three-dimensional material instead of abstract material in observation and experiments, the skills of drawing conclusions, generalizing and transferring knowledge develop better (Anagün, 2015). Therefore, students with intellectual disabilities can gain scientific process skills with instructional adaptations suitable for their performance.

21st century skills such as learning and innovation skills, information, media and technology skills, life and career skills also include scientific process skills (Yalçın, 2018). Scientific process skills are also included in the science curriculum (MEB, 2018). Scientific process skills are intellectual skills that enable to produce knowledge in logical and rational ways by thinking like a scientist (Anagün, 2015). Today, the rapid increase in the number of researches on scientific process skills (Arantika, et al., 2018; Aydoğdu, 2006; Budak, 2008; Kırılmazkaya 2014; Koyunlu Ünlü, 2015; Lee & Lee, 2010; Maxwell, Lambeth & Cox, 2015; Öç, 2019; Serevina, 2018; Tekin, 2019; Yücel, 2019) and the acquisition of scientific process skills in today's education system are an indicator of the value given to these skills. It is important to ensure that students with intellectual disability who learn these skills are more successful in solving the problems they will encounter both in school and in their daily lives, and to adapt to the environment. However, it has been noticed that the learning that will support the adaptation of students with intellectual disabilities to changing living conditions is insufficient. It is seen that scientific process skills, which have an important place in the education of students with normal development, are not given the necessary importance in the education of students with intellectual disabilities. The reason for this situation is thought to be due to wrong attitudes and perceptions regarding the learning performance of students with intellectual disability. Various skills that facilitate knowledge generation, problem solving, learning and increase retention are referred to as mind skills in a number of studies.

Scientific process skills, which are important in the daily lives of individuals, are defined and classified in various ways. Students can gain scientific process skills with certain techniques and

methods. The common views in the definitions are listed as mental skills that enable knowledge generation, problem solving, facilitating learning and increasing permanence (Anagün, 2015). American Commission for the Advancement of Science Education (1967), scientific process skills; divided into basic process skills and integrated process skills (Padilla, Okey & Garrardi, 1984). Basic process skills consist of classification, measurement, communication, estimation and inference skills, including observation skills starting from birth (Peters & Stout, 2006). AAAS states that integrated process skills can be gained at later education levels (Bozkurt & Olgun, 2005) and basic process skills can be developed from early childhood (Yaşar Ekici et al.,2018). It is thought that with scientific process skills, students will be able to produce solutions suitable for their maturity and intelligence level, and solve the problems encountered more easily and quickly (Tekin, 2019). Various methods are used in the acquisition of scientific process skills. In recent years, it is seen that the inquiry teaching approach is used more in studies aiming at the development of scientific process skills (Budak, 2008; Ceylan, 2019; Demirkıran, 2016; Ecevit, 2018; Güler, 2018; Juniar et al., 2018; Kırılmazkaya, 2014; Koyunlu Ünlü, 2015; Lee & Lee, 2010; Ünal, 2018).

The inquiry teaching approach is one of the student-centered approaches in which the student is active. In the inquiry teaching approach, students understand how scientists work and learn and internalize scientific thinking (National Research Council [NRC] 2000). Students can look at the events of daily life with a scientific eye. In the inquiry teaching approach, students research, ask questions, question and examine the sources, make inferences from the data, explain the results with their justifications, that is, it is an approach in which the student is active at every stage (Perry & Richardson, 2001). Research shows that the inquiry teaching approach is effective in gaining scientific process skills from pre-school to university level and its application is recommended (Abdelraheem & Asan, 2006). The scientific process skills gained with the inquiry approach are used not only for doing science but also in daily life (Liang, 2002). With an inquiring approach, individuals can solve many problems encountered in their daily lives more easily and faster. Therefore, it is seen that these individuals have a positive contribution to their lives. With the inquiry teaching approach, students with intellectual disabilities can gain basic scientific process skills that will positively affect their daily lives.

Although the inquiry approach has only recently taken its place in the science curriculum, its origins date back to Socrates. According to this approach, which is based on the philosophy of Socrates, it is argued that those who can ask the right questions and follow their curiosity realize learning. In the inquiry approach, four different techniques are used according to the student's level. These techniques consist of the beginner level, where teacher guidance and support are more, and advanced levels, where the control shifts to the student depending on the student's mastery of questioning (Banchi & Bell, 2008).

Level 1: Confirmatory Inquiry: In the experiment sheet, the theoretical background, experiment materials, how the experiment will be done, the data and results to be obtained as a result of the experiment are given. The student performs the experiment and compares the results and checks whether she/he reached it or not.

Level 2: Structured Inquiry: In the experiment sheet, the theoretical background, experiment materials, how the experiment will be conducted, and the data to be obtained as a result of the experiment will be written. The student observes, records the data and makes inferences.

Level 3: Guided Inquiry: The teacher asks the question, the theoretical background and variables are given in the experiment sheet. Process planning and obtaining results are done by the student.

Level 4: Open Inquiry: Only the research question is noticed by the teacher, defining the question, determining the variables, planning the process and obtaining results are all done by the student.

It is stated that the inquiry approach is effective in the development of critical thinking, structuring logical and mathematical knowledge, science literacy, scientific process skills, self-regulation skills, conceptual understanding and attitude towards science (Saylan Kırmızıgül, 2019). It is thought that this deficiency in science education of students with intellectual disabilities will be eliminated by using the inquiry approach and gaining basic scientific process skills. It is thought that realizing the potential of students with intellectual disabilities will be explanatory in terms of discovering the sources of their difficulties. Therefore, in this study, it was investigated whether the inquiry approach has an effect on the scientific process skills of students with intellectual disabilities and the effectiveness of these skills in the permanence and generalization processes.

METHODOLOGY

In this study, a case study in qualitative research methods was used to evaluate the effect of inquiry teaching approach on the scientific process skills of students with intellectual disabilities. A case study is a detailed analysis of a person, an event or documents with a special situation (Creswell, 2007). The case study is used by various researchers depending on its purpose, type or number of cases, etc. classified according to their characteristics. The aim of the case study is to identify the factors affecting the effects and efficiency of a teaching program (Cronbach, 1975). In this study, the effect of the curriculum prepared on the basis of inquiry-based teaching approach on the science process skills of students with intellectual disabilities was examined in detail as a case study.

Setting

The implementation of the measurement tool and activities was carried out in a separate room on the same floor with the special education class provided by the school administration. The room contained the materials required for the measurement tool and activities, 2 chairs and 1 table. In this process, no one other than the student and the researcher was present in the environment. All of the applications were carried out individually. The time required by the student in the implementation of the activities and the scale was given. The implementation time of the scale took an average of 30 minutes, and the implementation time of the activities took an average of 15-20 minutes. During the period when schools were closed due to the Covid-19 outbreak, the activities were carried out in the rehabilitation centres where the students participating in the study attended. Some students participating in the study were quarantined due to Covid-19 and could not participate in the activities for 15 days. When the quarantine period was over and they returned to rehabilitation education, these students continued with the activities they had left. In the practices in the rehabilitation centre, the activities were carried out in the room and time provided by the centre.

Research Group

The research group was formed by using a purposeful and convenient sampling method. Purposive sampling is a sampling method used to include individuals who have a certain characteristic and/or have had similar experiences in the research group. Convenience sampling is a sampling method that allows the researcher to easily reach the participants in terms of distance, time and economy (Yıldırım & Şimşek, 2008). The research group consisted of a total of nine students, five girls and four boys, who attended special education classes at the 5th and 6th grade level and had no absenteeism problems, seven students with mild and two students with moderate intellectual disability and no other disability. All students had educational diagnoses obtained from the Guidance Research Centre, but IQ scores were not shared with the researcher due to the law. The names of the students were kept confidential to avoid ethical problems, and code names were used for each student.

Data Collection Tools

The research data were collected using the scientific process skills inventory developed by Özkan (2015) and the activity observation form developed by the researcher.

Scientific Process Skills Inventory: In the research, the "Scientific Process Skills Inventory" developed by Özkan (2015) was used to measure the science process skills of 60-72 month old preschool students to determine the scientific process skills of the students before and after the application. The reason why this inventory was preferred regardless of age level was that the students in the research group did not have literacy skills. It was observed that the scale worked in the pilot study.

Activity Observation Form: Activity observation form and generalization activities observation form were developed by the researcher. It is a list of behaviors and expressions that should be considered during the observation of scientific process skills in each activity in the observation form. During the researcher's activity, the student's display of observation, classification, measurement, estimation, scientific communication and inference skills was recorded in this list. The different behaviors exhibited by the student, which were not found in the observation form, were noted on these forms as field notes.

Analysis of Data

The data obtained in the research were analyzed with the descriptive analysis method. The descriptive analysis method is based on summarizing the data obtained from different data collection tools by interpreting the relationships according to the codes of the predetermined subject. The researcher performs the analysis by making direct quotations from observations and interviews, establishing cause-effect relationships or making use of comparisons (Yıldırım & Şimşek, 2008).

Data analysis includes the process of analyzing and integrating the data obtained from the pre-test-post-test and observations made during the process, about the scientific process skills of students who were affected by intellectual disabilities. The pre-test and post-test in which the scientific process skills inventory was applied and all activities were recorded by video recording technique. Video recordings were transcribed and necessary notes were taken. Written records, observation notes and student products formed during the activity were coded and the development of scientific process skills was examined in various ways. Tables were created with the data obtained by giving nicknames to the students. By looking at the numerical data in the tables, their development both individually and as a group was determined. The consistency of the science process skills was determined by integrating the pre-test-post-test results with the developments in the activity process.

Research Ethics

All the rules stated in the "Higher Education Institutions Scientific Research and Publication Ethics Directive" were complied with in the whole process, from the planning of this research to its implementation, from data collection to data analysis. None of the actions specified under the title of "Actions Contrary to Scientific Research and Publication Ethics," which is the second part of the directive, were not carried out.

Scientific, ethical, and citation rules were followed in this study's writing process; no changes were made to the collected data, the participants officially accepted to participate, and this study was not sent to any other academic publication medium for evaluation. Participation in the research was conducted based on the voluntariness of the students, and the parent permission petition forms were obtained from the parents of the students.

Research ethics committee approval information

Name of the ethics committee: Duzce University

Date of the decision: 11/12/2019

Document issue number: E.69209

RESULTS

In order to determine the effectiveness of the inquiry teaching approach to students with intellectual disabilities, the findings of the observation skill, one of the scientific process skills, were obtained from the scientific process inventory used as pre-test-post-test and from the activity observation form used to evaluate the activity process. The results of the pretest-posttest data of the observation skill dimension of the science process skills inventory are presented in Table 1.

Table 1

Pre-test-Post-test Results of Observation Skill of Scientific Process Skills Inventory

Students	Pre-test				Post-test			
	O1	O2	O3	O4	O1	O2	O3	O4
Sami	-	-	-	-	-	+	+	+
Ali	-	-	-	+	-	+	+	+
Hale	-	+	+	+	+	+	+	+
Feza	+	+	-	-	+	+	-	+
Nur	+	+	+	-	+	+	+	+
Oya	-	-	-	+	-	+	+	+
Eda	-	-	+	-	+	+	+	+
Taha	-	-	-	-	-	+	-	+
Yunus	-	-	-	+	-	+	+	+
Total	2	3	3	4	4	9	7	9

Note: Student performance that meets the criterion is marked "+", student performance that does not meet the criterion is marked "-"..

As seen in Table 1, it is seen that 9 students who participated in the research met a total of 13 evaluation criteria out of 36 criteria in the pre-test and a total of 29 evaluation criteria in the post-test.

In the research, in order to determine the effect of the inquiry approach on the observation skills of students with intellectual disability, besides measuring and comparing the observation skills of the students before and after the application, the performance of the students in 12 activities applied to improve their scientific process skills was also observed. The diffusion of light in activities 1, 2 and 3, reflection of light in activities 4, 5, 6 and 7, light encountering matter in activities 8 and 9, variables affecting the formation of full shadow in activities 10, 11 and 12 will be discussed. Data were obtained from observations and field notes on observation skills during the activity process (See Table 2).

Table 2
The Development Process of Observation Skills in the Activities in the Diffusion of Light Unit

Students	Activities											
	1	2	3	4	5	6	7	8	9	10	11	12
Sami	-	+	+	+	+	+	-	+	+	+	+	+
Ali	+	+	+	+	+	+	+	+	+	+	+	+
Hale	-	+	+	+	-	-	+	+	+	+	+	+
Feza	-	+	+	+	+	+	-	+	+	+	+	+
Nur	+	+	+	+	+	+	+	+	+	+	+	+
Oya	-	+	+	+	-	-	+	+	+	+	+	+
Eda	+	+	+	+	+	+	+	+	+	+	+	+
Taha	-	+	+	+	+	-	+	+	+	+	+	+
Yunus	+	+	+	+	+	+	-	+	+	+	+	+
Total	4	9	9	9	7	6	6	9	9	9	9	9

Note: Those who meet the performance criterion "+", those who do not meet the performance criterion "-".

In this section, findings related to the development of students with intellectual disabilities, the inquiry teaching approach and the development of classification skills, are presented. In order to determine the effectiveness of the inquiry teaching approach to students with intellectual disabilities, the findings of the classification skill, one of the scientific process skills, were obtained from the scientific process inventory used as pre-test-post-test and from the activity observation form used to evaluate the activity process. The results of the pretest-posttest data of the classification skill dimension of the science process skills inventory are presented in Table 3.

Table 3
Pre-Test-Post-Test Results for Classification Skill of the Scientific Process Skills Inventory

Students	Pre-test								Post-test							
	C1	C2	C3	C4	C5	C6	C7	C8	C1	C2	C3	C4	C5	C6	C7	C8
Sami	-	+	+	-	-	-	+	-	+	+	-	-	+	+	+	-
Ali	-	+	-	-	-	+	+	-	+	+	+	+	-	+	+	-
Hale	+	+	+	-	-	+	-	-	+	+	+	-	+	+	+	-
Feza	-	-	-	-	-	-	-	-	+	+	+	-	+	+	+	-
Nur	+	-	+	-	+	+	+	-	+	+	+	+	+	+	+	-
Oya	-	-	-	-	-	+	+	-	+	+	-	-	+	+	+	-
Eda	+	+	-	-	-	-	-	-	+	+	+	+	+	+	+	+
Taha	+	-	-	-	+	-	+	+	+	+	+	-	+	+	+	+
Yunus	+	+	-	+	+	-	-	-	+	+	-	+	+	+	+	+
Total	5	5	3	1	3	4	5	1	9	9	6	4	8	9	9	3

Note: Student performance that meets the criterion is marked "+", student performance that does not meet the criterion is marked "-".

As seen in Table 3, it is seen that 9 students who participated in the research met a total of 26 performance evaluation criteria out of 72 criteria in the pre-test and a total of 57 performance evaluation criteria in the post-test.

In the research, in order to determine the effect of the inquiry approach on the classification skills of students with intellectual disabilities, besides measuring and comparing the classification skills of the students before and after the application, the performance of the students in 12 activities applied to improve their scientific process skills was also observed. Due to the nature of the subject, there are no activities involving classification skills in activity 3, 7 and 12. The topic of light propagation in activity 1 and 2, light reflection in activity 4, 5 and 6,

light encountering matter in activity 8 and 9, full shadow formation in activity 10 and 11 were discussed and data were obtained from observations and field notes regarding classification skills during the activities. The findings obtained as a result of the analysis of these data are given in Table 4.

Table 4
The Development Process of The Classification Skill in the Activities Performed in the Light Diffusion Unit

Students	Activities								
	1	2	4	5	6	8	9	10	11
Sami	+	-	-	+	+	-	-	+	+
Ali	-	-	-	-	-	-	-	+	+
Hale	-	-	+	-	-	-	-	+	+
Feza	+	+	+	-	-	-	-	+	+
Nur	+	+	+	+	+	-	+	+	+
Oya	-	-	+	-	-	-	-	+	+
Eda	+	+	+	+	+	+	+	+	+
Taha	+	+	+	-	-	-	-	+	+
Yunus	+	+	+	+	+	-	-	+	+
Total	6	5	7	4	4	1	2	9	9

Notes: "+" performance criteria achieved, "-" performance criteria not achieved.

In this section, the findings regarding the development of the students with intellectual disabilities, the inquiry approach and the measurement skills, and the process are presented. In order to determine the effectiveness of the inquiry approach to students with intellectual disabilities, the findings of the measurement skill, were obtained from the scientific process inventory used as pre-test-post-test and from the activity observation form used to evaluate the activity process. The results of the pretest-posttest data of the measurement skill dimension of the science process skills inventory are presented in Table 5.

Table 5
Pre-Test and Post-Test Results of the Measurement Skill of the Science Process Skills Inventory

Students	Pre-test							Post-test						
	M1	M2	M3	M4	M5	M6	M7	M1	M2	M3	M4	M5	M6	M7
Sami	+	-	-	-	-	+	+	+	+	+	+	+	+	+
Ali	+	+	-	-	-	+	-	+	+	+	+	-	+	+
Hale	+	+	-	-	-	+	-	+	+	+	+	-	-	+
Feza	-	-	-	-	-	-	-	+	+	+	+	+	+	+
Nur	+	-	-	+	+	+	+	+	+	+	+	+	+	+
Oya	+	-	-	-	-	-	-	+	+	+	+	-	+	+
Eda	+	-	-	+	+	+	+	+	+	+	+	+	+	+
Taha	+	+	-	-	-	+	+	+	+	+	+	-	+	+
Yunus	+	+	-	-	-	+	+	+	+	+	+	-	+	+
Total	8	4	0	2	2	7	5	9	9	9	9	4	8	9

Notes: "+" performance criteria achieved, "-" performance criteria not achieved.

As seen in Table 5, it is seen that 9 students who participated in the research met a total of 38 evaluation criteria out of 63 criteria in the pre-test and a total of 57 evaluation criteria in the post-test.

In the research, in order to determine the effect of the inquiry approach on the measurement skills of students with intellectual disability, besides measuring and comparing the measurement skills of the students before and after the application, the performance of the students in 12 activities applied to improve their scientific process skills was also observed within the scope of the research. Due to the nature of the subject, there are no activities involving measurement skills in activity 1, 2, 3, 4, 5, 6, 8, 9, 10 and 11. The reflection of the light in activity 7 and the variables affecting the full shadow formation in activity 12 were discussed, and data were obtained from the observations and field notes regarding the measurement skills during the activity process. The findings obtained as a result of the analysis of these data are given in Table 6.

Table 6
The development process of measurement skill in the activities performed in the light diffusion unit

Students	Activities	
	7	12
Sami	-	+
Ali	-	+
Hale	+	+
Feza	-	+
Nur	+	+
Oya	-	+
Eda	-	+
Taha	-	+
Yunus	-	+
Total	2	9

Notes: "+" performance criteria achieved, "-" performance criteria not achieved.

In order to determine the effectiveness of the inquiry approach to students with intellectual disabilities, the findings of the science process skills of estimation/inference/scientific communication skills were obtained from the scientific process inventory used as pre-test-post-test and from the activity observation form used to evaluate the activity process. In this section, findings related to the development outcome and process of the estimation/inference/scientific communication skills of students with intellectual disabilities are presented. The results of the pretest-posttest data of the estimation/inference/scientific communication skills dimension of the science process skills inventory are presented in Table 7.

Table 7
Pre-Test and Post-Test Results of the Science Process Skills Scale on Estimation / İnference/ Scientific Communication Skills.

Student	Pre-test												Post-test											
	EISC1	EISC 2	EISC 3	EISC 4	EISC 5	EISC 6	EISC 7	EISC 8	EISC 9	EISC 10	EISC 11	EISC 12	EISC 1	EISC 2	EISC 3	EISC 4	EISC 5	EISC 6	EISC 7	EISC 8	EISC 9	EISC10	EISC11	EISC12
Sami	+	+	-	-	-	-	-	-	-	-	-	+	+	-	+	-	-	-	+	+	+	+	-	+
Ali	-	+	-	+	-	-	-	+	-	-	-	-	-	-	+	+	-	-	+	+	+	+	-	+
Hale	-	-	+	-	-	-	-	-	-	-	-	+	-	+	+	+	-	+	+	-	-	-	-	+
Feza	-	-	-	-	-	-	-	-	-	-	-	+	-	+	-	+	-	-	-	+	+	+	-	+
Nur	-	+	+	+	-	-	-	-	+	+	-	+	-	+	+	+	-	-	+	+	+	+	-	+
Oya	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	+	+	+	+	-	-
Eda	-	+	+	-	-	+	+	-	+	+	-	+	+	+	+	+	-	+	+	+	+	+	-	+
Taha	-	-	+	-	-	-	-	+	-	-	-	+	-	+	+	+	-	-	-	+	+	-	-	+
Yunus	-	+	-	+	-	-	+	-	-	-	-	+	+	+	+	+	-	-	+	+	+	+	-	+
Toplam	1	6	4	3	0	1	2	2	2	2	0	7	3	6	7	8	0	2	7	8	8	7	0	8

Notes: "+" performance criteria achieved, "-" performance criteria not achieved.

In the research, in order to determine the effect of the inquiry approach on the estimation/inference/scientific communication skills dimension of students with intellectual disability, besides measuring and comparing the estimation/inference/scientific communication skills of the students before and after the application, the performance of the students in 12 activities applied to improve their scientific process skills was also observed. Spread of light in activity 1, 2 and 3, reflection of light in activity 4, 5, 6 and 7, the subject of light encountering matter in 8 and 9, full shadow formation in activity 10, 11 and 12 were discussed and observations on the prediction skills during the activity process were made and data were obtained from field notes. The findings about estimation, inference and scientific communication skills are presented in Table 8, 9 and 10.

Table 8
The Development Process of Estimation Skill in the Activities Performed in the Light Diffusion Unit

Students	Activities											
	1	2	3	4	5	6	7	8	9	10	11	12
Sami	-	+	+	+	+	+	+	+	+	+	+	+
Ali	-	+	+	+	+	+	-	+	+	+	+	+
Hale	-	+	-	+	-	+	+	+	+	+	+	+
Feza	-	+	+	+	-	+	+	+	+	+	+	+
Nur	+	+	+	+	+	+	+	+	+	+	+	+
Oya	-	+	+	+	+	-	-	+	+	-	+	+
Eda	-	+	+	+	-	-	-	+	+	+	+	+
Taha	-	-	+	+	+	+	-	+	+	+	+	+
Yunus	-	-	+	-	+	+	+	+	+	+	+	+
Toplam	1	7	8	8	6	7	4	9	9	8	9	9

Notes: "+" performance criteria achieved, "-" performance criteria not achieved.

Table 9
The Development Process of the Inference Skill in the Activities Performed in the Light Diffusion Unit

Students	Activities											
	1	2	3	4	5	6	7	8	9	10	11	12
Sami	-	-	-	-	-	-	-	-	-	-	-	-
Ali	-	-	-	-	-	-	-	-	-	-	-	-
Hale	-	-	-	-	-	-	-	-	-	+	-	-
Feza	-	-	-	-	-	-	-	-	-	-	-	-
Nur	-	-	-	-	-	-	-	-	-	-	-	-
Oya	-	-	-	-	-	-	-	-	-	-	-	-
Eda	-	+	-	-	-	-	-	-	-	+	-	-
Taha	-	-	-	-	-	-	-	+	-	-	-	+
Yunus	-	-	-	-	-	-	-	-	-	-	+	-
Toplam	0	1	0	0	0	0	0	1	0	2	1	1

Notes: "+" performance criteria achieved, "-" performance criteria not achieved.

As can be seen in Table 9, in activity 1, students did not have inference skills regarding the propagation of light.

Table 10
The Development Process of Scientific Communication Skills in the Activities Carried out in the Light Diffusion Unit

Students	Activities											
	1	2	3	4	5	6	7	8	9	10	11	12
Sami	-	+	+	+	-	+	+	+	+	+	+	+
Ali	-	+	+	+	+	+	+	+	+	+	+	+
Hale	-	+	+	+	+	+	+	+	+	+	+	+
Feza	+	+	+	-	-	-	+	+	+	+	+	+
Nur	+	+	-	-	+	+	+	+	+	+	+	+
Oya	-	+	+	+	+	-	+	+	+	+	+	+
Eda	+	+	+	+	+	+	+	+	+	+	+	+
Taha	+	-	-	+	+	-	+	+	+	+	+	+
Yunus	+	-	+	+	+	+	+	+	+	+	+	+
Toplam	5	7	7	7	7	6	9	9	9	9	9	9

Notes: "+" performance criteria achieved, "-" performance criteria not achieved.

As a result, it was seen that the findings obtained from the observations made on the performance change of the estimation /inference/scientific communication skills dimension in the post-test compared to the pre-test of the students with intellectual disability and the performances of the students during the activity process supported each other, and it was seen that the activities based on the inquiry teaching approach supported the scientific communication skills of the students with intellectual disability participating in the research. It was concluded that he improved his skills.

In the second sub-problem of the research; "Are students with intellectual disability taught with an inquiry teaching approach able to generalize their scientific process skills to different subject areas?" The answer to the question has been sought. The application was carried out in the light propagation unit, and generalization activities were carried out in three different subject areas, electrical conductivity, force and mixtures, in order to generalize the acquired skills. Findings are presented under these six skills, since basic science process skills are grouped under six skills: classification, observation, measurement, estimation, scientific communication and inference.

Are the students with intellectual disabilities who are taught with the inquiry approach able to generalise the science process skills they have gained to different subject areas?" the findings related to the generalisation of the classification skill among the science process skills. It is given in Table 11.

Table 11
Generalization of Classification Skills in Activities Performed in Different Subject Areas

Students	Classification Skill		
	Generalization Activity 1	Generalization Activity 2	Generalization Activity 3
Sami	+	+	+
Ali	+	+	+
Hale	+	+	+
Feza	+	+	+
Nur	+	+	+
Oya	+	+	+
Eda	+	+	+
Taha	+	+	+
Yunus	+	+	+
Toplam	9	9	9

Notes: "+" performance criteria achieved, "-" performance criteria not achieved.

As seen in Table 11, it is seen that 9 students were able to generalize their classification skills in the activities carried out in three different subject areas. As a result, it was seen that students with intellectual disabilities were able to generalize the classification skills they gained in the light diffusion unit, regardless of the subject.

"Are students with intellectual disability taught with an inquiry approach able to generalize their scientific process skills to different subject areas?" findings regarding the generalization of observation skill, one of the scientific process skills for the question, are given in Table 12.

Table 12
Generalization of Observation Skills in Activities in Different Subject Areas

Students	Observation Skill		
	Generalization Activity 1	Generalization Activity 2	Generalization Activity 3
Sami	+	+	+
Ali	+	+	+
Hale	+	+	+
Feza	+	+	+
Nur	+	+	+
Oya	+	+	+
Eda	+	+	+
Taha	+	+	+
Yunus	+	+	+
Toplam	9	9	9

Notes: "+" performance criteria achieved, "-" performance criteria not achieved.

As seen in Table 12, it is seen that 9 students generalize their observation skills in the activities carried out in three different subject areas. As a result, it was seen that students with intellectual disabilities were able to generalize the observation skill they gained in the light diffusion unit, regardless of the subject.

"Are students with intellectual disability taught with an inquiry approach able to generalize their scientific process skills to different subject areas?" findings regarding the generalization of the measurement skill, one of the science process skills for the question, are given in Table 13.

Table13
Generalization of Measurement Skills in Activities in Different Subject Areas

Students	Measurement Skill		
	Generalization Activity 1	Generalization Activity 2	Generalization Activity 3
Sami	+	+	+
Ali	-	+	+
Hale	+	+	+
Feza	+	+	+
Nur	+	+	+
Oya	+	+	+
Eda	+	+	+
Taha	+	+	+
Yunus	+	+	+
Toplam	8	9	9

Notes: "+" performance criteria achieved, "-" performance criteria not achieved.

As can be seen in Table 13, it is seen that 9 students were able to generalize their measurement skills in the activities carried out in three different subject areas. As a result, it was seen that students with intellectual disabilities were able to generalize the measurement skill they gained in the light diffusion unit, regardless of the subject.

"Are students with intellectual disability taught with an inquiry approach able to generalize their scientific process skills to different subject areas?" findings regarding the generalization of the estimation skill, one of the science process skills for the question, are given in Table 14.

Table 14
Generalization of Estimation Skills in Activities Performed in Different Subject Areas

Students	Estimation Skill		
	Generalization Activity 1	Generalization Activity 2	Generalization Activity 3
Sami	+	+	+
Ali	+	+	+
Hale	+	+	+
Feza	+	+	+
Nur	+	+	+
Oya	+	+	+
Eda	+	+	+
Taha	+	+	+
Yunus	+	+	+
Toplam	9	9	9

Notes: "+" performance criteria achieved, "-" performance criteria not achieved.

As seen in Table 14, it is seen that 9 students generalize their estimation skills in the activities carried out in three different subject areas.

As a result, it was seen that students with intellectual disabilities were able to generalize the estimation skills they gained in the light diffusion unit independently of the subject.

“Are students with intellectual disability taught with an inquiry approach able to generalize their scientific process skills to different subject areas?” findings regarding the generalization of the inference skill from the scientific process skills for the question are given in Table 15.

Table 15
Generalization of Inference Skills in Activities Performed in Different Subject Areas

Students	Inference Skill		
	Generalization Activity 1	Generalization Activity 2	Generalization Activity 3
Sami	-	-	-
Ali	-	-	-
Hale	-	-	-
Feza	-	-	-
Nur	-	+	-
Oya	-	-	-
Eda	-	-	-
Taha	+	-	-
Yunus	-	-	+
Toplam	1	1	1

Notes: "+" performance criteria achieved, "-" performance criteria not achieved.

Performance evaluation was made in the light diffusion unit of the inference skill and, as seen in Table 9, it was seen that the activities involving inference skill were completed in very few activities.

As a result, it was seen that students with intellectual disabilities were able to generalize the inference skill, which had a limited improvement in the light diffusion unit, independently of the subject.

“Are students with intellectual disability taught with an inquiry approach able to generalize their scientific process skills to different subject areas?” findings regarding the generalization of

scientific communication skills, one of the scientific process skills for the question, are given in Table 16.

Table 16
Generalization of Scientific Communication Skills in Activities in Different Subject Areas.

Students	Scientific Communication Skill		
	Generalization Activity 1	Generalization Activity 2	Generalization Activity 3
Sami	+	+	+
Ali	+	+	+
Hale	+	+	+
Feza	+	+	+
Nur	+	+	+
Oya	+	+	+
Eda	+	+	+
Taha	+	+	+
Yunus	+	+	+
Toplam	9	9	9

Notes: "+" performance criteria achieved, "-" performance criteria not achieved.

As seen in Table 17, it is seen that the students can generalize the scientific communication skills they have acquired during the application process without being affected by the change in the subject area.

As a result, it was seen that students with intellectual disabilities were able to generalize the scientific communication skills they gained in the unit of diffusion of light regardless of the subject.

CONCLUSION and DISCUSSION

In this study, the effects of the inquiry approach on the scientific process skills of students with intellectual disability was examined and the development of students' basic scientific process sub-skills such as observation, classification, measurement, estimation, scientific communication and inference was focused. Although findings obtained in this study conducted on students with intellectual disabilities and their development in scientific process sub-skills is not examined in the literature, several studies (Aminah, 2015; Demirkıran, 2016; Duygu, 2018; Junair et al., 2018; Juniar & Fardilah, 2019; Kırılmazkaya, 2014; Tatar, 2006; Özkan, 2015; Thoron & Myers, 2012; Wardani & Djukri, 2019) were conducted students without disabilities by implementing inquiry approach.

Although the competence of the observation skill, which is the first of the scientific process sub-skills, varies among individuals, it is the basic skill that starts to develop in all individuals from birth (Aslan et al., 2016). However, the skill of conscious and goal-oriented observation develops as it is used (Özkan, 2015). As a result of the study, it was observed that the observation skills of the students improved in general and it was also determined that the students' qualitative observation skills (color, texture, shape) made better progress than their quantitative observation skills (defining an event with number and quantity). The ability of individuals to group the entities they observe around them according to their various characteristics is defined as the ability to classify (Çepni, 2005). In the study, the improvement in the classification skills of individuals by using their sense organs is observed in the student named Taha's taking into account the roughness situations by touching the surfaces while trying to classify the scattered and smooth reflecting objects and benefiting from the sense of touch as well as the sense of sight. This situation is compatible with the view that students with intellectual disabilities learn

concrete subjects more easily than abstract subjects (Çapraz, 2020). At the same time, it supports the fact that the observation and classification skills are mutually influenced, and the individual who can classify can make better observations (Atik, 2019).

In the study, the rapid development in the ability to use the measurement tools for the development of measurement skills, to use the concepts such as few-many, large-small, long-short correctly, and to make a sequence is compatible with the knowledge that these individuals learn better when supported by visual objects (Çapraz, 2016). However, when the amount to be measured increases, the decrease in the number of correct answers is interpreted as the fact that students with intellectual disabilities have limited, scattered and shorter attention levels (Arpacik, 2014).

It has been seen that another scientific process sub-skill that shows the fastest development is the estimation skill. It was observed that the students who could not make predictions in the first activities of the study and did not understand what was asked, could make predictions if they were presented with options. In the application process, it was observed that this skill was acquired quickly. Due to the insecurity of students with intellectual disabilities towards their potential (Uysal, 2014), it was noticed that these students were not expected to make predictions, and the lack of an educational environment to demonstrate the skill was noticed. This situation is supported by the view that learning is a product of experiences in the literature (Çoban, 2018).

During the activities carried out with students with intellectual disabilities, it was expected that students would be able to convey scientific facts correctly and answer the questions posed using logical and scientific concepts in accordance with their purpose. Although the answers received were in the form of showing body movements, expressing them with a single word, and simple drawings, it was observed that scientific communication took place and an improvement was observed in scientific communication skills. The literature view that information can be shared verbally or non-verbally and a common understanding between the parties is important (Aslan et al., 2016) supports that scientific communication skills develop in students with intellectual disabilities.

The hypothesis established for the scientific process skills in the study was that the inquiry approach had a positive effect on all scientific process skills, even if the students had intellectual disability. However, as in the study (Özkan, 2015), in which the scientific process skills of preschool students with limited mental activities were developed by using concrete concepts and activities from the close environment of the students (Özkan, 2015), an improvement was observed in the basic scientific process skills of the students with intellectual disabilities, except for the inference skills. One of the reasons why the inquiry teaching approach does not affect the inference skills of students with intellectual disability positively is that the development of inference skills depends on the development of other scientific process skills, that is, as the skills of observation, classification, measurement and scientific communication develop, the inference skills improve afterwards. It is supported by the view that inference skill is affected by basic scientific process skills such as observation and measurement and requires higher level thinking processes (Atik, 2019).

The second reason for the problems encountered in the process of acquiring inference skills is the memory of students with intellectual disabilities (Gürsel, 2017; Heward, 2013; Smith, 2007; Turnbull et al., 2013; Westwood, 2007) and generalization (Heward, 2013; Smith, 2007; Turnbull et al., 2013). This situation consists of students with intellectual disabilities having problems in the transition of information from short-term memory to long-term memory (Çayır, 2021; Özokçu, 2013). However, it is seen that they make inferences and generalizations, albeit rarely, by using the knowledge and skills transferred to long-term memory (Özsoy et al., 1998) (Cromby et al., 1996). The results of this study support the studies in the literature. Activities carried out with plenty of experience and concrete materials can provide inference skills (Vuran 2002). In this study, adherence to the unit's achievements and limited application time limited

the number of activities. The lack of development in inference skills and the problems of concentrating and focusing were associated with students with intellectual disabilities. Another interpretation of this situation is that it supports the idea that the development of inference skills may be a predictor of mental disability.

It is thought that starting the acquisition of science-related knowledge and skills in the early period and continuing it throughout life will increase the use of these skills by students with intellectual disabilities and become more meaningful for them (Martin, 2005).

When the findings obtained in the study were evaluated, it was observed that students with intellectual disabilities had an effect on the development of scientific process skills with an inquiry teaching approach. It can be said that the use of inquiry teaching approach in science teaching to students with intellectual disabilities will have positive effects on the development of students. As a result, this study differs from the studies in the literature in terms of examining scientific process skills on the basis of sub-skills, and it has been shown that the inquiry teaching approach is effective in acquiring basic scientific process skills for students with intellectual disabilities and in generalizing these skills.

Limitations of the Study

During the period when schools were closed due to the Covid-19 outbreak, activities continued in rehabilitation centres where students participated. Some students included in the study were quarantined due to Covid-19 and could not participate in the activities for 15 days. After the end of the quarantine period, these students were given the opportunity to continue their rehabilitation education from the point where they left off.

The activities implemented in the rehabilitation centre were carried out within the framework of the facilities offered by the centre and the specified time frame. The 5th grade Light Unit outcomes in the 2018 Science Curriculum are generally focused on scientific process skills and include observation, prediction, communication and inference skills. Since they are suitable for these skills, activities for these skills were included in all of the activities.

However, since some objectives were not suitable for classification and measurement skills due to their nature, activities for such skills could not be realised in some activities. The activities designed for the development of scientific process skills were limited to the objectives in the 5th grade Light Unit and 2 activities were organised per week due to time constraints.

Acknowledgement and Support

This study was produced from the master's thesis titled " The effect of inquiry teaching approach on scientific process skills of students with intellectual disabilities" (2021) prepared by Saadet BAYRAK under the supervisions of Sedat Karaçam and Hakan ÖZAK.

Statement of Contribution Rate

The authors of the study contributed equally to all processes of the study.

Declaration of Conflict of Interest

As the study authors, we declare that we do not have any declaration of interest/conflict.

Statement of Publication Ethics

All the rules specified in the "Directive on Scientific Research and Publication Ethics of Higher Education Institutions" were complied with in the whole process from planning, implementation, data collection to data analysis of this research. None of the actions specified under the second section of the Directive, "Actions Contrary to Scientific Research and Publication Ethics", have been carried out.

In the writing process of this study, scientific, ethical and citation rules were followed; no falsification was made on the collected data and this study was not sent to any other academic publication environment for evaluation. .

Research ethics committee approval information

Name of the ethics committee: Duzce University

Date of the decision: 11/12/2019

Document issue number: E.69209

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GENİŞLETİLMİŞ ÖZ

Giriş

Zihinsel engelli öğrencilerin öğrenmede yaşadıkları bilişsel güçlükler nedeniyle öğrencilerin özelliklerine uygun birçok özel öğretim yöntemi geliştirilmiştir. Zihinsel engelli öğrencilerin eğitim süreçleri incelendiğinde, çalışmaların öğrencinin sık tekrar yapmasına dayalı farklı öğretim yöntemleri ile kavramların edinimi üzerine kurulu olduğu görülmektedir (Biber, 2009; Çapraz, 2016; Öner, 2018). Gözlem ve deneylerde soyut materyaller yerine somut üç boyutlu materyallerle çalışma fırsatı verildiğinde sonuç çıkarma, genelleme yapma ve bilgiyi transfer etme becerileri daha iyi gelişir (Anagün, 2015). Dolayısıyla zihinsel yetersizliği olan öğrencilere performanslarına uygun öğretimsel uyarlamalarla bilimsel süreç becerileri kazandırılabilir. Bu becerileri öğrenen zihinsel yetersizliği olan öğrencilerin hem okulda hem de günlük yaşamlarında karşılaşacakları birçok problemi çözmede daha başarılı olmalarını sağlamak ve çevreye uyum sağlamaları açısından önemlidir.

Zihinsel yetersizliği olan öğrencilere performanslarına uygun öğretimsel uyarlamalarla bilimsel süreç becerileri kazandırılabilir. Bu becerileri öğrenen zihinsel yetersizliği olan öğrencilerin hem okulda hem de günlük yaşamlarında karşılaşacakları birçok problemi çözmede daha başarılı olmalarını sağlamak ve çevreye uyum sağlamaları açısından önemlidir. Ancak zihinsel yetersizliği olan öğrencilerin değişen yaşam koşullarına uyumunu destekleyecek öğrenmelerin yetersiz olduğu fark edilmiştir. Sorgulayıcı öğretim yaklaşımı ile zihinsel engelli öğrencilere günlük yaşamlarını olumlu yönde etkileyecek temel süreç becerileri kazandırılabilir. Bu nedenle bu çalışmada, araştırma-inceleme yoluyla öğretim yaklaşımının zihinsel yetersizliği olan öğrencilerin bilimsel süreç becerilerine ve bu becerilerin kalıcılık ve genelleme süreçlerindeki etkililiğine etkisi olup olmadığı araştırılmıştır.

Yöntem

Bu çalışmada, sorgulayıcı öğretim yaklaşımının zihinsel engelli öğrencilerin bilimsel süreç becerileri üzerindeki etkisini değerlendirmek için nitel araştırma yöntemlerinden durum çalışması kullanılmıştır.

Araştırma grubu amaçlı ve uygun örnekleme yöntemi kullanılarak oluşturulmuştur. Araştırma grubu, ortaokul 5. veya 6. sınıfa devam eden, özel eğitim sınıfına devam eden ve devamsızlık sorunu olmayan hafif veya orta düzeyde zihinsel yetersizliği olan 9 öğrenciden oluşmaktadır. Öğrencilerin isimleri gizli tutulmuş ve bunun yerine kod adları kullanılmıştır.

Araştırma verileri Özkan (2015) tarafından geliştirilen bilimsel süreç becerileri envanteri ve araştırmacı tarafından geliştirilen etkinlik gözlem formu kullanılarak toplanmıştır.

Gözlem formunda yer alan her bir etkinlikte bilimsel süreç becerilerinin gözlemlenmesi sırasında dikkat edilmesi gereken davranış ve ifadelerin bir listesidir. Gözlem formunda bulunmayan öğrencinin sergilediği farklı davranışlar ise alan notu olarak bu formlara not edilmiştir.

Araştırmada elde edilen veriler betimsel analiz yöntemi ile analiz edilmiştir. Veri analizi, zihinsel yetersizlikten etkilenmiş öğrencilerin bilimsel süreç becerilerine ilişkin ön test-son testten elde edilen verilerin ve süreç boyunca yapılan gözlemlerin analiz edilmesi ve bütünleştirilmesi sürecini kapsamaktadır. Bilimsel süreç becerileri envanterinin uygulandığı ön test ve son test ile tüm etkinlikler video kayıt tekniği ile kaydedilmiştir. Elde edilen verilerden tablolar oluşturularak hem bireysel hem de grup olarak gelişimleri tespit edilmiştir. Ön test-son test sonuçları ile etkinlik sürecindeki gelişmeler bütünleştirilerek bilimsel süreç becerilerinin tutarlılığı belirlenmiştir.

Bulgular

Çalışmada elde edilen bulgular değerlendirildiğinde, zihinsel engelli öğrencilerin bilimsel süreç becerilerinin gelişiminde sorgulayıcı öğretim yaklaşımının etkisi olduğu görülmüştür. Zihinsel

engelli öğrencilere fen öğretiminde sorgulayıcı öğretim yaklaşımının kullanılmasının öğrencilerin gelişimleri üzerinde olumlu etkileri olacağı söylenebilir. Sonuç olarak bu çalışma, bilimsel süreç becerilerinin alt beceriler bazında incelenmesi açısından literatürdeki çalışmalardan farklılık göstermekte olup, zihinsel yetersizliği olan öğrencilere temel bilimsel süreç becerilerinin kazandırılmasında ve bu becerilerin genellenmesinde sorgulayıcı öğretim yaklaşımının etkili olduğu gösterilmiştir.

Tartışma ve Sonuç

Araştırma-inceleme yoluyla öğretim yaklaşımının zihinsel yetersizliği olan öğrencilerin bilimsel süreç becerilerine etkisinin incelendiği bu çalışmada, araştırma-inceleme yoluyla öğretim yaklaşımının öğrencilerin gözlem, sınıflandırma, ölçme, tahmin etme, bilimsel iletişim ve çıkarım yapma gibi temel bilimsel süreç alt becerileri üzerindeki gelişimine odaklanılmıştır.

Bilimsel süreç alt becerilerinden ilki olan gözlem becerisinin yeterliliği bireyler arasında farklılık gösterse de doğumdan itibaren tüm bireylerde gelişmeye başlayan temel beceridir (Aslan ve ark., 2016). Ancak bilinçli ve amaca yönelik gözlem yapma becerisi kullanıldıkça gelişir (Özkan, 2015). Çalışma sonucunda genel olarak gözlem becerilerinin geliştiği görülmüş ve öğrencilerin nitel gözlem becerilerinin (renk, doku, şekil) nicel gözlem becerilerine (bir olayı sayı ve miktarla anlatma) göre daha iyi ilerleme kaydettiği belirlenmiştir.

Bireylerin çevrelerinde gözlemledikleri varlıkları çeşitli özelliklerine göre gruplandırabilmeleri sınıflandırma yeteneği olarak tanımlanmaktadır (Çepni, 2005). Çalışmada Taha isimli öğrencinin dağınık ve düzgün yansıyan nesneleri sınıflandırmaya çalışırken yüzeylere dokunarak pürüzlülük durumlarını dikkate alması ve görme duyusunun yanı sıra dokunma duyusundan da faydalanması ile bireylerin duyu organlarını kullanarak sınıflandırma becerilerindeki gelişim gözlemlenmiştir.

Çalışmada ölçme becerilerinin gelişimi için ölçme araçlarını kullanma, az-çok, büyük-küçük, uzun-kısa gibi kavramları doğru kullanma ve sıralama yapma becerilerindeki hızlı gelişim, bu bireylerin görsel nesnelerle desteklendiğinde daha iyi öğrendikleri bilgisi ile uyumludur (Çapraz, 2016). Ancak ölçülecek miktar arttığında doğru cevap sayısının azalması zihinsel engelli öğrencilerin sınırlı, dağınık ve daha kısa dikkat düzeyine sahip oldukları şeklinde yorumlanmaktadır (Arpacık, 2014).

En hızlı gelişim gösteren bir diğer bilimsel süreç alt becerisinin ise tahmin becerisi olduğu görülmüştür. Çalışmanın ilk etkinliklerinde tahmin yapamayan ve ne sorulduğunu anlamayan öğrencilerin kendilerine seçenek sunulması durumunda tahmin yapabildikleri görülmüştür. Uygulama sürecinde ise bu becerinin hızlı bir şekilde kazanıldığı gözlemlenmiştir. Zihinsel yetersizliği olan öğrencilerin potansiyellerine yönelik güvensizlikleri (Uysal, 2014) nedeniyle bu öğrencilerden tahmin yapmalarının beklenmediği ve beceriyi ortaya koyabilecekleri bir eğitim ortamının eksikliği fark edilmiştir.

Zihinsel engelli öğrencilerle gerçekleştirilen etkinliklerde, öğrencilerin bilimsel gerçekleri doğru bir şekilde aktarabilmeleri ve sorulan sorulara amacına uygun olarak mantıksal ve bilimsel kavramları kullanarak cevap verebilmeleri beklenmiştir. Alınan cevaplar vücut hareketlerini gösterme, tek kelime ile ifade etme ve basit çizimler şeklinde olsa da bilimsel iletişimin gerçekleştiği ve bilimsel iletişim becerilerinde gelişme olduğu gözlemlenmiştir.

Araştırmada bilimsel süreç becerileri için kurulan hipotez, öğrenciler zihinsel yetersizliğe sahip olsalar bile sorgulayıcı öğretim yaklaşımının tüm bilimsel süreç becerileri üzerinde olumlu bir etkiye sahip olduğu yönündedir. Ancak zihinsel faaliyetleri sınırlı olan okul öncesi öğrencilerinin bilimsel süreç becerilerinin somut kavramlar ve öğrencilerin yakın çevresinden etkinlikler kullanılarak geliştirildiği çalışmada (Özkan, 2015) olduğu gibi zihinsel yetersizliği olan öğrencilerin temel bilimsel süreç becerilerinde çıkarım yapma becerisi dışında bir gelişme gözlenmemiştir. Sorgulayıcı öğretim yaklaşımının zihinsel yetersizliği olan öğrencilerin çıkarım yapma becerilerini olumlu yönde etkilememesinin nedenlerinden biri, çıkarım yapma becerilerinin gelişiminin diğer bilimsel süreç becerilerinin gelişimine bağlı olması, yani gözlem,

sınıflama, ölçme ve bilimsel iletişim becerileri geliştikçe çıkarım yapma becerilerinin de gelişmesidir. Çıkarım becerisinin diğer temel bilimsel süreç becerilerinden etkilendiği ve daha üst düzey düşünme süreçleri gerektirdiği görüşü ile desteklenmektedir (Atik, 2019).

Çıkarım becerilerinin kazanılması sürecinde karşılaşılan sorunların ikinci nedeni zihinsel yetersizliği olan öğrencilerin bellekleri ve genellemeleridir (Heward, 2013; Smith, 2007; Turnbull ve ark., 2013). Bu durum zihinsel yetersizliği olan öğrencilerin kısa süreli bellekten uzun süreli belleğe bilgi geçişinde sorun yaşamalarından kaynaklanmaktadır (Çayır, 2021; Özokçu, 2013).