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# Comparing the Solitary and Tablet Assisted Presentations of Direct Instruction Method in Teaching Science Topics to Students with Intellectual Disabilities

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## Abstract

The purpose of the study is to determine whether the solitary and tablet assisted presentations of direct instruction method differed in terms of efficiency and effectiveness in teaching science topics to students with intellectual disabilities and to obtain the opinions of participating students and their real-time teachers about two different instructions. The participants were four male students who had been diagnosed with intellectual disability. Adapted alternating treatments model, among single-subject research designs, was used in the study. The research findings indicated that the solitary and tablet assisted presentations of direct instruction method were both effective in teaching respiratory system and digestive system topics to students with mental disabilities, the participants could generalize what they had acquired to different settings and people, and they preserved what they had learnt 10, 20, and 35 days after the instruction was over. The productivity findings of the study implied that the tablet assisted presentation of the direct instruction method was more efficient. Social validity findings uncovered that students and teachers had positive opinions about the study.

**Keywords:** Intellectual Disability, Direct Instruction, Tablet Computer Application, Science Concepts

## 1. Introduction

The effects of economic, scientific, and technological developments and changes on our lives have been obvious in today's age of technology. In an era of change, the welfare level of countries is related to the degree of adaptation to those developments (Yener & Yılmaz, 2017). Therefore, superiority in science and technology plays a decisive role in increasing social welfare. Prioritizing science is among the ways of increasing the welfare level of countries (Gürses, Açıkıldız, Bayrak, Yalçın, & Doğar, 2004). Innovations and inventions in science both contribute to the development of countries and lead to scientific and technological improvements (Aksüt, 2011). Therefore, countries tend to attribute special importance to science education for raising

productive individuals in knowledge and technology so as not to lag behind scientific and technological developments and to ensure continuous progress (Ayas, Çepni, & Akdeniz, 1993).

In the present age of information and technology, the objectives of science courses include raising individuals with science awareness who understand and grasp information, produce information using mental processes (Okcu, 2016), and improve themselves (Karakoç, 2016). In line with these, the vision of the Science Curriculum has been determined to be cultivating science-literate students regardless of their differences (Ministry of National Education [MoNE], 2018).

The literature indicates that various methods and techniques in science courses have been exploited to raise science-literate individuals based on the needs of students. Small group teaching, observational learning, unintended teaching, peer modeling, and peer teaching methods for teaching functional academic skills, and the methods using reaction clues for accurate teaching methods have been used in teaching science to students with special needs (Batu, 2008). The direct instruction method has intensively been used to teach topics and concepts in science lessons to students with special needs (MoNE, 2018).

Direct instruction is a teaching method consisting of reiterated exercises to ensure permanence and the steps of modeling, guided application, and independent application (Dağseven-Emecen, 2011; Karabulut & Özkubat, 2021). Direct instruction is a frequently used teaching method for special needs students in teaching courses with academic skills such as mathematics, literacy, life studies, social studies, and science (Vuran & Çelik, 2013). Besides, it is an extremely effective method in achieving different educational goals (Uçar, 2017; Özkubat, Karabulut & Uçar, 2021).

It was observed that there had been various studies in local and global literature examining the effectiveness and/or efficiency of direct instruction method thanks to the use of direct instruction method (Alptekin & Özyürek, 2013; Dağseven-Emecen, 2011; Özokcu, Akçamete, & Özyürek, 2011; Çakır, 2006; Tavil, 2005; Ekeril, 2000; Güzel, 1999).

Equality of opportunity in education, advances in technology, and legislations result in the widespread use of technology in education and particularly in the field of special education (Acungil, 2014). Considering the positive effects, the use of technology becomes significant for the education of individuals with intellectual disabilities.

There have been various studies in the literature on the effectiveness of teaching via technological instruments and tablet computers (Özbek, 2019; Boşnak, Yıkımsı, & Cavkaytar, 2015; Acungil, 2014; Özak, 2008). There were also international studies conducted with technological instruments and tablet computers (Hammond, Whatley, Ayres & Gast, 2010; Kagohara, Sigafos, Achmadi, Meer, O'Reilly & Lancioni, 2011; Allen, Burke, Howard, Wallace & Bowen, 2012; Cullen, 2013; Doenyas, Şimdi, Çataltepe & Birkan, 2014). However, the number of studies involving technological instruments and tablet computer applications in science education on individuals with intellectual disabilities is limited (Olsen, 2007; Wood, 2014; Sola-Özgüç, 2015; Sola Özgüç & Cavkaytar, 2016).

The increase in the use of tablet computers in the world has been gaining momentum in recent years. It has been observed that tablet-based teaching for students with special needs yields effective results (Özbek, 2014; Öztürk & Yıkımsı, 2020; Boşnak, Yıkımsı, & Cavkaytar, 2015; Acungil, 2014). However, the number of studies involving tablet computer applications in science education on individuals with intellectual disabilities is limited in both local and global literature (Wood, 2014; Sola-Özgüç, 2015; Sola Özgüç & Cavkaytar, 2016). As the studies involving tablet computer applications in the training of students with intellectual disabilities are quite recent, it is necessary to test their effectiveness and efficiency by conducting further research. Therefore, this study is deemed to be significant in terms of comparing the direct instruction method, which has been proven effective in teaching science topics (Türker Yıldırım & Çifci Tekinarslan, 2020; Yılmaz, 2017; Çapraz, 2016; Knight, Smith, Spooner, & Browder, 2012; İlik, 2009) and tablet computer applications in which technology is involved.

This study aimed to determine whether the solitary and tablet assisted presentations of the direct instruction method differed in terms of efficiency and effectiveness in teaching science topics to students with intellectual disabilities. Answers to the following questions were sought in the study.

1. Does the effectiveness of the solitary and tablet assisted presentations of the direct instruction method to differ in terms of the acquisition, monitoring, and generalization in teaching digestive system topic to students with intellectual disability?
2. Does the effectiveness of the solitary and tablet assisted presentations of direct instruction method differ in terms of the acquisition, monitoring, and generalization in teaching respiratory system topic to students with intellectual disability?
3. Is there any difference between the solitary and tablet assisted presentations of direct instruction method in teaching science topics to students with intellectual disability in terms of (a) the number of sessions, (b) the number of trials, (c) the number of errors, and (d) the total instruction period until the criteria were met?
4. What are the opinions of the participating students about the research procedure?
5. What are the opinions of the real-time teachers of the participating students about the research process?

## 2. Method

### 2.1. Research Model

Adapted alternating treatments model, among single-subject research designs, was used in the study.

#### 2.1.1. Dependent Variables

The study had two dependent variables. The first one was the respiratory system topic which was intended to be taught to individuals with intellectual disability with 80% of achievement, and the second one was the digestive system topic with 80% of achievement.

#### 2.1.2. Independent Variables

The independent variables of the study were the instruction of the tablet assisted presentation of the direct instruction method, and that of the direct instruction method without the tablets.

The dependent and independent variables for the participating students were presented in Table 2.1.

Table 2.1: Independent and dependent variables for participating students

Participants	Tablet assisted Presentation of Direct Instruction Method	Solitary Presentation of Direct Instruction Method
Onur	Respiratory system	Digestive system
Eren	Respiratory system	Digestive system
Mert	Respiratory system	Digestive system
Emre	Respiratory system	Digestive system

### 2.2. The Participants

This study was conducted with four students who had been diagnosed with mild intellectual disability and attending a special education class in a secondary school in Bolu city center in the academic year of 2018-2019. The prerequisites were sought in determining the participants for the study. They were (a) not having a previous systematic instruction on the digestive system and respiratory system topics which determined to be the dependent variables of the study, (b) to be literate and understand written material, (c) to fulfil verbal instructions (d) to be able to answer written questions directed to him/her in black and white, (e) to be able to answer verbal questions orally, (f) to be able to direct attention to an activity for at least five minutes.

Pseudonyms were used in the study instead of the real names of the participants. The demographics of the participants were submitted in Table 2.2.

Table 2.2: The Demographics of the Participants

Participants	Age	Gender	Type of Disability
Onur	12 y 3 m	Male	Mild intellectual disability
Mert	12 y 9 m	Male	Mild intellectual disability
Eren	11 y 9 m	Male	Mild intellectual disability
Emre	11 y 10 m	Male	Mild intellectual disability

### 2.3. The Practitioner and Observer

The instruction procedure was carried out by the first author. The second author, on the other hand, acted as a consultant at each stage. Inter-observer reliability and instruction reliability data of the study were obtained by two observer field experts.

### 2.4. Setting

All sessions of the study (baseline, teaching, daily “probe,” generalization, and follow-up sessions) were held in the parent-teacher association room of approximately 15m<sup>2</sup> within the school. There were a desk, five chairs, and a coffee table in the room. During the sessions, the researcher and the participating student sat side-by-side at the desk.

### 2.5. Aids and Materials Used in the Study

Two tablet computers, a video camera, digestive system software, respiratory system software, external hard drive for storing videos, tripod, teaching material prepared by the researcher for respiratory system, teaching material prepared by the researcher for the digestive system, various reinforcers, pens, and data collection instruments for teaching, daily “probe,” generalization and follow-up sessions to keep performance records of the participants were used in the study.

#### 2.5.1. Digestive System and Respiratory System Mobile Applications

Mobile applications in Turkish were developed within the scope of this study to teach digestive system and respiratory system topics to children with intellectual disabilities.

Two mobile applications related to the digestive and respiratory systems have been developed in line with the target behaviours for the present study. It was aimed to develop a user-friendly tablet application. Moreover, plain screen designs for the mobile apps were preferred not to distract the users’ attention and only the required number of buttons were placed. The number of written texts was kept to the minimum in the Respiratory System and Digestive System Mobile Application, and the texts were voiced and arranged at a proper level for the student’s understanding. Besides, similar designs were used for the digestive system and respiratory system applications. Figure 2.1: presented the screenshot of the user login for the application. The user must first enter his/her name and click the “LOGIN” button to use the application.



Figure 2.1: The screenshot of Digestive System mobile app user login

After the login, the user is directed to the page with the definition of digestion. After listening to the definition, the user can proceed to the next page by clicking the organs button. The red door button allows returning to the main page.



Figure 2.2: The screenshot of the definition of digestion

When the user proceeds to the organs in the digestive system, it is possible to listen to what the organs are by clicking on the organs one by one. If s/he clicks the "function" button, s/he is forwarded to the relevant organ whose function is to be heard.



Figure 2.3: The screenshot of the organs in the digestive system



Figure 2.4: The screenshot of the function of the small intestine



Figure 2.5: The screenshot of the function of the large intestine

If the user clicks the listen button, s/he listens to the function of the relevant organ. It is possible to proceed by clicking the buttons for home, previous screen, and next screen.



Figure 2.6: The screenshot of Let's answer the questions section

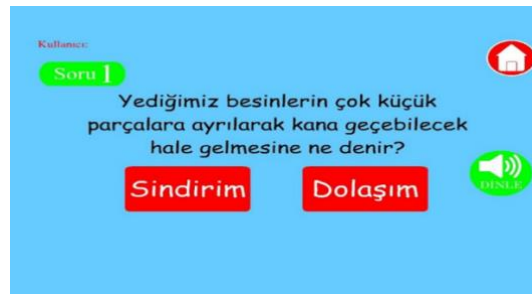


Figure 2.7: The screenshot of Question 1

There is a “Start” button at the beginning of the “Let’s answer the questions” section. On the next page, the user may listen to the question and options by clicking the “Listen” button. If the user clicks on the correct option after listening to the question, “Well done! Username” on the screen is displayed in accompany with an applause effect, and the “Next” button has been added to proceed to the next question. If the user clicks on the wrong option, “Try Again” is displayed on the screen in accompany with a warning beep. The user is warned that the topic should be listened to again by pressing the “Back to Topic” button, and s/he is directed to the previous page where the topic has been covered.

### 2.6. The Experimental Procedure

The experimental procedure of the study consisted of the pilot scheme, baseline sessions, teaching sessions, daily “probe” sessions, generalization sessions, and follow-up sessions. All the stages in the experimental process were carried out by the researcher and recorded with a video camera. All sessions were conducted in a one-to-one teaching arrangement.

The pilot scheme was conducted to determine the potential problems that may arise during the experimental procedure and to take necessary precautions. The participant in the pilot scheme was an 11-year-old male student who had been diagnosed with intellectual disability and attending a special education class. No problems arose during the pilot scheme. The experimental procedure was carried out as it was planned.

The baseline probe lasted for at least three consecutive sessions until stable data was obtained. The respiratory system data collection form and digestive system data collection form were used with all participants for three days in respective probe sessions for each topic. During these sessions, attention grabbers were used to attract the student's attention (“Hello! Are you ready to work with me?”). It was reinforced when the student orally expressed that s/he was ready (“Great, you are ready.”). Then, questions in the data collection form were posed depending on the topic to be taught. After posing a question, the practitioner waited for the student for five seconds to react, and then, the questions with correct answers were recorded as correct responses (+), and those with incorrect or no answers were recorded as false responses (-) to the data collection form. No feedback or correction was provided to the students during the baseline session.

### 2.6.1. The Solitary Presentation Of Direct Instruction Method For The Digestive System And Respiratory System

During the teaching sessions, the practitioner briefly explained the rules that the student should obey, which topic should be covered, and why it should be learned by sitting side-by-side with the student while starting the teaching session. The aids to be used in the teaching process were introduced to the student and s/he was allowed to examine for a while. The lesson plans based on the direct instruction method consisted of materials, preparation for teaching, modelling, guided application, and independent application phases. During the modelling phase, the practitioner verbally presented the information together with the material in front and repeated it several times. The practitioner waited for the student to repeat after several repetitions. The student's correct answers were reinforced. If the student was mistaken, the practitioner repeated and waited for the student to follow. During the guided practice phase, the practitioner asked what the student was taught during the modelling phase together with the material in front. The practitioner reinforced the student's correct answer. If the student did not react or made a mistake, the practitioner reiterated and waited for the student to follow. During the independent application phase, the practitioner asked the student to answer the questions in the section of let's answer the questions. The student answered the questions. If the student answered the questions correctly, s/he moved on to the other question, if s/he answered incorrectly, the practitioner returned to the topic. Then, the student answered the question again. S/he moved on to the other question. The process continued in the same way.

### 2.6.2. The Tablet Assisted Presentation Of Direct Instruction Method For The Digestive System And Respiratory System

Preparatory education was provided to each student beforehand. Before the teaching, the participants were supplied with applied information on how to use the tablet computer by the researcher. Preparatory education lasted approximately 10 minutes for each student.

During the teaching sessions, the practitioner briefly explained the rules that the student should obey, which topic should be covered, and why it should be learned by sitting side-by-side with the student while starting the teaching session. The aids to be used in the teaching process were introduced to the student and s/he was allowed to examine for a while. The lesson plans based on the direct instruction method consisted of materials, preparation for teaching, modelling, guided application, and independent application phases. During the modelling phase, the practitioner stated that they would click the button next to the text and learn the relevant words. The student and the practitioner clicked the dubbing button in the application and listened to the verbal information. After listening to the verbal information on the tablet, the practitioner expected the student to repeat what s/he had listened to. The student's correct answers were reinforced. The student was asked to listen to the tablet again if s/he was mistaken. During the guided practice phase, the implementer asked the student to repeat what s/he had heard on the tablet during the modelling phase. The practitioner reinforced the student's correct answer. If the student did not react or made a mistake, the teacher asked him/her to listen to the tablet again and repeat. During the independent application phase, the practitioner asked the student to do the section of let's answer the question on the tablet. The student answered the questions on the tablet. If the student answered the questions on the tablet correctly, s/he moved on to the next question, but if s/he gave the wrong answer, s/he returned to the topic on the tablet and listened. S/He listened to the question and answered it again. Then, s/he moved on to the next question. The process continued in the same way. The practitioner declared what s/he learned at the end. The practitioner celebrated the student for working very well during the lesson and following the rules and finished the lesson by announcing the award. Then, the evaluation session began.

### 2.7. Monitoring Sessions

Follow-up sessions were held to determine to what extent students preserved the target behaviours they learned after the end of teaching. Follow-up data were collected by the researcher on the tenth, twentieth, and thirty-fifth days following the acquisition of target behaviours by all students. Monitoring sessions were conducted following the same process as baseline sessions. The obtained data were recorded in the data registration form.



## 2.8. Generalization Sessions

Data on the generalization sessions of the study were collected using different materials and people. Generalization sessions were held with all participating students one week after the end of the teaching sessions. Generalization data were obtained from the participants by preparing materials in 30\*40 cm with over questions about target behaviours. Besides, generalization data were retrieved by posing questions about target behaviours to the participants by a different teacher.

## 2.9. Data Collection and Analysis

Four types of data were obtained in the study: effectiveness, efficiency, social validity, and reliability data (inter-observer reliability and instruction reliability data). The effectiveness data of the study were estimated based on the baseline level of the topics, their correct responses in daily “probe,” follow-up and generalization sessions and were graphically analysed. The charts contained data regarding baseline level, teaching, daily “probe” and monitoring sessions. Besides, the students’ correct responses for the generalization pre-test and post-test sessions were also presented with a column chart.

Whether the solitary and tablet assisted presentations of direct instruction method differed in terms of efficiency was revealed through descriptive analysis of the data for (a) the number of sessions, (b) the number of trials, (c) the number of errors, and (d) the total instruction period until the criteria were met for each student.

The social validity data of the study obtained both from the students and their real-time teachers were analysed qualitatively. The data based on the sessions for teaching, baseline, daily “probe,” follow-up, and generalization were independently analysed for the reliability of instruction thanks to data registration forms. The obtained data were analysed using the formula of “Observed Implementer Behaviour / Planned Implementer Behaviour X 100” (Tekin-İftar, 2012). The results of the instruction reliability analysis for the baseline, daily “probe,” generalization, and follow-up sessions were found to be 100% in all four participants. The scores of teaching sessions varied between 90% and 100%.

The formula of  $\text{Consensus} / (\text{Consensus} + \text{Dissensus}) \times 100$  was used in estimating inter-rater reliability (Tekin-İftar, 2012). The consensus and dissensus were decided by comparing the data collection forms filled in by the observer with those by the researcher. The instruction reliability findings obtained for baseline, daily “probe,” generalization and follow-up sessions were found to be 100%.

## 3. Results

### 3.1. The Effectiveness Of The Solitary And Tablet Assisted Presentations Of The Direct Instruction Method In Teaching Respiratory System And Digestive System Topics

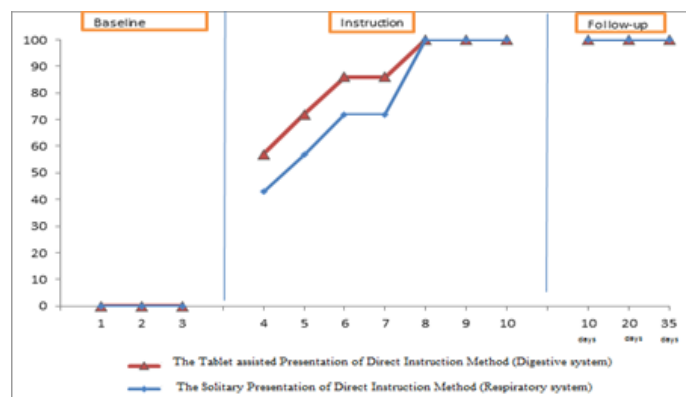


Figure 3.1: Eren’s baseline level, correct response percentages on digestive system and respiratory system topics during instruction and monitoring sessions

The examination of Eren’s teaching sessions data for the solitary and tablet assisted presentations of direct instruction method in Figure 3.1 yielded that Eren could meet the criteria after the third teaching session with the tablet assisted presentation of the direct instruction method while it was achieved only after the fifth teaching session in the solitary presentation of direct instruction method. Eren performed at a 100% accuracy level in the sixth, seventh, and eighth consecutive sessions in both the solitary and tablet assisted presentations of the direct instruction method. The follow-up data implied that Eren preserved the covered topics in both ways at a 100% accuracy level 10, 20, and 35 days after the instruction was over. It was concluded that both the solitary and tablet assisted presentations of the direct instruction method were effective in teaching the digestive system and respiratory system topics based on the research findings of Eren.

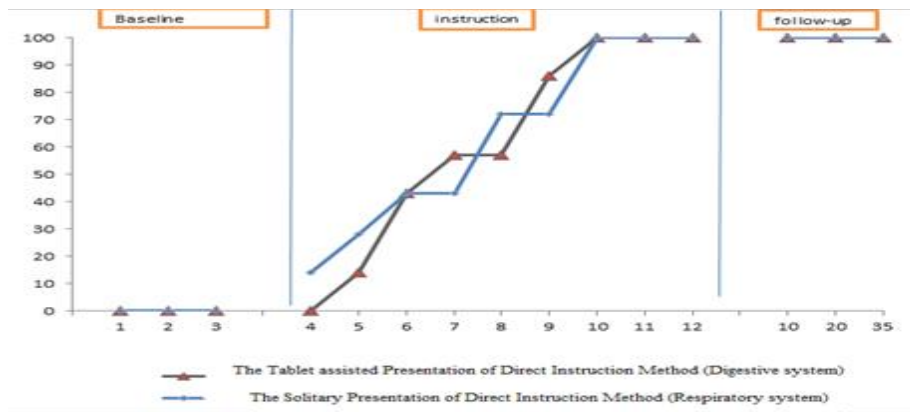


Figure 3.2: Emre’s baseline level, correct response percentages on digestive system and respiratory system topics during instruction and monitoring sessions

The examination of Emre’s teaching sessions data for the solitary and tablet assisted presentations of direct instruction method in Figure 3.2 yielded that Emre could meet the criteria after the sixth teaching session with the tablet assisted presentation of the direct instruction method while it was achieved only after the seventh teaching session in the solitary presentation of direct instruction method. Emre performed at a 100% accuracy level in the seventh, eighth, and ninth consecutive sessions in both the solitary and tablet assisted presentations of the direct instruction method. The follow-up data implied that Emre preserved the covered topics in both ways at a 100% accuracy level 10, 20, and 35 days after the instruction was over. It was concluded that both the solitary and tablet assisted presentations of the direct instruction method were effective in teaching the digestive system and respiratory system topics based on the research findings of Emre.

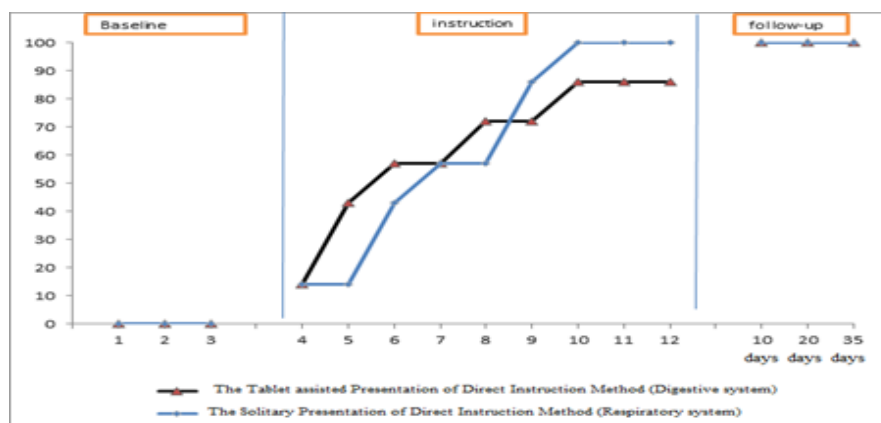


Figure 3.3: Mert’s baseline level, correct response percentages on digestive system and respiratory system topics during instruction and monitoring sessions

The examination of Mert’s teaching sessions data for the solitary and tablet assisted presentations of direct instruction method in Figure 3.3 yielded that Mert could meet the criteria after the sixth teaching session with the

tablet assisted presentation of the direct instruction method while it was achieved only after the seventh teaching session in the solitary presentation of direct instruction method. Mert performed at 85.71% accuracy level in the seventh, eighth, and ninth consecutive sessions in the tablet assisted presentation of direct instruction method and a 100% accuracy level in the solitary presentation of direct instruction method for the identical sessions. The follow-up data implied that Mert preserved the covered topics in both ways at a 100% accuracy level 10, 20, and 35 days after the instruction was over. It was concluded that both the solitary and tablet assisted presentations of the direct instruction method were effective in teaching the digestive system and respiratory system topics based on the research findings of Mert.

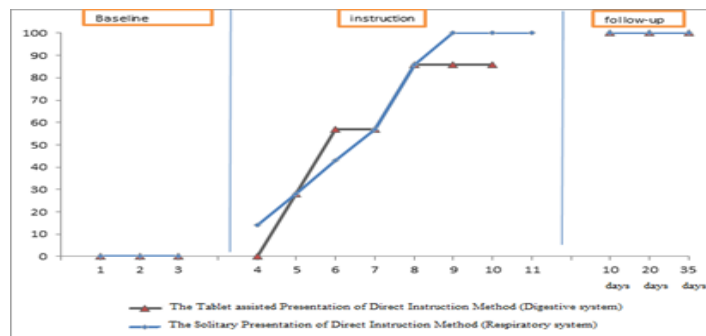


Figure 3.4: Onur's baseline level, correct response percentages on digestive system and respiratory system topics during instruction and monitoring sessions

The examination of Onur's teaching sessions data for the solitary and tablet assisted presentations of direct instruction method in Figure 3.4 yielded that Onur could meet the criteria after the fifth teaching session with both the solitary and tablet assisted presentations of the direct instruction method. Onur performed at 85.71% accuracy level in the fifth, sixth, and seventh consecutive sessions in the tablet assisted presentation of direct instruction method and a 100% accuracy level in the solitary presentation of direct instruction method for the sixth, seventh and eighth sessions. The follow-up data implied that Onur preserved the covered topics in both ways at a 100% accuracy level 10, 20, and 35 days after the instruction was over. It was concluded that both the solitary and tablet assisted presentations of the direct instruction method were effective in teaching the digestive system and respiratory system topics based on the research findings of Onur.

### 3.2. The Generalization Of The Solitary And Tablet Assisted Presentations Of The Direct Instruction Method In Teaching Respiratory System And Digestive System Topics

The findings including the correct responses of Eren, Emre, Mert, and Onur in the generalization pre-test and post-test sessions for the respiratory system and digestive system topics were submitted in Figure 3.5. While all students did not respond correctly regarding both respiratory system and digestive system topics in the generalization pre-test session, they gave 100% correct responses to both topics and generalized the covered topics to different people and settings in the generalization post-test session.

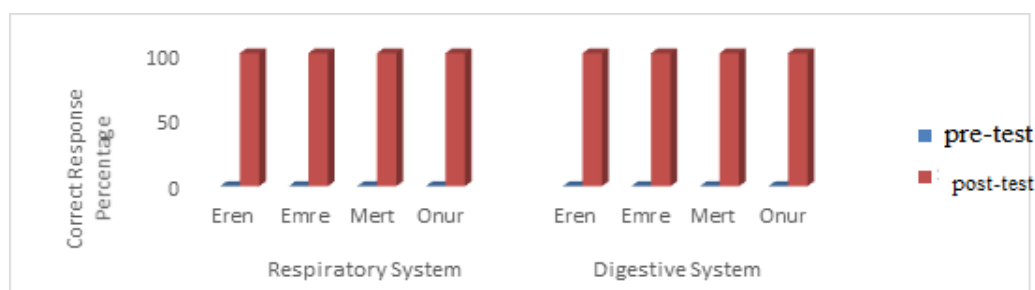


Figure 3.5. The correct response percentages of Eren, Emre, Mert, and Onur in the generalization pre-test and post-test sessions for respiratory system and digestive system topics

### 3.3. Productivity Findings

The number of sessions, the number of trials, the number of errors, and the total instruction period until the criteria were met were initially determined to compare the productivity findings of the solitary and tablet assisted presentations of direct instruction method in teaching respiratory system and digestive system topics. Table 3.1 submitted data on the number of sessions, the number of trials, the number of errors, and the total instruction period for all students until the criteria for both topics were met. As seen in Table 3.1, there was no significant difference for three of the participants (Eren, Emre, and Mert) in terms of the number of sessions held and the number of trials performed for the intended topics until the criteria were met. It was observed that the tablet assisted presentation of the direct instruction method was more efficient for one of the participants (Onur). It was determined that the tablet assisted presentation of the direct instruction method was more efficient in terms of the number of errors for two participants (Eren and Mert) when compared to the solitary direct instruction method. It was found that the solitary direct instruction method was more efficient than the tablet assisted presentation for two participants (Emir and Onur). It was observed that the tablet assisted presentation of the direct instruction method was conducted in lesser time for three participants (Eren, Mert, and Onur) in terms of the total instruction period.

Table 3.1: Productivity Findings for the Solitary and Tablet assisted Presentations of Direct Instruction Method

Student	Independent variable	Dependent variable	Number of Sessions	Number of Trials	Number of Errors	Total Instruction Period
Eren	Tablet assisted Presentation of Direct Instruction Method	Digestive system	7	49	7	57min 55sec
	Solitary Presentation of Direct Instruction Method	Respiratory system	7	49	11	1h 1min 12sec
Emre	Tablet assisted Presentation of Direct Instruction Method	Digestive system	9	63	24	1h 43min 17sec
	Solitary Presentation of Direct Instruction Method	Respiratory system	9	63	23	1h 28min 53sec
Mert	Tablet assisted Presentation of Direct Instruction Method	Digestive system	9	63	23	1h 3min 36sec
	Solitary Presentation of Direct Instruction Method	Respiratory system	9	63	24	1h 41min 42sec
Onur	Tablet assisted Presentation of Direct Instruction Method	Digestive system	7	49	21	1h 6min 7sec
	Solitary Presentation of Direct Instruction Method	Respiratory system	8	56	19	1h 19min 32sec

### 3.4. Social Validity Findings

The social validity data of the study were obtained from the participating students and their real-time teachers. This study examined their opinions regarding the significance of research objectives and the appropriateness of the methods used at the end of the instruction. The participating students and their teachers expressed positive opinions to a great extent.

#### 4. Discussion

The research findings indicated that the solitary and tablet assisted presentations of the direct instruction method were both effective in teaching the respiratory system and digestive system topics to individuals with intellectual disability, and the acquisition levels of students were permanent in the monitoring sessions held after the fulfilment of instructions, and they were generalized to different settings and people. It was concluded that both teaching methods did not differ in terms of effectiveness in teaching science topics. The present study found that there was a difference in productivity in favour of the tablet assisted presentation of the direct instruction method. The social validity findings of the interviews implied that the students and teachers had positive opinions. All these aspects of the study were discussed below in line with the obtained findings.

As a result of the instruction session for the tablet assisted presentation of the direct instruction method to teach the respiratory system and digestive system topics to individuals with intellectual disabilities, it was determined that there was an increase at the end of the instruction compared to their baseline levels in all four participants in the study group. While the acquisition level of topics was 0% at the beginning, it was found to be between 85% and 100% at the end of the instruction. It was observed that the participants preserved what they had learnt in the monitoring sessions held 10, 20, and 35 days after the instruction was over. These findings indicated that the tablet assisted presentation of the direct instruction method was effective in the acquisition of science topics and the perseverance of covered topics after the instruction. This finding overlapped with those of other studies in the relevant literature implying that the use of technology has been effective in gaining academic skills for individuals with intellectual disabilities (Kot, 2019; Öner, 2018; Öztürk & Yıkımsı, 2020; Sola-Özgüç, 2015; Sola Özgüç & Cavkaytar, 2016; Campigotto, McEwen, & Demmans Epp, 2013; Liu, Wu, & Chen, 2013). As a result, it was found that supporting science topics with a tablet computer application was a useful and effective method for students with intellectual disabilities.

It is important to monitor the acquisition levels of the topics as well as the acquisition of new topics during the process of introducing new topics to individuals with intellectual disabilities. It was observed that the acquisition levels of the respiratory system and digestive system topics were permanent in all participants 10, 20, and 35 days after the instruction was over. In light of these findings, it can be alleged that the presentation of the tablet assisted direct instruction method supported the permanence of the science topics in students with intellectual disabilities. This finding of the study also overlapped with other research findings in the literature indicating that technology has had positive effects on the permanency of the concepts, topics, and skills taught to individuals with special needs (Kot, 2019; Öner, 2018; Sola Özgüç & Cavkaytar, 2016; Sola-Özgüç, 2015; Boşnak, Yıkımsı, & Cavkaytar, 2015; Özbek, 2014; Campigotto, McEwen & Demmans Epp, 2013; Murdock, Ganz & Crittendon, 2013; Liu, Wu & Chen, 2013; Hart & Whalon, 2012; Fitzgerald & Koury, 2008). It can be alleged that this study contributed to the relevant literature by supporting the existing data.

There were a limited number of studies with generalization data among those addressing the use of technology in teaching topics, concepts, and skills to individuals with special needs (Strasberger & Ferreri, 2014; Öztürk & Yıkımsı, 2020; Boşnak, Yıkımsı, & Cavkaytar, 2015; Genç-Tosun & Kurt, 2017; Kot, 2019). Generalization sessions were conducted on both different people and different settings in this study. Generalization findings implied that the participants could generalize the covered topics to different people and settings.

During the experimental procedure, the researcher had some observations supporting the effectiveness findings for the tablet assisted presentation of the direct instruction method. It was observed that all students avoided using tablet computers in the first week of the instruction session. In the following sessions, the students stated that they enjoyed using tablet computers and that they were happy during the teaching period. Besides, it was monitored that the students were very eager and excited to use tablet computers. Teachers also voiced in the interviews that their students were willing for the intervention. It was believed that certain characteristics (visual, auditory, and tactual) of the tablet application had effects on the motivation, desire, and interest of the students.

As a result of the instruction session of the direct instruction method to teach respiratory system and digestive system issues to students with intellectual disabilities, it was discovered that there was an increase at the end of

the instruction compared to the baseline level of four participants in the study group. It was observed that the participants maintained the acquisition levels of topics in the follow-up sessions held 10, 20, and 35 days after the end of the instruction. It pointed out that the direct instruction method was effective in students' acquisition levels of science topics and permanency after teaching. This finding of the study was consistent with the previous ones examining the effectiveness of the direct instruction method in teaching science topics and concepts to students with special needs (Çıkılı-Soylu, Dağseven-Emecen, D., & Yıkımsı, A., 2019; Türker Yıldırım & Çifci Tekinarslan, 2020; Yılmaz, 2017; Çapraz, 2016; Mete, 2016; Knight, Smith, Spooner & Browder, 2012; Spooner et al., 2011; İlik, 2009).

It was also investigated whether students with intellectual disabilities maintain their respiratory system and digestive system acquisitions after ten, twenty, and thirty-five days after teaching with the direct instruction method. The examination of the findings yielded that the participants displayed similar performance with the post-teaching performance during the follow-up sessions held after the instruction was over. Based on the permanence of respiratory system and digestive system topics at the end of thirty-five days, it was understood that the direct instruction method was effective in terms of maintaining the respiratory system and digestive system topics.

The obtained findings regarding the comparison of the presentations of the direct instruction method with and without tablets in terms of efficiency were complicated. There was no significant difference in three of the participants (Eren, Emre, and Mert) according to the number of sessions held and the number of trials performed until the criteria were met. On the other hand, it was found that the solitary presentation of the direct instruction method was more efficient for one of the participants (Onur) according to the number of sessions held and the number of trials performed until the criteria were met. It was established that the tablet assisted presentation of the direct instruction method was more efficient than the solitary direct instruction method in terms of the number of errors for two of the participants (Eren and Mert). It was concluded that the solitary presentation of the direct instruction method was more efficient than the tablet assisted presentation of the direct instruction method for the other two participants (Emir and Onur). In terms of the total instruction period, it was observed that the tablet assisted presentation of the direct instruction method was more efficient for three participants (Eren, Mert, and Onur) while the solitary presentation of the direct instruction method was more efficient for one of the participants (Emre).

The social validity data of the study were obtained from the participating students and their real-time teachers. The participating students and teachers expressed positive opinions to a great extent. The literature review revealed that the studies with tablet applications collected social validity data from teachers and participants through interviews (Acungil, 2014; Boşnak, Yıkımsı, & Cavkaytar, 2015; Geçal, 2016; Bahçalı & Özen, 2019; Öztürk & Yıkımsı, 2020; Kot, 2019). Additionally, social validity data were also obtained in studies with the solitary presentation of direct instruction (Tufan, 2018).

As a result, it was witnessed that the tablet assisted and solitary presentations of direct instruction method were both effective in teaching the projected science topics to students with intellectual disabilities, the topics were preserved 10, 20, and 35 days after the instruction was over, and they could be generalized to different settings and people. Besides, social validity findings revealed that the study was socially acceptable in terms of purpose, method, and findings. In light of these, it is hoped that the study will contribute to the literature and future research is believed to be a requirement to enhance our understanding.

The experimental procedure uncovered that the solitary and tablet assisted presentations of the direct instruction method were both effective. In this vein, the practitioners can be suggested to use both practices during the training of students with intellectual disabilities. This study included the science topics of the digestive system and respiratory system. Further research may incorporate different science topics.

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