TEACHING AND REINFORCING FOUR OPERATIONS IN MATHEMATICS TO STUDENTS WITH LOW VISION BY ASSOCIATING THEM WITH ENGLISH TOPICS: HORIZONTAL ARTICULATION

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Abstract: *This study aims to teach low vision third-grade primary school students by connecting the subject of the four operations in mathematics with the English course subjects. The sample of the study consists of low vision students in the third grade of Primary School for the Visually Impaired, as well as their class and English teachers. The data were collected through interviews, pre-tests, and post-tests. The research method is qualitative, and the research design is a case study.. Horizontal articulation-based activities were prepared by the researchers, provided that they were suitable for the students' mathematics and English course programs. Through these activities, the students were instructed for six weeks, with two class hours per week. Before the teaching process, the students were given a pre-test, and their teachers were interviewed. Following the process, a post-test was administered to the students, and both the teachers and students were interviewed. To analyse the data from the pre- and post-tests, the student answers were evaluated using an answer key. The results were then summarised in a table, and based on this table, descriptive analysis was performed. For the analysis of the interviews, content analysis was employed.As a result of the horizontal articulation-based instruction, the students' success levels increased, and the students expressed their satisfaction with the classes. Before the instruction, the classroom teacher stated that she related her lessons with other lessons but had no idea about associating mathematics with English lessons. After the instruction, however, she realised that she could apply horizontal articulation in cooperation with the English teacher. She additionally indicated that the teaching based on horizontal articulation had a positive impact on the students. The English teacher also agreed that this practice was beneficial. However, she mentioned before the instruction that she couldn't apply it due to the limited lesson hours. After the instruction, she repeated that she wouldn't be able to adopt that teaching style, citing the same reason.*

Key words: Horizontal articulation, Mathematics and English, Partially-sighted students

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1. INTRODUCTION

The infrastructure for development in science, technology and art is provided by education. Thanks to education, individuals in society can have the necessary knowledge and skills (Samaniego & Espinosa, 2022). Education is carried out with programs. Programs consist of four elements, namely target, content, educational status and measurement and evaluation, in accordance with the characteristics of each course. There are various criteria to determine the elements of the program. Thanks to these criteria, the quality of the program is tried to be increased. One of the criteria that determines the quality of the content element of the program is horizontal articulation. Horizontal articulation means establishing a relationship between different courses at the same grade level (Atmaca & Bumen, 2023) and is also expressed as interdisciplinary articulation (Baysal, Kara & Bümen , 2022). In horizontal articulation, the learning topics in a course are associated with the learning topics in other courses. In the

education of various countries, it is aimed to achieve quality with horizontal articulation. Finland is at the forefront of these countries, aiming to increase the quality of education and training and achieving success in this direction (Şahin, Göcük & Sevgi, 2018). Finland has ensured that students establish relationships with various courses with the education it has provided in this direction. For this reason, horizontal articulation is one of the concepts that should be emphasized.

Yıldırım (1996) argued that students learn subjects meaningfully when they receive education and training that integrates information from different courses through consistent connections. Newel (as cited in Spelt, Biemans, Tobi, Luning & Mulder, 2009) stated that this relationship contributes to a better understanding of comprehensive subjects. From these sentences, we can say that horizontal articulation causes permanent learning in students. Nandan and London (2013) hold the opinion that interdisciplinarity is synonymous with innovation, creativity and reform. Gür (as cited in Tanrıverdi & Kılıç, 2019) emphasized that the interdisciplinary approach enables the individual to know himself/herself, to be aware of what is happening around him/her and to create changes. Therefore, this approach turns students into individuals who think critically and have the power to question by removing them from dogmatic, irrational and mediocre thinking. Considering that horizontal articulation is interdisciplinary articulation, the idea that the characteristics provided by the interdisciplinary approach on the student can also be provided by an education based on horizontal articulation is formed. Horizontal articulation requires teachers to come together with other branch teachers at the same grade level within the scope of education-training activities and relate the subjects. In this way, teachers will interact with each other and be able to exchange information. Information exchange can lead to positive relationships between teachers. The reflection of these warm relationships on the students is an inevitable result. Indeed, Rogers and Threatt (Akt. Yarım, Morkoç & Sulak, 2022) underlined that cooperation and assistance between teachers is important and beneficial for students and education.

Due to the above mentioned issues, it is thought that it is beneficial to include horizontal articulation in the teaching and learning process. What should be considered here is to prepare the content, teaching and learning process by examining the achievements of the lessons decided to be explained by establishing a relationship between them. Horizontal articulation is valid not only for non-disabled students and their teachers, but also for disabled students and their teachers. Among the disabled students, there are visually impaired students. Legally, visually impaired are grouped as totally visually impaired and those with low vision (Tanrıkulu,

2011). Visual impairment is explained in two ways: legally and educationally. The legal definition of visual impairment is based on the measurement of vision and visual field, and while this definition is used by those working in the medical field and other interested parties, the educational definition concerns us, the educators.

The educational definition of visual impairment; According to Gürsel (Akt. Okçu & Sözbilir, 2016), individuals who are severely affected by visual impairment and who absolutely need to use Braille or talking books are "blind"; individuals who can read large-print written material with the help of magnifying devices or large-print written material are "low-vision". Therefore, students with low vision are students whose vision is limited or restricted. Students with low vision can be taught lessons that are in line with horizontal articulation. In horizontal articulation-based teaching, it is sufficient to make some arrangements during the planning and implementation of the lesson. We can teach with various teaching methods by using large-print written and visual materials, arranging the classroom environment according to their visual needs, and making them both like and teach. Therefore, it is possible for teachers working in schools with disabilities to include this concept in the education-teaching process they apply to their low-vision students.

2. METHODOLOGY

2.1. Model of the Research: This research, triangulation was preferred as a case study among the qualitative research methods.

2.2. Sample of the Study: The sample of the study consists of “low vision” students studying in the third grade of the Primary School for the Visually Impaired and their class and English teachers. The total number of students studying in the third grade of the school is seven. However, two students are totally visually impaired and one student is low vision, but since they could not participate in the activities due to their illness, the study was conducted with four students with low vision.

2.3. Data Collection Tool:

In the study, data were collected through pre-test, post-test and interview. Since it was a study that included the association of four operations in mathematics with English subjects, two experts, one in English and the other in Mathematics education, were consulted in the preparation of the tests and interview questions. In addition, a literature review was conducted

on horizontal articulation while preparing the interview questions for the teacher and students. The same questions were asked in both tests. Pre-test questions aimed to determine the level of the students' association of the four operations in mathematics with English subjects before they started the study. Post-test questions aimed to reveal the level at which the objectives of the applied activity were achieved. Thus, according to the results of the Pre-test and Post-tests, the difference between the students' success levels was tried to be presented to the reader.

Pre-test and Post-test The four operations topics in Mathematics consist of questions that aim to measure and evaluate the achievements in the activities prepared by associating them with English topics. The number of questions in the test is six, and each question consists of items. The first and second questions are ten, the third question is five, the fourth question is eight, the fifth question is five and the sixth question is two, making a total of 40 items. In the tests, the students were asked to write the numbers between 1-20 in English, to do the four operations and express them in English and to answer the questions directed to them using the English patterns in the activities. Since the tests are prerequisites for writing the numbers between 1-20 in English, to do the four operations and express them in English, there are questions related to this topic in the test.

In the first part of the test (ten items), students were asked to match the English spellings of the numbers given in the left column with the words in the right column; in the second part, they were asked to match the English spellings of the numbers in the left column with the numbers in the opposite column; in the third part, they were asked to match the four operations and the equality symbols (+, -, x, ÷, =) with the English words given in the other column. In the fourth part of the test, students were asked about their knowledge of four operations and whether they could express this operation in English. In this part, students were asked to express the result of each operation in English by performing four operations covering the numbers 1-20. In the fifth part, students were given a picture and asked questions about the picture.

The questions were created by associating the numbers 1-20 that the students learned in the math class with the patterns they learned in the English class. In the last part of the test, two questions were given that required the English pattern to be associated with the numbers, but unlike the fifth part, instead of a visual, the students were asked questions about the letters and the number of letters in their own names. The second data collection tool was a structured interview with students and teachers. After the activity, the students' opinions about the implemented activities were obtained. The students' class teachers and English teachers were also interviewed before and after the application. In the interviews before the application, the

teachers were asked whether they had implemented horizontal articulation, and at the end of the application, interview questions were prepared and used to reveal their ideas and evaluations about the horizontal articulation applied in the current study.

2.3. Data Analysis:: For the analysis of the data obtained in the pre-test and post-test, the student answers were first evaluated using the answer key. The answers given to the questions were classified and scored as unanswered, wrong, partially correct and correct. Each correct answer has a score of 2.5, a partially correct answer has a score of 1.25, there are 40 items in the test and the evaluations were made out of 100 points and were tabulated. Descriptive analysis was performed using this table for the analysis of the data obtained from the pre-test and post-test. Descriptive analysis is a qualitative analysis method based on the summary and interpretation of the data according to previously determined categories (Yıldırım and Şimşek, 2021).

Content analysis was used in the analysis of the interviews. Content analysis is the objective and systematic classification of the message contained in verbal, written and other materials in terms of meaning and/or grammar, converting them into numbers and making inferences(Tavşancıl and Aslan, 2001).

FINDINGS

1. Findings related to the first sub-problem of the research, "What are the success levels of the students as a result of applying the subject of the four operations of mathematics to the subjects of the English course to the third grade students with low vision in primary school?"

Table 1. Findings obtained from the pre-test and post-test

		S1		S2		S3		S4	
		Pre-test	Post-test	Pre-test	Post-test	Pre-test	Post-test	Pre-test	Post-test
Sections									
Q1 **Match the following numbers**	**Q1**	**3**	**3**	**0**	**3**	**3**	**3**	**1**	**3**
	Q2	**0**	**3**	**0**	**3**	**3**	**3**	**1**	**3**
	Q3	**0**	**3**	**0**	**3**	**3**	**3**	**1**	**3**
	Q4	**0**	**3**	**0**	**0**	**1**	**3**	**0**	**0**
	Q5	**0**	**1**	**0**	**3**	**3**	**3**	**0**	**3**

	Q6	0	3	0	3	3	3	1	3
	Q7	3	1	3	3	3	3	1	3
	Q8	0	3	0	3	1	3	1	3
	Q9	0	3	0	3	3	3	3	3
	Q10	0	3	3	3	0	3	1	3
	Total	5	20	5	22.5	17.5	25	2.5	22.5

Q2 Match the following numbers	Q1	1	3	0	3	3	3	0	3
	Q2	3	3	0	3	0	3	0	3
	Q3	3	3	0	3	3	3	0	3
	Q4	0	3	0	3	3	3	0	3
	Q5	3	3	0	3	3	3	3	3
	Q6	0	3	0	3	3	3	0	3
	Q7	0	3	0	3	3	3	0	3
	Q8	0	3	0	0	3	0	0	0
	Q9	3	3	0	3	3	3	0	3
	Q10	0	3	0	3	3	3	0	3
	Total	10	25	0	22.5	22.5	22.5	2.5	22.5

Q3 Match the words with the symbols	Q1	0	3	0	3	0	3	3	3
	Q2	0	3	0	3	0	3	0	3
	Q3	0	3	0	3	0	3	1	3
	Q4	0	3	0	3	0	3	1	3
	Q5	0	3	0	3	0	3	1	3
	Total	0	12.5	0	12.5	0	12.5	2.5	12.5
Q4 Do the exercises and write in English	Q1	2	3	2	3	2	3	2	3
	Q2	2	3	1	3	2	3	2	3
	Q3	1	3	1	3	2	3	1	3
	Q4	2	3	2	3	2	3	1	3
	Q5	2	3	0	3	1	3	1	3
	Q6	0	3	0	3	1	3	1	3
	Q7	2	3	1	2	1	3	1	3
	Q8	0	2	0	3	1	2	1	1

	Total	**6.25**	**18.75**	**2.5**	**18.75**	**5**	**18.75**	**2.5**	**17.5**
Q5 **Look at the picture and answer the Suestions**	**Q1**	**0**	**3**	**0**	**3**	**0**	**3**	**0**	**3**
	Q2	**0**	**3**	**0**	**3**	**0**	**3**	**0**	**3**
	Q3	**0**	**3**	**0**	**3**	**0**	**3**	**0**	**1**
	Q4	**0**	**3**	**0**	**3**	**0**	**3**	**0**	**3**
	Q5	**0**	**3**	**0**	**3**	**0**	**1**	**0**	**3**
	Total	**0**	**12.5**	**0**	**12.5**	**0**	**10**	**0**	**10**
Q6 **Answer the following Suestions**	**Q1**	**0**	**3**	**0**	**3**	**0**	**3**	**0**	**3**
	Q2	**0**	**3**	**0**	**3**	**0**	**2**	**0**	**3**
	Total	**0**	**5**	**0**	**5**	**0**	**3.75**	**0**	**5**
TOTAL		**21.25**	**93.75**	**7.5**	**93.75**	**45**	**92.5**	**10**	**90**

0= No answer, 1= False, 2= Partially true, 3= True, Q1,2,3,4,5,6=Question1,2,3,4,5,6 S1,2,3,4=Student 1,2,3,4

Table 1 was created according to the students' answers obtained from the Pre- and Post-tests. The answers given to the questions were coded as unanswered 0, wrong 1, partially correct 2 and correct 3. The score of the correct answer was 2.5, the score of the partially correct answer was 1.25, there were 40 items in each test and the evaluations were made out of 100 points and were tabulated. When Table 1 is examined in general, the scores that the students received from the post-test are much higher than the scores they received from the pre-test. The answers that are considered partially correct here are the answers of the students in the fourth and sixth sections. In the fourth section, the answers that are accepted as partially correct are the answers that the students did the operation correctly and the numbers that should be written in the boxes left blank in English could not be written correctly.

In the first and second questions of the pre-test and post-test, students were asked to match the numbers between 1-20 with their English spellings. In the pre-test, three students mostly matched the English spellings of the numbers incorrectly or left the questions blank. One student matched most of the requested matches correctly. In the post-test, the majority of the students answered the questions correctly and received 20 and above.

2. Findings related to the second sub-problem of the research, "What are the views of the teachers participating in the research on "Horizontal mirroring and its application" in relating the learning topics they teach to the learning topics in other courses?"

Table 2. Category, Code Table for the question, "Do you relate the learning topics in your courses to the learning topics in English or other courses?"

(CT=Class Teacher, ET=English Teacher, R= Researcher)

Category	Code	Teacher
Yes	Maths course; Games, Physical Activities and Independent Movement	CT
	Skills and Free Activities course	
	Science and Life Sciences course	
No	Because English class hours are two hours	ET
	Gains come to us in a correlated manner	

When Table 2 is examined, it is seen that only the Classroom teacher associated the Mathematics course with the Games, Physical Activities and Independent Movement Skills course and the Free Activities course; and the Science course with the Life Sciences course. The English teacher stated that she could not make an association, claiming that the lesson time was two hours. She also emphasized that the association was in the curriculum. The dialogues between the Classroom teacher, the English teacher and the researcher are given below.

R: "*Do you relate the learning topics in your lessons to the learning topics in English or other lessons?"*

CT: "*I don't take English lessons. However, sometimes we combine a math lesson with the Game, Physical Activities and Independent Movement Skills lesson and complete counting activities there or play some fun games."*

ET: "*I can't do that in two hours a week anyway, even if I wanted to, I can't. It's in the curriculum, but it doesn't go into it very deeply, in other words, it tells us to do it with a few examples and move on."*

Since the English teacher stated that she couldn't make connections with her own lesson or other lessons when the lesson was two hours long, the questions "Do you communicate with the teachers of other lessons you make connections with while making connections?" "Does there a change in the students' learning levels when you make connections with the topics in your lessons or other lessons?" were asked only to the classroom teacher. The findings of these questions are given in Tables 3 and 4.

Table 3. Category Code Table for the question "Do You Communicate with the Teachers of Other Courses You Have Made Connections with While Making Connections?"

Category	Code	Teacher
Yes	Matematik konularında ekstra bilgiye ihtiyaç duyma, ya da herhangi bir dersteki konuyu farklı bir yöntemle öğretme hususunda bilgi alış verişinde bulunma	CT

From Table 3, it is seen that while the Class Teacher is making connections, he exchanges information with the teachers of other subjects about extra information and how he can teach the subjects of the subjects he teaches better. The opinion of the class teacher is,

CT: "*Sometimes I need a little more extra information about mathematics. Or in the Turkish branch, I wonder if I had taught this subject in this way or if I had taught it by adding it, if I had taught it with a game, what would it be like, and of course we exchange ideas with other teachers."*

Table 4. Category Code Table for the question "Does there any change in students' learning levels when you make connections between the subjects in your courses and other courses?"

Category	Code	Teacher
Positive	They enjoy it very much, there are changes in their learning levels	CT
Negative	Sometimes it moves away from the intended goal and there is no change in learning levels.	CT

According to the findings, the Classroom Teacher observes positive and negative aspects in this regard. The classroom teacher thinks that the students are happy as a result of this association and this happiness is reflected positively on their learning levels. What the classroom teacher observes negatively is that the activities sometimes do not serve their purpose and move away from the target. The excerpts from the classroom teacher's answers to this question are as follows:

CT: "*But as I said, sometimes there can be problems when making that association in subjects such as science and social studies. Because I can say that they are slightly more divergent."*

Table 5. Category Code Table for the question "Do You Think Mathematics and English Can Be Associated?"

Category	Code	Teacher
No idea	No, because I don't teach English Course.	CT
Negative	There are few lesson hours	ET

According to the information in Table 5, the classroom teacher has no idea about this issue, and the English teacher cannot be associated due to insufficient lesson hours. Teachers' opinions on this question:

CT: *"In other words, I don't actually have any idea about this issue since I don't teach English."*

ET: *"There are few lesson hours."*

3. Findings related to the third sub-problem of the research, "What are the opinions of the students and teachers on this issue as a result of applying the subject of the four operations in mathematics to the third grade primary school students with low vision by associating it with the English lesson subjects?"

Table 6. Category Code Table for the question "What are your evaluations about the association with Mathematics and English lessons after the application?"

Category	Code	Teacher
Positive	Students loved it, enjoyed it very much, were motivated, provided practice in mathematics; students' English thinking skills increased	CT
	Their performance increased	ET
Negative		

Table 6 tells us the thoughts of the Classroom and English teachers that teaching Mathematics and English lessons in a way that makes connections has positive effects on the students. The teachers stated that the students enjoyed the application, their performance in Mathematics and

English lessons increased, and they did not state any negative aspects of the application. The opinions of the teachers are given below.

CT: "*While doing mathematics, writing or answering in English actually requires dealing with those numbers together with their English or thinking about them in a scientific sense in English, and I think it was beneficial for the students in this regard.* "

ET: "*For example, S4, S4's performance today was incredible. So you had a role in this. We worked on the numbers and S4 did it like a charm. I was actually very surprised. I said, you're great. Today's name is S4. "*

Table 7. Category Code Table for the question "Do you plan to apply the association between Mathematics and English in your lessons?"

Category	Code	Teacher
Yes	I can do it	
No	*There are few lesson hours.*	ET

When their thoughts on implementing the activities in their classes are examined, the class teacher stated that he could do mathematics and English in collaboration with the English teacher. The English teacher stated that the class hours would not allow this.

CT: *"Because it is not my area of expertise, but it seemed enjoyable to me to handle other classes within each other because on the one hand it supports and reinforces, and on the other hand you may be teaching a new subject."*

ET: *"So, I want it to be at least four hours, six hours in primary schools. With these sentences, they answered the researchers' question."*

Table 8. Category Code Table regarding the question "Did you like the lessons we taught?" to the students

Category	Code	Student
Yes	Fun	S3
	I liked the writing the most	S4
	Let the lessons be taught like thi	S2
	I loved it	S1
No	Sometimes I get confused	S4
	It was a little difficult	S2

S1: "*No, I knew how to write numbers. But I didn't know how to write them yet. It seems like it was easier now that you came."*

S2: *"Yes, it was a little difficult."*

S3: *"We were counting numbers because we had just learned them, but when you came it became easy. For example, there were those questions after equal, divide by, they were very nice."*

S4: *"I didn't know much about plus, minus, etc., but I knew numbers but I didn't know them very well, but when you came I know them better."*

It is understood from the sentences of S1, S2, S3 and S4 and Table 8 that the students liked the lessons that were implemented and wanted the lessons to be taught in this way. In addition, S4 stated that he sometimes got confused in the lessons, and S2 stated that they had a little difficulty.

CONCLUSION

The students' post-test scores were considerably higher than the pre-test scores. All students stated that they were satisfied with the application. Based on the findings about the teachers' thoughts on relating the learning topics in their lessons to the learning topics in other lessons, we can say the following. A classroom teacher can relate the topics in a lesson to other lessons more. For example, he can relate the geometric patterns topic in the Mathematics lesson to the Fine Arts lesson. It is not a desirable result for an English teacher to teach based only on the connections in the curriculum, claiming that the lesson hours are two hours per week. The English teacher can prepare and present various activities that will cover two lesson hours and establish connections with other lessons. The program should definitely be implemented, but the flexibility of the program should be used to include connections that are not included in the program.

From here, we can conclude that both of our teachers have insufficient knowledge about horizontal articulation and its importance. According to Duman and Aybek (Akt., Gecitli & Bümen 2020), there are very few resources in our country regarding the content and how it can be implemented, compared to many countries. This situation causes our teachers to be given superficial information about horizontal articulation. It is very valuable for a classroom teacher to communicate with other teachers only for some extra information or for problems in teaching a subject better. We believe that communication only about these issues will not be sufficient. If horizontal articulation can be applied in teaching, we believe that communication between teachers, which is one of the requirements of horizontal articulation, will increase. Because

horizontal articulation prepares the ground for teachers to share their pedagogical ideas and thoughts, and their knowledge about their branches with each other (Ceviz, 2023).

The teachers who participated in the study may encounter positive and negative results in the learning levels of the students when they associate their lessons with other lessons. According to the classroom teacher who encountered negative results, the intended associations do not reach their goal. Bozkurt (2012) argued that the preparation and implementation of activities in the classroom are shaped by the pedagogical knowledge of the teachers. Therefore, it is possible for a teacher with good pedagogical knowledge to plan and implement activities suitable for the cognitive, affective and psychomotor characteristics of the students. Otherwise, if a good activity planning is not made by considering the possible problems, the negativities will always continue to exist. Therefore, when a lesson is associated with the subjects of another lesson with a good activity planning, positive results can always be possible.

The fact that the classroom teacher does not have an idea about connecting the Mathematics course with the English course is an indication that he/she does not have knowledge about horizontal articulation. In horizontal articulation, teachers who will connect the subjects can do this by informing each other about the relevant achievements and helping each other about unknown issues. The opinions of the two teachers about the application were positive and there were no negative opinions. In response to the question “Do you plan to apply the activities in your lessons?”, the classroom teacher stated that he/she can connect the English course with the Mathematics course. This result can be considered as a valuable result for us because it broke the classroom teacher’s thought of “I have no idea” about this subject before the application. The classroom teacher can work together with the English teacher to prepare and apply activities. Because this research was prepared and applied in this direction.

Despite the English teacher's positive view of this application, he gave a negative answer to the question "Do you plan to implement the activities in your classes?" As in the interviews before the application, he put forward the limited class hours as the reason for not being able to implement the activities. However, in this study, an activity implemented was completed in two class hours, one class hour being 40 minutes, and in 80 minutes. In addition, the English teacher can prepare class activities for horizontal articulation for his students by cooperating with the Class Teacher. He can implement these activities in the students' five-hour mathematics class with the permission of the school administrators. Although he respects the English teacher's views, it is thought that he has negative attitudes about horizontal articulation.

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