International Journal
Pedagogy of Social Studies
Journal homepage: http://ejournal.upi.edu/index.php/pips/index

The Effect of Out-Of-School Learning Environments on Students' Mental Models and Academic Achievements: the Case of the Tropical Ecosystem

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ABSTRACT

The aim of this study is to examine the effects of out-of-school learning environments (İzmir Natural Life Park) on the development of secondary school 7th-grade students' mental models about tropical environments and their academic achievement. The research was carried out with the participation of 57 students studying in the 7th grade at a public school in Izmir. During the discovery phase of the lesson plans prepared under the 4E teaching model, lessons were taught under the conservative curriculum with the control group (27), and a visit to the Izmir Natural Life Park Tropical Center was made with the experimental group (30). To compare the mental model developments and academic achievements of the experimental and control groups, the Achievement test consisting of twelve multiple-choice questions with drawings before and after the research was applied in the study conducted in a mixed design. In addition, an interview form consisting of five open-ended questions was given to the experimental group to get their opinions after the trip. The data obtained from the Achievement Test were subjected to independent groups t-test and it was determined that there was a statistically significant difference between the two groups. This result proves that out-of-school learning environments are used in a planned way, they positively affect students' learning and increase their academic success. The preliminary and final drawings of the mental model and their explanations were analyzed under the guidance of the 'Development Level Evaluation Table' determined by the researchers. Accordingly, it is seen that students' perspectives and perceptions about the tropical ecosystem develop after the application. In particular, it is seen that the explanations and drawings of the experimental group are customized, the diversity of life is deepened specific to

ARTICLE INFO

Article History:
Submitted/Received 01Aug 2023
First Revised 02 September 2023
Accepted 01 October 2023
First Available online 05 Oct 2023
Publication Date 01 Dec 2023

Keyword:
Informal learning environment;
Mental model;
Tropical ecosystem.

tropical environments, and the connections are elaborated. In the interview questions applied after the trip, the students stated that they contributed to their learning by observing, experiencing, and enjoying the tropical environment during their visit.

1. INTRODUCTION

Science teaching aims to educate students as individuals who can reduce the scientific subjects they learn in school to their daily life and use them in their lives. Due to the abstract concepts included in the science course, students have had difficulties and negative attitudes in learning for many reasons for years (Kaptan & Korkmaz, 2002). To overcome this problem, since 2005, the curriculum of the science course has also been rearranged, and bringing individuals to society as science literate has been among the important goals and functions of science teaching. In this way, the traditional education approach, which aims to provide students with only cognitive processes, has been eliminated, and the values and skills that contribute to the processing of knowledge have been ensured to participate in science learning. This participation has left the traditional teacher-centered methods and instead, the methods in which the student is activated and makes sense of the information in line with curiosity, prior knowledge, self-skills, and daily life experiences have been included in our education system.

While this change is not limited to learning and teaching, its expansion in the learning environment is discussed. He continues to learn until he gets to school or later in school life. Since nature is also the source of scientific knowledge, educators have decided that it will contribute to our children's learning in school life by using out-of-school environments and that it will be beneficial to increase learning environments in the light of scientific research. We should help our children learn by using natural environments such as forests, lakes, etc. that we define as out-of-school environments, as well as social areas such as botany and zoos, science centers, aquariums, and museums (Türkmen, 2018). In addition to these environments, many environments such as digital environments (TV, tablets, computers, phones) and social media where individuals are constantly interacting are also used as out-of-school learning environments in the 21st century. When the research on out-of-school learning environments is examined, it is seen that these environments, especially if used in a planned way in line with the curriculum, provide positive changes in students' interest, motivation, and attitudes toward the course, that meaningful learning takes place thanks to experience and increases students' academic success (Bowker & Tearle, 2007; Bozdoğan & Yalçın, 2006; Doğan et al., 2018; Ertaş et al., 2011; Metin & Bozdoğan, 2020; Orion & Hofstein, 1994; Sturm & Bogner, 2010; Turkmen, 2018).

Students need to reflect the information they have structured in their minds to their teacher or friends. New information is structured in the mind as a result of the formation of schema in the mind of the individual or its expansion by participating in the existing schema. This leads to the recognition of the individual's learning or existing deficiencies and/or the need to correct his/her incorrect information. This has led researchers to seek reflective methods of learning to reflect what the individual has learned (Reith, 1997; cited in Bowker, 2007). According to the research, it has been revealed that only the words of the individuals remain inadequate and abstract level in explaining their inner world and that they use

DOI: Prefix 10.17509/ijposs by Crossref
p- ISSN 2550-0600 e- ISSN 2549-6530

drawings and explanations to support these drawings to express themselves in the context of concretization. These representations also lead us to the concept of model. Schemas created in our minds are mental models that individuals think they represent (Sözcü et al., 2016). Mental models make it easier for us to understand the inner world of individuals by reflecting on their understanding and perceptions (Kurnaz & Eksi, 2015). Mental models are influenced by individuals' lives, experiences, and prior knowledge. In this context, individuals are dynamic and create mental models while looking for solutions to problems, expressing themselves, and decision-making processes (Vosniadou & Brewer, 1992; cited in Çelikler & Harman, 2015). Mental models created in individuals to understand their learning are one of the most preferred drawings (Ültay et al., 2017; Uçar, 2020). The reason why drawings are frequently used in research is that they make the abstract processes that individuals structure in their minds concrete, make them understandable to others and provide an option to express themselves more easily (Zangori & Forbes, 2015; Zangori et al., 2015).

When the research conducted in the context are examined, it is concluded that in the study conducted by Kurnaz and Değirmenci in 2012 to determine the mental models of seventh-grade students regarding the Sun, Earth, and Moon, it was concluded that the students in general drew mental models that did not match the scientific information. In the study conducted by Türkoğlu and Öztürk in 2019, the mental models of science teacher candidates regarding socio-scientific issues were investigated, and according to the findings obtained, it was concluded that teacher candidates showed limited understanding of alternative concepts related to socio-scientific issues while drawing mental models in detail on issues that are more on the agenda in society, they could not reflect the subjects that are less on the agenda clearly and clearly on the drawings. The findings of the study conducted by İyibil and Arslan in 2010 with prospective physics teachers to determine their mental models regarding the concept of stars show that prospective teachers generally have mental models that are not compatible with scientific knowledge. In Bowker's 2007 study of children's learning and drawings of tropical rainforests, it was observed that students' perceptions of these environments before and after visiting them changed, and their perceptions of living species and inanimate factors developed. In the study of Shepardson et al. in 2007, in which they examined the perceptions of primary school students and the environment and related mental models within the scope of science course, it was determined that students reflected the connections between the environment, living things, and ecosystems rather than concepts on the drawings. Judson's 4th and 7th In the study of the mental model perceptions of the classroom students about the desert ecosystem and other factors found here, it was observed that the students showed improvement between their preliminary and final drawings with the help of field trips. According to other studies, drawings were used in the evaluation and analysis processes to concretize the development and change in individuals (Ayvacı et al, 2018; Barraza, 1999; Bowker, 2007; Emli & Afacan, 2017; İyibil & Arslan, 2010; Judson, 2011; Kurnaz & Değirmenci, 2012; Rennive & Jarvis, 1995; Shepardson et al., 2007; Türkoğlu & Öztürk, 2019).

One of the topics discussed in the Science course that is difficult to understand due to the abstract concepts it contains is reproduction, growth, and development in living things, biodiversity, and ecosystems. In this context, in the teaching of abstract concepts in the subject, they are one of the environments that provide learning by making and living artificial biomes designed by their natural conditions such as zoos and tropical centers, and access to information from the primary source.

DOI: Prefix 10.17509/ijposs by Crossref
p- ISSN 2550-0600 e- ISSN 2549-6530

Although there are various tropical ecosystems in regions such as Latin America, Central Africa, and Southeast Asia, Turkey does not have these ecosystems due to its location. It is very difficult for students to reach regions with tropical ecosystems within the scope of learning. For this reason, this scientific knowledge is usually limited to teaching in the classroom. However, there is a prototype in the Natural Life Park in İzmir province in our country. İzmir Sasalı Natural Life Park Tropical Center consists of alligators, snake-like reptiles, turtles, parrots, fish, and various bird species and 66 animals of 18 species and various plants, and accordingly, it is the center where the ambient temperature and humidity are regulated in an artificial environment. Tropical centers, which give their visitors the feeling that they are in a tropical ecosystem, are important for students to be able to observe, satisfy their curiosity and acquire scientific experiences about the living species and inanimate factors found here. Thus, knowledge, concepts, and phenomena are better interpreted and structured. However, this time, we face the problem of evaluating the structuring processes of the knowledge acquired by the students.

This study was conducted in the tropical center located in İzmir Sasalı Natural Life Park, which is one of the out-of-school learning environments, this study aimed to examine the effect of mental models on the development and academic success of tropical ecosystems, which is one of the ecosystems in which living things complete their life cycles, within the scope of the 'Reproduction, growth and development of living things unit. Especially in terms of Turkey, which does not have a tropical climate and tropical rainforests due to its location in the world, it is thought that it will contribute to the literature in terms of how students perceive this ecosystem that they are foreigners and how their mental models will change after the field trip. In this context, research questions;

1) How does the course taught in the tropical center affect students' academic success in the tropical ecosystem?
2) How does the tropical center affect the change in students' mental models about the tropical ecosystem?
3) What are the students' perspectives on teaching in the tropical center from out-of-school learning environments?

2. METHODS

Research Design

This study was structured according to the exploratory sequencing pattern, one of the mixed research methods. The connections obtained by collecting quantitative data in the exploratory sequential pattern are explained by qualitative research stages. According to this pattern, firstly, quantitative data are collected in the light of research questions, followed by the collection of qualitative data (Dawadi, et.al, 2021). In the study, qualitative data were collected using the post-trip interview form consisting of open-ended questions and mental model drawings and explanations describing students' observations; and quantitative data were collected using the Success Test prepared.

Study Group

57 of the students studying in the 7th grade of a public school in Izmir province were selected by appropriate sampling to participate in the study. In the appropriate sampling, the sample is determined and data are collected from volunteers where the researcher is easily accessible (Gravetter & Forzano, 2012). The demographic information (gender and group) of the students is given in Table 1.

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Table 1. *Demographic Information of Participants*

	Female	Male	Total
Control G.	12	15	27
Experiment G.	16	14	30
Total	28	29	57

Data Collection Tools

In the quantitative part of the study conducted in a mixed design, a Success Test (CT) consisting of 12 multiple-choice questions was prepared by the researchers to measure the academic success of the students before and after the application. The structure and content validity of the questions in the achievement test prepared by taking the opinions of 3 experts in their fields were ensured. As a result of the analysis, the mean item difficulty index of the test was 0.78 and the discrimination index was 0.43.

In the qualitative part, the "The Environments Task" part of the study created by Shepardson et al. (2007) was used to reveal the mental models of students about tropical ecosystems by adapting it to tropical environments. Here, students were asked, "What is a tropical ecosystem?" they were asked to draw a picture of it, and at the same time, they were asked to explain why they thought that this drawing represented a tropical environment. Thus, thanks to this tool applied before and after the study, the change in the mental models of the students in the experimental and control groups was compared. Finally, an interview form consisting of 5 open-ended questions was prepared and applied to learn the thoughts of the experimental group about teaching in the tropical center in order to answer them after the trip. Content validity was ensured by obtaining the opinions of 3 experts in the field about the questions in the interview form.

Applying the Study

The study was continued for a week (4 hours) in line with the lesson plans prepared in accordance with the 4E teaching model about the tropical ecosystem, which is one of the ecosystems in which living things complete their life cycles, within the scope of the 7th grade unit of 'Reproduction, Growth, and Development in Living Things'. Before the application, the Achievement Test prepared for the students was applied as a pre-test, and they were also asked to draw the tropical ecosystem in the minds of the students. In the discovery phase, which is the first stage of the 4E teaching model, different applications were made to the experimental and control groups. Accordingly, two images from the smart board were shown to the control group, and the brainstorming technique enabled the students to reveal the discussions and differences in line with the connotations that came to their minds. The experimental group was taken to the tropical center in İzmir Sasalı Natural Life Park and asked to answer the research questions given to them in line with their observations. In the explanation phase, scientific information was reached with discussion techniques and question-answer techniques in line with the data they obtained in the experimental and control group discovery. Through the presentation prepared afterward, videos were shown by summarizing the characteristics of the different living environments in which living things live and how plant and animal species differ according to these environments (especially by emphasizing the tropical ecosystem). In the deepening stage, which is the next stage, the studies were carried out in parallel with each other, and the

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p- ISSN 2550-0600 e- ISSN 2549-6530

students were asked to draw and explain their mental models describing the tropical ecosystem. In the final evaluation phase, the same Achievement Test was applied again to both groups. In addition to all these, in the next lesson, a semi-structured interview form consisting of 5 open-ended questions was given to the experimental group students reflecting their views on teaching in the tropical center.

Data Analysis

In the analysis of quantitative data, the results obtained from CT applied to the normally distributed experimental and control groups before and after the application were subjected to independent groups t-test using the IBM SPSS 26.0 statistical program. In addition, the achievements of the experimental and control groups were compared by evaluating them based on questions.

Descriptive analysis was used in the analysis of the qualitative data collected in the research. While analyzing qualitative data, the validity and reliability were tried to be increased by putting examples of students' opinions (Ezer & Aksüt, 2021). To codify the mental models related to the tropical ecosystem and the explanations related to it, the Development Level Evaluation Table was designed by the researchers considering the scheme consisting of 4 models designed by Shepardson et al. (2007) (Table 2). Accordingly, the mental models of the students consist of 4 models shaped according to the number of factors they cover, and each model consists of 3 categories as *Weak, Medium, and Advanced* in terms of development level. All qualitative data, that is, all data obtained under the guidance of the Development Level Evaluation Table and fifteen randomly selected interview forms among the answers given to 5 open-ended questions, were evaluated separately by 2 researchers. In this way, reliability between raters was ensured. Accordingly, the inter-category reliability obtained from the Development Level Evaluation Table was determined as 0.87 for mental model drawings and 0.79 for 5 open-ended questions in the interview form. The data obtained are presented as frequency tables.

Table 2. *Development Level Assessment Table*

	Weak	**Intermediate**	**Advanced**
Model 1 (Plants, Animal are found)	In a tropical environment, only plant and animal species defend that they live, and can give examples of living species.	It can distinguish between plant and animal species specific to a tropical environment. Draws living things.	He/she knows and draws pla and animal species in a tropi environment and can explain t interactions with drawings establishing connections betwe them.
Model 2 (Plant, Animal, Human)	It knows that plants, animals, and humans live in a tropical environment and can give	It can distinguish species specific to a tropical environment. Draws living things.	He/she knows the species in tropical environment and dra and explains the interactions supporting them with drawings establishing connections betwe living things.

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p- ISSN 2550-0600 e- ISSN 2549-6530

	examples of various living species.		
Model 3 (Plant, Animal, and Inorganic factors are found)	It knows that there are plants, animals, and inanimate factors in a tropical environment and can give examples of living species.	It can distinguish between plant and animal species specific to a tropical environment. Draws the living environments of living things.	It can distinguish between pla and animal species specific tc tropical environment. He/she c explain his/her living and nc living interactions by drawing.
Model 4 (Plant, Animal, Human, and Inorganic factors are found)	He/she knows that there are plants, animals, people, and inanimate factors in a tropical environment and can give examples.	It can distinguish between plant and animal species specific to a tropical environment. He says that people will also live in this environment. Draws the living environments of living things.	He/she knows and draws plar animals, and human species ir tropical environment and c explain the interactions supporting them with drawings establishing connections betwe them.

The mental model drawings of the students according to the four models are given below from the mental model drawings and explanations analysis of the students under the guidance of the Level of Development Evaluation Table (Figure 1, 2,3,4):

Figure 1. Model 1 (Plant-Animal) Example

Figure 2. Model 2 (Plant-Animal-Human) Example

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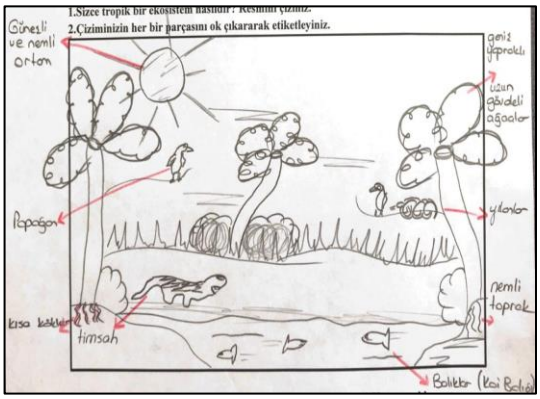

Figure 3. Model 3 (Plant-Animal-Inorganic Meat) Example

Figure 4. Model 4 (Plant-Animal-Human-Living meat.) Example

3. RESULTS AND DISCUSSION

To or the quantitative data, the "Achievement Test" was first applied to the experimental and control groups as a pre-test, and independent groups were analyzed with the t-test on the results obtained by both groups. In the statistical results obtained, the arithmetic mean score obtained from CT, which consisted of 12 multiple-choice questions and was evaluated as 1 point each, was found to be X=7.27 for the experimental group and X=7.19 for the control group.

In addition, as a result of the independent group's t-test (t=,180), no statistically significant difference was found between the mean values of the groups (p>.05). This result shows that the academic achievement of the control and experimental groups before the application is at the same level (Table 3).

Table 3. *The t-test results of the scores obtained by the control and experimental groups from the pre-test*

Groups		N	X	S	t	p
Pre-test	Control	27	7.19	2.020	.180	.86
	Experimental	30	7.27	1.363		

Post-test arithmetic mean scores of the experimental and control groups were found to be X=9.93 for the experimental group and X=8.89 for the control group. In addition, as a result of the independent group's t-test (t= 2.127), a statistically significant difference was found between the mean values of the groups (p<.05). This result shows that the field trip to the tropical environment with the experimental group increases student achievement in terms of the characteristics of tropical environments and their biodiversity (Table 4).

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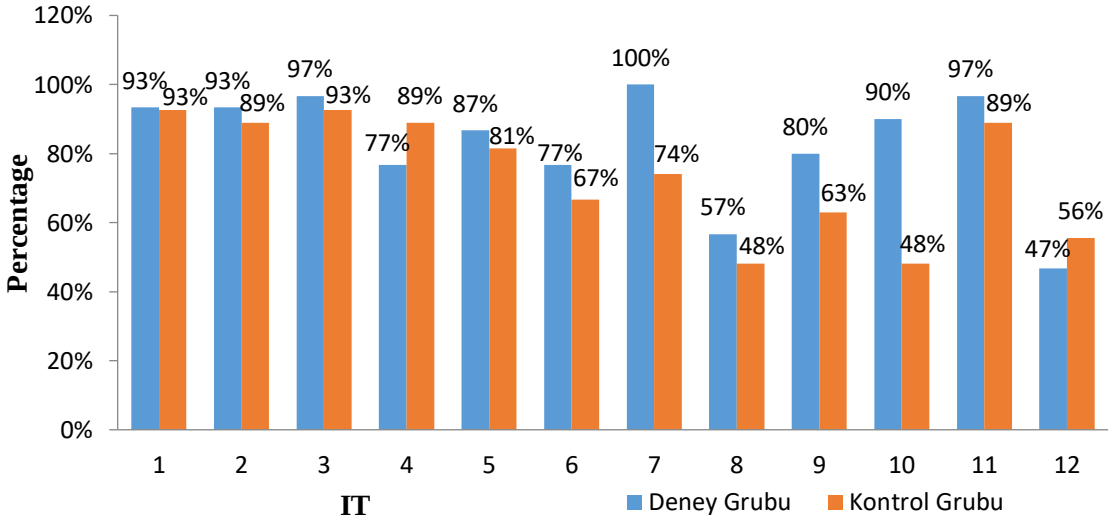
Table 4 *The t-test results of the scores obtained by the control and experimental groups from the post-test*

Groups		N	X	S	t	p
Post-test	Control	27	8.89	2.259	2.127	.03
	Experimental	30	9.93	1.388		

(*p<0.05 indicates a statistically significant difference between the CT post-test scores of the control and experimental groups.)

Graph1. *Comparison of success percentages in IT Questions*



When the answers to the questions of the achievement test are examined one by one, it is seen that the experimental group is more successful than the control group in all questions except the 4th and 12th questions. When the 4th and 12th questions, in which the control group was prominent, were examined, it was determined that there were questions at the level of knowledge about the characteristics of the tropical environment and the locations of tropical ecosystems on Earth.

Question 4. Which of the following information pertains to the characteristics of tropical rainforests?

1) *There are plant species that have large leaves and can always remain green.*
2) *Trees can grow up to 40-60 meters in length due to excess rainfall.*
3) *It has sparse and weak grass communities that grow due to spring rains and cannot withstand drought, but turn yellow and dry in summer.*
4) *a)1 and 2, b)1 and 3, c) 1 only, d)1,2 and 3*

Question 12. In which parts of the world are tropical rainforests not found?
a) America, b) Africa, c)South Asia, d)Europe

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The questions with the highest difference in success between the two groups are the 7th, 9th, and 10th questions. While the experimental group students were seen to be more successful in the 7th and 10th questions asking animal species specialized to the tropical ecosystem at the level of knowledge, in the 9th question, which is at the level of analysis of Bloom's cognitive taxonomy, the characteristics of plant species that can live in humid and dry environments were given by illustrating and the students were asked to determine the feature that does not play a role in adapting the plants to the humid environment.

Question 7: Which of the following animal species does not belong to the tropical ecosystem?
a) Snake, b) Turtle, c)Crocodile, d)Hedgehog

Question 10: In which of the following living environments is the living environment of the creatures given correctly?

Koi Fish

(I)

Polar Bear

(II)

d. Camel

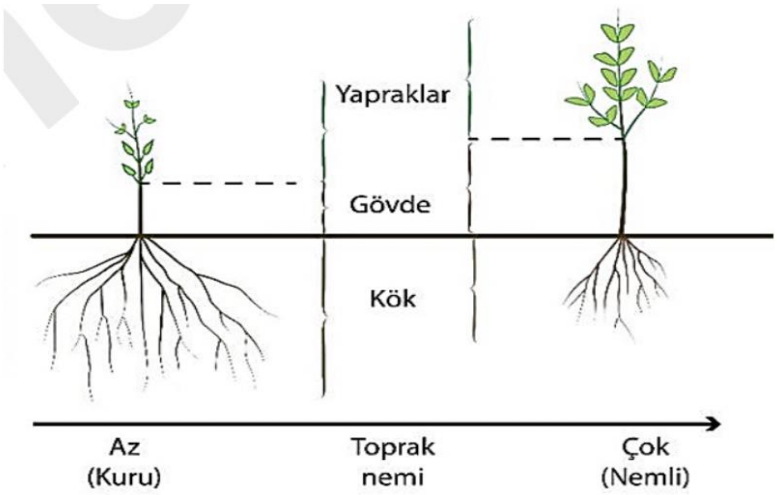
(III)

King Snake

(IV)

	I	*II*	*III*	*IV*
a)	*Sea*	*Pole*	*Tundra*	*Tropical*
b)	*Tropical*	*Polar*	*Desert*	*Tropical*
c)	*Marine*	*Forest*	*Desert*	*Tundra*
d)	*Tropical*	*Forest*	*Tundra*	*Forest*

Question 9: In the image below, the structures of damp and arid region plants are given.



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p- ISSN 2550-0600 e- ISSN 2549-6530

Accordingly, which of the following features does not play a role in adapting to the humid environment in plants living in humid environments?

a) The leaves are wide, b) The stems are long
c) Small roots, d) Storage of water in their bodies

It can be concluded that the reason why the experimental group was more successful in these questions is that it provided more permanent learning by experiencing the environment under the guidance of the research questions answered during the tropical center trip.

It was determined that the 8th question, which had the lowest mean response (experiment: 0.57 and control: 0.48) in both groups, measured the gains related to plant species in the tropical ecosystem. Such a conclusion may have been reached due to the low attribution to plant species in both the exhibition labels on the visit to the tropical center and the course videos at the explanation stage at the school.

Question 8: Which of the following is not a plant species in the tropical ecosystem?
a) Fern, b) Banana, c) Carnation, d) Orchid

According to the Level of Development Evaluation Table *used to measure students' perceptions of the tropical ecosystem*, it is seen that the pre-mental models of the students in the experimental group are weak and moderate in terms of their levels, and in the latest models made after the trip, these levels generally increase to medium and advanced levels. At the same time, when the drawings of the experimental group *were examined, no drawings suitable for Model 2 (plant-animal-human)* were found. In addition, after the visit to the tropical environment, it was observed that the students did not make drawings in accordance with Model 4 (plant-human-animal-living), where all the factors were together. It was determined that the student drawings of the experimental group were intensively concentrated in Model 1 (*plant-animal*) and 3 (plant-animal-living). This situation shows that the understanding that the tropical ecosystem is a system in continuous operation consisting of living and non-living factors is limited in the preliminary drawings before the trip, and that the tropical environment is considered as a habitat where only plants and animals are together. In addition, it has been determined that the knowledge of living diversity is generally weak. When the last drawings obtained after the trip are examined, it is seen that the explanations and drawings are customized, the diversity of living things is deepened specific to tropical environments and this functioning system is more detailed (table 5).

Table 5. *Frequency table of tropical center perceptions of Control and Experimental groups*

	Experimental Group						Control Group					
	Pre-test			Post-test			Pre-test			Post-test		
	Z	(	G		O	G	O	C	Z	C	G	
Model 1 (Plant+Animal)	7	1	1		6	3	-	-	1	3	2	

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Model 2 (Plant+Animal+Human)	-	-	-		-	-		-	-	-	-	1
Model 3 (Plant+Animal+Unliving)	10	9	-		8	12		8	6	12	1	5
Model 4 (Plant+Animal+Human+Unliving)	1	1	-		-	-		2	-	-	2	-

However, it has been determined that animal species are more detailed than plant species in the drawings and explanations, and that there is not enough environment-specific customization in the size of plant species. Sample drawings of the Weak and Advanced level are given in Figures 5 and 6.

Figure 5. Student D13 Weak Model 3 Mental Model Example

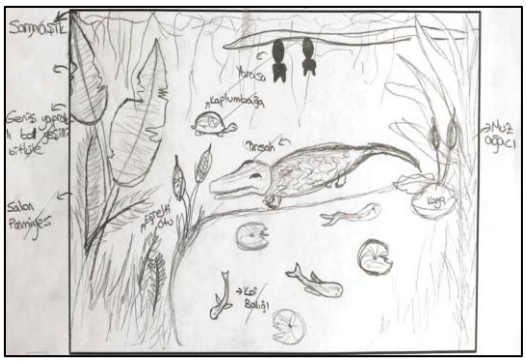

Figure 6. Student D13 Advanced level Model 3 Mental Model Example

When the control group is examined, it is seen that the preliminary mental models obtained before the application are generally weak and moderate, and the general mental models of the students are concentrated at a moderate level in the final drawings applied after various visuals, videos, and presentations. At the same time, while Model 1 (*plant-animal*) was not encountered in the preliminary drawings, it was determined that the preliminary and final drawings of the students were in accordance with Model 3 (plant-animal-living).

Accordingly, it is seen that some of the students deepened the diversity of living things specific to tropical environments in their drawings and explanations after the course in line with the usual curriculum, but could not explain this functioning system in depth. In addition, in the last drawings, it was determined that the control group, just like the experimental group, diversified animal species more than plant species. On the other hand, it was observed that the control group included the human factor more in the mental model drawings than the experimental group. In addition, it was determined that some of the students cited the videos and documentaries they watched as a reason for them to portray the tropical environment in this way (Table 5).

According to the findings obtained from the interview questions applied to the experimental group after the Izmir Sasalı Natural Life Park Tropical Center trip, the question

DOI: Prefix 10.17509/ijposs by Crossref
p- ISSN 2550-0600 e- ISSN 2549-6530

"Did this visit to contribute to your learning, can you briefly explain?" all of the students (n=30) stated that it contributed to their learning and the reason for this was by visiting, observing and experiencing.

The next question to the students, *"What do you think is the difference between learning on this trip and learning at school?*" question was directed. Students stated that the tropical center trip to the natural life park, which is one of the out-of-school learning environments, allows them to observe (13), experience (7) according to the school environment, learn by engaging and having fun (5), ensure permanence in learning by going to this environment (3), and learn more easily while being in these environments (2) (Table 6).

Table 6. *"What do you think is the difference between learning on this trip and learning at school?" codes related to the answers given to the question*

Codes	Example expressions;	f
Ability to observe	D23: *We learned better by observing on the trip, not just by dreaming at school.*	13
Ability to Experience (Learning by Living)	D21: In the *meantime, we learned everything by experiencing and seeing. Someone might have told me it was humid, but I didn't think it was as humid as I saw it, as much as I felt it.*	7
Entertaining - Attracting	D16: *It's very different. No matter how much the teacher tries to attract our attention between the four walls at school, we can get bored. During the trip, we learned by looking at everything and reading. Everything is o funny*	5
Permanence	D10: *I think it is better and more memorable to see them alive on the trip*.	3
Comfortable Learning	D18: *It was better to learn outside than in school, it made me feel comfortable.*	2

In the interview form, the question *"Would you like to teach in such environments again?" the next* question, all of the participants (n=30) stated that they wanted to teach again in such environments.

Question 4*: "What were the things you were most interested in during the trip?"* " While the student data were divided into two as ing and non-living themes, snakes, one of the most animal species related to living things, said that plants were diverse and broad-leaved. In the lifeless theme, they stated that they were interested in the general characteristics of the tropical environment and its climatic features. Only one student stated that nothing was interesting about the trip because it was a place he frequently visited (Table 7).

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Table 7. *"What were the things you were most interested in during the trip?" codes related to the answers given to the question*

Main Theme	Theme	Category	Codes	f
Positive	Living	Plant	Variety of Species	6
			Large and Wide Leafy	6
		Animal	Snakes	13
			Parrots	6
			Crocodilia	5
			Koi Fish	3
			Tarantulas	1
	Unliving	Environment	Tropical forests	1
			Living Areas	2
		Climate	Excess Temperature and Humidity	8
Negative				1

Students expressed their views on what was most interesting to them on the trip as follows:
D17: The tropical center is suffocatingly hot and humid. We are surrounded by a constant variety of plants.
D19: I was interested in Koi Fish, snakes, parrots, tarantulas, and crocodiles.
Contrary to these views
The student coded D28 explained, "Since it was my third trip, nothing interested me."

Finally, in the interview form, one of the students asked, "What *do you think are the negative aspects of the Tropical Center Visit in Sasalı Zoo?*" were asked to answer the question. Students generally answered this question the negative by stating that the environment is humid and hot (22), smells bad due to the indoor environment (2), the environment is unsuitable for human life because it is artificial (1), the places are muddy due to the humidity in the environment (1) and the seating area for visitors is low (1). However, three students stated that the environment was interesting to them and they enjoyed it, so there was no negative aspect to their visit (Table 8).

Table 8. *"What do you think are the negative aspects of the Tropical Center Visit at Sasalı Zoo?" codes related to the answers given to the question*

Category	Code	Example expressions;	f
Climate	Being Moist and	D16:.....*It was very hot and we had*	22

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	Warm	*difficulty breathing, apart from that there was no problem.*	
Environment	Bad Oder	D8: *The environment is very hot and smells strange due to the humidity*	2
	Unhealthy Living Space	D11: Sweating the *negative side and being out of breath.*	1
	Muddy Environment	D27: *Being hot, muddy, and damp*	1
	Lack of Seating Space	D13: *Seating areas were few, and there was no shade area.*	1
	No negative thoughts	D15: *I think there were no negative aspects. Because we did it by experiencing, observing, and experiencing learning there…… on the contrary, it had positive aspects.*	3

In this study, the effect of out-of-school learning environments (İzmir Natural Life Park Tropical Center) on the development of mental models of secondary school 7th-grade students about tropical environments and the success of students was examined. When the results of the achievement test conducted after the application were analyzed, it was seen that there was a significant difference between the success of the experimental group visiting Izmir Natural Life Park Tropical Center, one of the out-of-school learning environments, and the control group progressing under the guidance of the usual curriculum, which was designed under the 4E learning model.

This result proves that out-of-school learning environments increase students' academic success by positively affecting their learning, especially when used in a planned way in line with the curriculum. When the literature is examined, similar studies have shown that out-of-school learning environments increase academic achievement by providing permanent learning to students (Bowker & Tearle, 2007; Bozdoğan &Yalçın, 2006; Doğan et al., 2018; Ertaş et al., 2011; Metin & Bozdoğan, 2020; Orion & Hofstein, 1994; Sturm & Bogner, 2010; Türkmen, 2018). When the analysis is made in the context of the question, it is seen that the experimental group is more successful than the control group in all other questions except for two questions.

The reason why the control group is more successful in these questions, which are at the level of knowledge about the characteristics of tropical ecosystems and their position in the world, maybe that they focus on the videos and explanations in the explanation stage of the course and the permanent learning they provide from the visual and documentaries published in the digital environment that they emphasize in their mental model explanations. When the questions that the experimental group is more successful at are examined, it is seen that the questions include animal species, environmental characteristics, and adaptations developed by living things to adapt to this environment. It is thought that the reason for their success in these questions is that students observe and experience the environment while answering the research questions in the brochure given

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during the trip and provide permanent learning. It was noticed that the eighth question, which had the least response rate by both groups, was related to plant species specific to the tropical environment; as a result, it can be considered that the attribution to plant species is low both in the exhibition labels in the tropical center and in the course videos in the explanation stage in the school. This result once again emphasized that it is not enough to exhibit only objects in out-of-school learning environments and that the learning process should be supported by interactions such as object tags, videos and visuals (Land-Zanstra et al., 2020).

Considering the student drawings, it is seen that the preliminary and final drawings differ from each other in terms of model types and levels of models. It was determined that the pre-mental models of the students in the experimental and control groups were weak and moderate in terms of their levels. According to the results obtained in the latest drawings in the experimental and control groups, it is seen that students' perspectives and perceptions about the tropical ecosystem have improved. When the literature is examined, it is seen that this result is parallel to many studies (Barraza, 1999; İyibil & Arslan, 2010; Judson, 2011; Rennie & Jarvis, 1995; Shepardson et al., 2007).

When the control group was examined, the elements of model 3 (plant-animal-living) were generally found in the preliminary and final drawings of the students. Despite the course taught in the classroom environment in line with the science curriculum, it is seen that students cannot explain the specialized plant and animal species of tropical ecosystems in detail. In addition, considering the explanations of the control group about why they drew the tropical environment like this, the emphasis on 'Because it was like this in the documentary and video I watched' is remarkable. It can be interpreted that students often provide informal learning from the visuals, documentaries, or social media content they encounter in school or their social lives, in digital environments (TV, tablets, computers, phones) related to the tropical ecosystem, but cannot provide in-depth explanations as a result of their learning remaining at the level of knowledge. Social media and especially documentaries have been identified in some studies in the literature that have a positive effect on learning (Kapucu & Aydoğdu, 2014; Sarsar et al., 2015).

When the mental model drawings of the experimental group are examined, it is seen that the tropical ecosystem mostly contains living and non-living factors in its preliminary drawings, these systems interact with each other, but the students are insufficient to reflect this situation. In addition, it was determined that their drawings generally contain animal and plant species, but these are also limited. When the final drawings are examined, it is seen that the explanations and drawings are customized, the diversity of life is deepened specific to tropical environments and the connections are detailed. However, it is noteworthy that animal species are more detailed than plant species in the drawings and explanations, and there is not enough environment-specific customization in the size of plant species. The reason for this is that the plant species information labels in the tropical center are insufficient and the animal species labels are designed more and more in accordance with the exhibition label rules.

This finding, which shows the extent to which students are affected by labels during informal environment visits, is parallel to many studies in the literature (Fragomeni, 2010; Mcmanus, 1989). In terms of animal and plant species elaboration, this study was found to be different from Bowker's (2007) study on students' perceptions of tropical rainforests,

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especially in terms of the content of recent drawings. In Bowker's research, students analyzed and drew plant species more deeply than animal species after the trip. It can be said that this situation is because both travel environments are designed differently despite being tropical and the workshops carried out during the travel process in the other study. In addition, in the drawings, the tropical ecosystem is depicted in the documentary line as traditional and intact, and the existence of humans is not sufficiently processed. This may be because the students in Turkey are unfamiliar with this ecosystem, the fact that the emphasis has not been made that the artificial environment they go to may be the habitat of people while it is being regulated, and the fact that the environment is too humid and warm, they think that this environment is not suitable for human life.

In the interview questions applied after the trip, the students stated that they contributed to their learning by visiting, observing, and experiencing the tropical environment. When the students talked about the difference between field trips and learning at school, they mostly commented that they had the opportunity to make observations on field trips, thus providing permanent learning and enjoying learning in the environment they are in with their peers.

Similarly, Kıyıcı and Yiğit (2010), in their study in which they investigated the views of prospective science teachers on technical trips, concluded that these environments embody information, provide permanent learning, and include the dimension of entertainment by providing social interaction as well as learning, due to their openness to observation and experience. Then, when the students were asked whether they wanted to teach again in out-of-school environments, it was seen that they had a positive attitude because they were actively involved in these processes during the trip, and they all gave answers indicating that they wanted to teach again. On the other hand, when asked about the things that attracted their attention in the tropical center of İzmir Sasalı Natural Life Park and the negative aspects of the visit, students stated that they were most interested in animal species (snake, parrots, koi fish, etc.), then the general characteristics of the tropical environment and its climatic characteristics (temperature, humidity, etc.). Regarding the negative aspects of the visit, it was generally commented that they had difficulty breathing due to the tropical center being very hot and humid, and the environment was suffocating.

4. CONCLUSION

As a result, in this study, students in Turkey, who were strangers to the tropical ecosystem, were able to observe examples of various living and non-living species in the environment they went to, which reflected in their academic achievements, drawings, and thoughts as mental models. When the results are examined together, the students' enjoyment, observation, experience, careful and willing learning in out-of-school environments have improved their final drawings and increased their success.

Considering the results of the research, the following suggestions were made: The research can be repeated in different learning environments (different ecosystems) in line with the outcome of this study, or it can be carried out within long-term planning by expanding its scope in different age groups in the context of different outcomes. In addition, students can be enabled to describe their mental models with different methods (independent word association, interview, etc.) other than drawing.

DOI: Prefix 10.17509/ijposs by Crossref
p- ISSN 2550-0600 e- ISSN 2549-6530

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