4MAT Teaching Model Activity Designed to Be Compatible with the Whole Brain Model

ABSTRACT

Ali Şahin[1] & Ali Bozkurt[2]

In this study, the design, implementation and evaluation processes of the 4MAT teaching model activity, which is designed in accordance with the holistic brain model for teaching the graphic representation of data at the 8th grade level and making the appropriate transformations between these representations, are presented in this study. The implementation of the event took place in two village secondary school in the central district of a province in the south of Turkey in the 2021-2022 academic year. The activity was applied to 42 eighth grade students in two separate classes. A student opinion form was created by the researcher to see how the activity was perceived by the students. Content analysis was carried out in the light of the data obtained from the applied student opinion form. At the end of the research, it was seen that the students stated positive statements about the activity such as realizing permanent learning, prompting thinking, finding original ideas, giving various examples, and providing fun and understandable At the end of the research, students commented on the activity as providing permanent learning, encouraging thinking, allowing original ideas to be found, and providing fun and understandable learning by giving various examples.

Keywords: Holistic Brain Model, 4MAT, Data Analysis.

Bütünsel Beyin Modeline Uyumlu Olarak Tasarlanmış 4MAT Öğretim Modeli Etkinliği

ÖZ

Bu çalışmada ortaokul sekizinci sınıf düzeyinde verilerin grafikle gösterimi ve bu gösterimler arasında uygun olan dönüşümleri yapma konusunun öğretimine yönelik bütünsel beyin modeline uyumlu olarak tasarlanmış 4MAT öğretim modeli etkinliğinin tasarım, uygulama ve değerlendirme süreçleri sunulmuştur. Etkinliğin uygulaması 2021-2022 eğitim öğretim yılında Türkiye'nin güneydoğu bölgesinde bulunan bir ilin merkez ilçesine bağlı köy ortaokulunda gerçekleştirilmiştir. Etkinlik iki ayrı sınıfta toplamda 42 sekizinci sınıf öğrencisine uygulanmıştır. Etkinliğin öğrenciler tarafından nasıl algılandığının belirlenmesi için araştırmacı tarafından öğrenci görüş formu oluşturulmuştur. Uygulanan öğrenci görüş formundan elde edilen verilerin içerik analizi yapılmıştır. Araştırma sonunda etkinliğe yönelik öğrenciler, kalıcı öğrenme gerçekleştirdiği, düşünmeye sevk ettiği, orijinal fikirlerin bulunmasına imkân sunduğu, çeşitli örneklerin verilerek eğlenceli ve anlaşılır öğrenmeler sağlanması gibi yorumlarda bulunmuşlardır.

Anahtar kelimeler: Bütünsel Beyin Modeli, 4MAT, Veri Analizi.

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INTRODUCTION

Research questions are the main questions that a study or research project aims to answer. The information obtained in accordance with the research questions is called data. Interpreting the obtained data in an easy and understandable way falls under the data analysis section. Data analysis is defined as a system that allows the data obtained in accordance with the research questions to be easily interpreted with the help of tables, graphs or figures (Baki & Çelik, 2018). There are various studies on the subject of data analysis. Some studies have investigated making inferences about the problems that individuals may encounter in daily life, analyzing the problems and producing appropriate solutions (Hafiyusholeh et al., 2018; Toptaş et al., 2019; Tosun & Özen Ünal, 2019). Some studies seem to focus on the statistical interpretation of data, how the data obtained should be interpreted, and how problems should be analyzed and interpreted in parts (Çakmak & Durmuş, 2015; Garfield & Ben-Zvi, 2008; Schield, 2011). As can be seen, the subject of data analysis is not only a subject of mathematics course, but also an important issue in terms of analyzing the problem, producing solutions, making sense and interpreting the problems that individuals will encounter in daily life.

The subject of data analysis finds its place in all secondary school levels, starting from the fifth grade of the curriculum (Ministry of National Education, 2018). The program includes two outcomes regarding data analysis at the eighth grade level. These; "It interprets line and column charts belonging to a maximum of three data groups" and "It displays the data as a column, circle or line chart and makes appropriate transformations between these representations." (MEB, 2018, p.76). Within the scope of this study, the implementation process and evaluation of an activity designed according to the 4MAT teaching model compatible with the holistic brain model for the second outcome was carried out.

Holistic Brain Model

The holistic brain model is a brain-based model put forward by Ned Hermann. According to Herrmann, in addition to being composed of two hemispheres, both hemispheres are divided into two limbic systems, upper and lower, thus stating that it actually has a structure consisting of four quadrants in terms of brain characteristics (Herrmann, 2000). The four-quadrant holistic brain model and the properties of these quadrants are given in Figure 1.

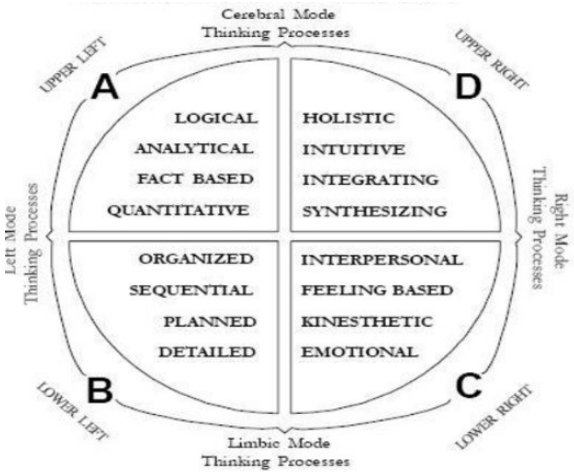

Figure 1. Holistic Brain Model (Demirogları, 2021, s.37)

Preparing the teaching to individuals in accordance with the holistic brain model allows the teaching to provide more understandable and permanent learning (Demirogları, 2021). Especially before teaching, it should be determined which dominance the students have by applying the brain dominance inventory created by Ned Hermann by the people who will teach them. Afterwards, the teaching, lectures, activities, exercises, etc. are to be given to the students. It is thought that preparing applications according to this brain dominance will be more effective for students in terms of academic success and retention of information.

4MAT Teaching Model

The 4MAT teaching model, based on the constructivist teaching approach, was developed by McCarthy in the 1970s. McCarthy states that this model has a student-centered structure that includes all differences between students and organizes events or situations according to students (McCarthy, 1987). The model consists of an eight-step cycle that has a hierarchical structure and proceeds clockwise (Figure 2).

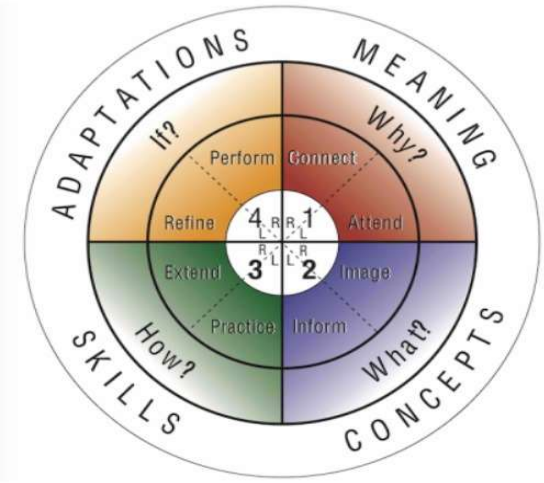

Figure 2. 4MAT Teaching Model (Kösa & Ardıç, 2018)

The first step of the 4MAT teaching model is the relationship building phase. In this step, the people who will teach are given examples that students can see in their environment in order to connect the subject to be taught with daily life. The second step is to attract attention. In this step, the attention of the students is drawn to the subject by teachers asking various questions to the students in order to move towards the essence of the subject with examples given from daily life. The third step of this model is the visualization phase. At this stage, in the light of the questions asked from the students, the students are asked to create thoughts related to the subject with the help of their imagination (Ergin, 2011). The fourth step of the 4MAT teaching model is the information phase. At this stage, teachers provide students with all the necessary theoretical information about the subject. The fifth step of the model is the implementation phase. This can be described as the step where students apply the theoretical knowledge given by teachers and do exercises. The sixth step of this model is the deepening phase. At this stage, the content of the subject is enriched by showing students various examples specific to the subject. Although the seventh step of the 4MAT teaching model is expressed as the correction step, it is also seen in some sources as perfecting or producing an original product (Alanazi, 2020; Aliustaoğlu, 2018). At this stage, students are released within a certain period of time and asked to create new examples specific to the subject, sometimes individually or in groups (Yanti et al., 2021). At this step, it should be noted that students are not expected to produce something from scratch, but are asked to find various examples specific to the subject in their own words. The eighth step of this model is the presentation phase. Here, students are asked to present the examples they found themselves in the classroom environment in the seventh step (Sabry et al., 2021). This example is expected to be discussed and analyzed by classmates. At this stage, teachers are the guides. While teachers are responsible for maintaining classroom order so that discussions can take place, they only intervene when students go off topic.

Within this model, it is seen that easy and permanent learning occurs due to its features such as starting the subject with examples from daily life, encouraging students to think, giving theoretical information in certain steps, performing various exercises, finding original examples specific to the subject and sharing them with the class (Alanazi, 2020; Aliustaoğlu, 2018; Ergin, 2011; Sabry et al., 2021; Yanti et al., 2021).

In this study, it is aimed to design the 4MAT teaching model in line with the holistic brain model in order to include almost all features such as further enrichment of the content and taking individual characteristics into account in detail, instead of creating activities within the general framework for the left and right brain dominance of the brain. Because, as Hermann (2000) stated, the brain characteristics of individuals indicate that they do not only have left and right brain dominance, but that these hemispheres are divided into two limbic systems that have different characteristics within themselves. We aim to take this model into account and create a teaching practice and activities that are suitable for the brain characteristics of the students in the classroom environment and include all of them.

DESIGNING THE EVENT

The following points were taken into consideration while designing the 4MAT teaching model activity, which is compatible with the holistic brain model:

1. The brain dominance of the quadrants of the holistic brain model and the steps of

the 4MAT teaching model were taken into account.

2. It was prepared by looking at the characteristics of the quadrants of the holistic brain model and the steps of the 4MAT teaching model, according to which they have similar characteristics.

3. Another point is that an effort was made to include all quadrants of the holistic brain model in equal amounts in the eight-step 4MAT teaching model.

Four lesson hours have been determined for the activity (Annex 1) prepared for the achievement of "It displays the data as a column, circle or line graph and makes appropriate transformations between these representations" (MEB, 2018, p.76). These course hours were prepared by the researcher, taking into account the hours given to the achievements published by the Ministry of National Education and the steps of the 4MAT teaching model. Steps 1, 2 and 3 in the first lesson hour are to create an experience for the students before the subject-specific information is given to the students; In the second lesson, steps 4 and 5 are given, where expert information is given and the steps closest to traditional teaching are; In the third lesson, steps 6 and 7 are carried out to find and diversify examples in students' own words; In the fourth lesson hour, it is planned to share the last step, the 8th step, that is, the examples produced by the students within the class. It should also be noted that the activities included in these steps are examples that should be performed at a minimum level during the lesson. If there is time remaining in the course period, the teacher is expected to enrich the process.

A student opinion form was prepared by the researcher to obtain student opinions about the use of the 4MAT teaching model, which is designed to be compatible with the holistic brain model. The final version of this form was created by taking the opinions of two lecturers who are experts in the field. The student opinion form consists of two open-ended questions. While one of these questions was a question within the general framework of the 4MAT teaching model, the other was aimed at a specific step of this model. These questions are explained in more detail under the heading of evaluation of effectiveness. Content analysis was used to analyze the data obtained from the student opinion form. Content analysis allows the expressions to become visible by collecting the data obtained from the research questions under certain categories (Ubay, 2022). It is expected that we will reach a general framework about the use of this model by finding the categories chosen to make visible the subjective expressions given by the students about the use of the 4MAT teaching model and the number of people who prefer these categories.

Materials used in these activities; The activity sheet shown in Appendix 1 contains blank papers, cardboard, colored pencils and blackboard markers for the answers to be received from the students. These materials were used in the implementation of the activity, that is, in the student products shown in the photographs.

IMPLEMENTATION OF THE EVENT

The research was applied separately to one eighth grade class in two different village secondary schools in the central district of Karaköprü in Şanlıurfa province. There are 21 students in each class. While there is one eighth grade in each of these village schools, a researcher works in one of them. Since the 4MAT teaching model applied in the research was requested to be carried out with two groups in order to find out whether there are similar effects, independent of the people conducting the research, two village schools with the closest characteristics such as socio-economic structures, lifestyles, livelihoods and cultural structures were preferred. Necessary permissions were obtained from school, district and provincial national education directorates to carry out the study in these schools. In addition, the ethics committee approval numbered 132137 was received from Gaziantep University Social and Human Sciences on 30.12.2021 for this study.

The time allocated for the activity is four lesson hours. The first, second and third steps of the activity were implemented in the first lesson hour. During this course hour, the questions specified in the steps were asked so

that the students could reach the essence of the subject, and the content was enriched according to the feedback received from the students. These steps aimed to attract students' interest in the subject, encourage them to think, increase their motivation for the subject, and see their preliminary knowledge of the subject. One of the applications carried out by the students regarding these three steps is given in Photo 1.

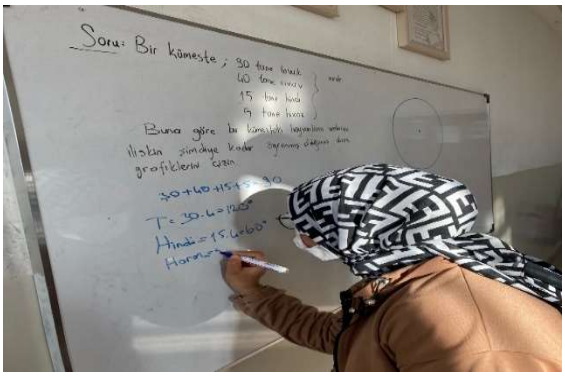

Photo 1. Student Creating a Pie Chart

The fourth and fifth steps of the 4MAT teaching model cycle were carried out during the second lesson hour. These steps are seen as the closest steps to the traditional teaching model that is most preferred in schools. In this course, theoretical information about the subject was given and the necessary rules, formulas and solutions were conveyed to the students.

In the third lesson hour, the sixth and seventh steps of the 4MAT teaching model were implemented. In the sixth step, while the subject was enriched with various examples, original ideas began to be produced. In the sixth step, they were asked to answer the examples given. Then, as part of the seventh step, students were asked to find original examples specific to the subject. By the way, it should be noted that finding original samples should not be perceived as producing something new from scratch. It is expressed this way because the expression of creating an original product is used in the 4MAT teaching model. At this stage, students are released for a certain period of time and are asked to present their own examples specific to the subject. The term originality is used because students create examples on their own without getting help from anyone, that is, they present the examples in their own words without quoting from anywhere. One of these examples is given in Photo 2.

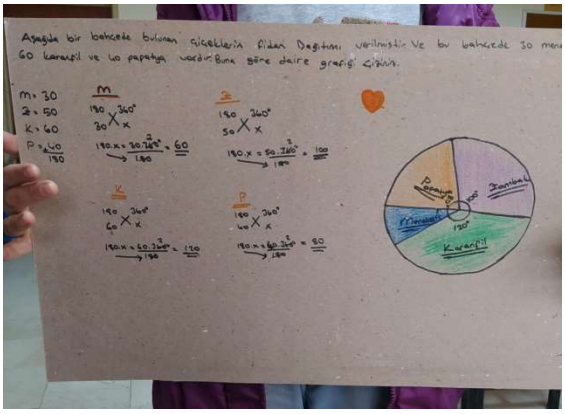

Photo 2. Sample Question and Solution Created by the Student

The presentation step, which is the last step of the 4MAT teaching cycle, was carried out in the fourth hour. During this class period, a randomly selected student was asked to present his or her original example regarding the subject in the class environment during the third class period, and it was discussed with the class. In this way, peer evaluation was carried out, allowing students to examine the subject, seeing different examples, and creating a democratic environment in the classroom.

One of the new examples produced by the students with their own ideas was asked by the teacher to randomly select a student and present his example on the board and present the questions he had created regarding his example to his classmates. An example of this application is given in Photo 3.

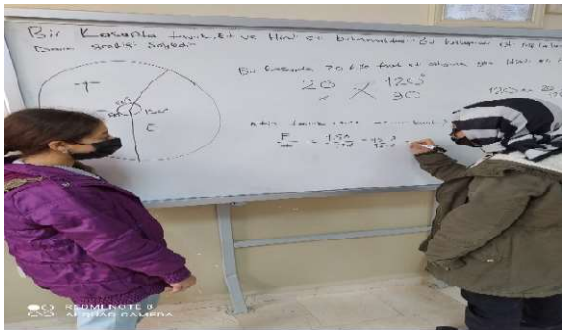

Photo 3. A Classmate Solving the Example Prepared by the Student

The sample prepared by the student was subjected to peer evaluation. Guidance was given by the course teacher according to the feedback received from the students. Teachers

act as guides during this lesson time. Thus, the event will be completed. To elaborate on the contributions of this activity to students, the traditional teaching model is generally applied in school environments. In this model, teachers convey all the theoretical knowledge specific to the subject to the students, then do exercises, and then the students are expected to produce solutions similar to the solutions in the exercises. Finally, the process is completed by making evaluations with test questions or various questions. The 4MAT teaching model, on the other hand, draws the student's motivation, interest and attention to the subject before teaching the subject by giving examples from daily life, asking questions about the subject and encouraging students to think, thanks to its first three steps, instead of giving theoretical information directly. For example, since the activity in the study took place in village schools, the activity started with a question about poultry in order to establish a relationship with the subject. Afterwards, various questions were asked to the students based on the same example to ensure that the students paid attention to the subject. Steps four and five of this model are almost exactly the same as traditional teaching. In the sixth step, different examples related to the subject are shown, in addition to the examples shown by the teacher. Perhaps the most important difference between this model and the other model is the seventh and eighth steps. In the seventh step, students are given some time and are expected to create new examples related to the subject and prepare questions for these examples. In the eighth step, students share the examples or activities they prepared in the previous step with the class. From here on, discussions with classmates take place under the guidance of the teacher. Let's give an example to make this situation more understandable. A student asked the question, ‘‘*With which graph can we show the comparison of the five-year peanut production amount of Şanlıurfa and Gaziantep provinces?’’* another student took permission and answered *"Line graph"*. To this answer, the student who asked the question said, *“No. ‘‘A line chart is a chart used for instantaneous changes,’’* he said. When another student stated, *‘‘It can be shown with a table.’’*, the teacher guided him by saying, *‘‘It can be shown with a table chart, but I think it would be good to pay attention to the word comparison in the question, as well as to know which of the subjects we see can be shown with which one.’’* also by saying that, the teacher managed to prevent the student from getting of topic. Another student in the class answered, *‘‘This can be shown with a column chart.’’* However, the student who asked the question said, *‘‘Correct.’’* Then, he shared the years and amounts he had prepared for the provinces of Şanlıurfa and Gaziantep with the class. Based on these numbers, he asked various questions and began to receive answers from the class. In short, the first three steps and the last two steps of this model, unlike the teaching that is mainly carried out in schools, include 4MAT teaching in various aspects such as actively involving the student in the process, attracting their attention to the subject, seeing various examples specific to the subject, creating new examples by the students in their own words, sharing them with the class, and discussing them. It can be said that the model has its own original aspects.

EVALUATION OF THE EVENT

At the end of the activity application, two open-ended questions were asked to the students by the researcher and the answers were received in writing. The resulting student opinion form was applied to the students. The data obtained from the student opinion form was subjected to content analysis. Thus, it was aimed to get their opinions about the activity based on the 4MAT teaching model, which is compatible with the holistic brain model prepared for teaching the subject of data analysis.

A total of 12 student opinion forms, 6 from each class, were randomly selected and analyzed. The reason for this selection process is that there are 21 student groups in both grade levels. In other words, a total of 42 student opinion forms were obtained. Due to the abundance of data, this number was reduced. While selecting from this data, after first removing the forms in which the questions were not answered or in which short answers were given, that is, the questions could not be answered explanatory, still too many opinion forms were obtained. Therefore, 12 student opinion forms, 6 from each class, were selected and analyzed.

The first question in the form was *"An eight-step activity was implemented regarding data analysis in the mathematics teaching process. Do you think this practice is effective? If yes, can you explain how? If no, please explain why?"* is the question. This question was prepared to determine whether the activity applied in teaching the subject is seen as generally effective by the students. Of course, it should be noted that students were given general information about this model, which consists of eight steps, without giving direct information about the steps. Since these eight steps are carried out practically in teaching data analysis subjects, it is thought that students have a general knowledge about this model. The content analysis result obtained from the students' answers to the first question is given in Table 1.

Table 1. Students' opinions on the implementation of the 4MAT teaching model activity

Code	Frequency
Finding and sorting samples	5
Be understandable	1
To be fun	2
Being a new method	2
Join your friends	2

Tablo 1 When Table 1 is examined, it can be seen that students generally have a positive opinion about the use of the 4MAT teaching model, which is compatible with the holistic brain model, in teaching the subject of data analysis. It can only be said that they have different ideas when expressing the reason for this situation. For example, a student said, *"Yes. Because we found examples and did them ourselves... I think it was effective."* Another student said, *"Yes. Because we can make it both fun and easy by doing activities ourselves..''* As can be seen, they stated that the subject was more enjoyable than traditional teaching, thanks to different practices such as students actively participating in the teaching process, doing activities, producing and sharing things with their friends.

The purpose of the questions prepared for the steps of the 4MAT teaching model is to see whether these steps work according to their functions. *''Do you find the work you did to find relevant examples during the application process useful? "Explain with why."* The question is a question created for the sixth and seventh steps of the 4MAT teaching model cycle. The content analysis result obtained from the answers given by the students to this question is shown in Table 2 below.

Table 2. Students' opinions about their experiences finding examples

Code	Frequency
Finding original samples	5
Finding various examples	4
Make you think	1
Waste of time	2

When Table 2 is examined, 10 students expressed positive opinions and 2 students expressed negative opinions regarding the students' ability to find subject-specific examples themselves.

CONCLUSIONS and SUGGESTIONS

In the study, the effect of an activity designed in accordance with the 4MAT teaching model compatible with the holistic brain model in teaching the subject of graphical representation of data and making appropriate transformations between these representations at the eighth grade level of secondary school was investigated. The research was applied to two groups. The student opinion form prepared by the researcher was applied and the obtained data was subjected to content analysis.

While students express positive opinions about the application, it is seen that they express this situation as being a new method, being fun, being understandable, involving their friends in the process, finding and solving various examples. In the research conducted by Bülbül (2013) about the use of 4MAT teaching model by ninth grade students in the two-dimensional art workshop course, it was observed that the students had positive opinions about the use of this model. He attributes the reasons for this to the reasons such as the fact that this model is understandable, entertaining, various examples are created, and examples from daily life are included. As can be seen, it can be stated that they are in the same direction as this study.

In the research, it was seen that while most of the students had a positive perception regarding the sixth and seventh steps of the 4MAT teaching model, they expressed this as finding original examples, creating various examples and encouraging students to think. In addition, two students seem to have negative thoughts because this situation takes too much time. In his study, Aktaş (2011) investigated the effect of using the 4MAT teaching model in explaining the structure and properties of matter in the seventh grade secondary school science course. As a result of the research, it is stated that while students generally find the use of the 4MAT teaching model positive, there is a point where students criticize it. While students stated positively that the 4MAT teaching model takes into account individual differences, has a variety of examples, provides permanent learning, is fun and creates original examples, it is also negatively stated that it causes a lot of time loss (Aktaş, 2011). With this result, it can be stated that the study is in the same parallelism, that is, the students have approximately the same thoughts.

As a result, it seems that the use of the 4MAT teaching model, compatible with the holistic brain model, in teaching the graphical representation of data and making appropriate transformations between these representations at the eighth grade level of secondary school, has a positive effect on students. It is recommended that future studies should examine the effects of such activities by using them in different disciplines as well as in different grade levels of mathematics.

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APPENDICE 1

The activity of graphically representing data and making appropriate transformations between these representations

Holistic Brain Model Part	4MAT Teaching Model Step	Application
C	Step one: Relationship Building	- There are 30 chickens, 40 chicks, 15 turkeys and 5 roosters in a coop. Have a student draw a pie chart for the data generated by the animals in this chicken coop.
A	Step two: Pay Attention	- Is there a relationship between the ratio of the central angles of any two animals in the pie chart and the ratio of their quantities? Explain why. - If 30 more chickens are added to this coop, how much will the central angle of the rooster's circle graph change?
D	Step three: Relating Reflected Analyzes to Concepts	- (Three students stand up to the board. One draws a line, the other draws a column, and the other draws a line graph showing the number of animals in the chicken coop.) - Explain together which of the line, column and circle graphs drawn by your three friends would be suitable for comparison of animal numbers.
B	Step four: Giving Information	- A circle chart is a graph created with the help of circle slices proportionally to the data. - The most appropriate graph used to show the changes of data over time is the line graph. - The most appropriate type of chart used to compare two or more groups of data is the column chart. - The most appropriate chart used to compare proportionally the parts that make up a whole is the circle chart.
B	Step five: Application	- There are 20 cars of brand A, 10 of brand B and 30 of brand C in a car dealership. Accordingly, find the angle of car A on the pie chart. - Which graph is more appropriate to show the income amount of a company over the years? - When making rice 4 glasses of water are added to 1 glass of rice. Accordingly, if we want to show the ingredients in rice making in the pie chart, what is the central angle of the rice?
C	Step six: Self-Improvement	- Which chart is appropriate to show the monthly exchange value of the dollar against the Turkish lira? - If we want to create a graph according to the types of universities that students who graduated from Şanlıurfa Science High School in 2020 were placed in, please indicate which graph would be appropriate. - Which graph do you think is more appropriate to show the monthly earnings of markets A, B and C in a year? - The percentages of monthly expenses of a house are as follows; Rent 20%, Education 15%, Kitchen 30%, Bills 25% and the remaining part goes to other expenses of the house. Accordingly, if we want to show the house expenses on the circle chart, find the central angle measure of the other expenses of the house.
D	Step seven: Perfecting	- Write in your notebook two examples of events that you see or can be seen around you that might constitute examples of line, column and circle graphs?
A	Step eight: Presenting	- Share these examples with your classmates and express your opinions about the examples your friends found?