THE EFFECT OF CASE BASED LEARNING ON TENTH GRADE STUDENTS' UNDERSTANDING OF HUMAN REPRODUCTIVE SYSTEM AND THEIR PERCEIVED MOTIVATION

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I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

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ABSTRACT

THE EFFECT OF CASE BASED LEARNING ON TENTH GRADE STUDENTS' UNDERSTANDING OF HUMAN REPRODUCTIVE SYSTEM AND THEIR PERCEIVED MOTIVATION

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The effect of case based learning on 10^{th} grade students' academic achievement in the unit of human reproductive system and their perceived motivation (Intrinsic Goal Orientation, Extrinsic Goal Orientation and Task Value) was investigated in this study.

The study was conducted during 2007-2008 spring semester in a private high school in Ankara, Turkey. A total of 80 (48 males and 32 females) tenth grade students from four biology classes of two teachers were involved in the study. One class of each individual teacher was assigned as control group and the other class of the same teacher was assigned as experimental group to sustain randomization. Two of the classes assigned as experimental group were instructed with case based learning, while two classes of the control group were received traditionally designed biology instruction.

In the experimental group, two cases that are divided into several parts were assigned in an interrupted manner. Students learned the human reproductive system via cases in experimental group without any additional method. The cases include incomplete data and students were needed to search for and discuss to answer the questions posed in the cases and by themselves and to complete the

data. When the students completed a part of the case, next part was distributed. While dealing with the dilemma presented in cases, students did independent study as well as group work. In the control group, instruction was based on teacher explanations and web based notes prepared by the biology department of the high school.

Human Reproductive System Achievement Test, Motivated Strategies for Learning Questionnaire were administered as pre-test and post-test to the students in both groups to measure the students' academic achievement in the unit of human reproductive system; and their perceived motivation; specifically, task value, intrinsic goal orientation, and extrinsic goal orientation.

Multivariate Analysis of Variance (MANOVA) was used to investigate the effect of case based learning on the students' academic achievement in the unit of human reproductive system and their perceived motivation. Results revealed that case based learning improved students' academic achievement and task value.

Keywords: Human Reproductive System, Case Based Learning, Traditionally Designed Biology Instruction, Academic Achievement, Motivation, Task Value, Intrinsic goal Orientation, Extrinsic Goal Orientation

öz

ÖRNEK OLAYA DAYALI ÖĞRENMENİN ONUNCU SINIF LİSE ÖĞRENCİLERİNİN İNSANDA ÜREME SİSTEMİ KONUSUNU ÖĞRENMELERİNE VE MOTİVASYONLARINA KATKISI

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Bu çalışmada örnek olaya dayalı öğrenmenin onuncu sınıf öğrencilerinin insanda üreme ünitesindeki akademik başarılarına ve güdülenmelerine etkisi araştırılmıştır.

Çalışma 2007 -2008 bahar döneminde Ankara'daki özel bir lisede gerçekleştirilmiştir. Çalışmaya iki öğretmenin dört sınıfından 48si erkek 32si kız olmak üzere toplam 80 onuncu sınıf öğrencisi katılmışlardır. Rastgele dağılımı sağlamak üzere, öğretmenlerin her birinin sınıflarından biri kontrol grubu olarak atanırken aynı öğretmenin diğer sınıfı deney grubu olarak atanmıştır. Deney grubu olan iki sınıf konuyu örnek olaya dayalı öğrenme yöntemiyle öğrenirken kontrol grubu olan diğer iki sınıf konuyu geleneksel öğrenme yöntemiyle öğrenmişlerdir.

Deney grubunda örnek olaylar birkaç bölüm halinde her defasında bölümlerden biri verilerek uygulanmıştır. Bu gruptaki öğrenciler insanda üreme ünitesini örnek olaylar yoluyla başka herhangi bir ilave yöntem olmaksızın öğrenmişlerdir. Örnek olaylarda eksik bilgi verildiğinden, öğrencilerden hem örnek olaylarda sorulan veya kendilerinin yönelttiği soruları çözümlemek hem de verilen eksik bilgileri tamamlamak üzere araştırma yapmaları ve çözüm yolunda tartışmaları istenmiştir. Öğrenciler örnek olayın bir bölümünü tamamladıklarında diğer bölümleri sırayla almışlardır. Örnek olaylarda sunulan muammaya çözüm ararken öğrenciler hem

bireysel hem da grup çalışması yapmışlardır. Kontrol grubunda öğretim öğretmenin açıklamaları ve okul zümre öğretmenleri tarafından hazırlanmış olan internet erişimli ders notları aracılığıyla sürdürülmüştür.

Öğrencilerin insanda üreme ünitesindeki akademik başarılarını ve güdülenmelerini ölçmek üzere İnsanda Üreme Başarı Testi ve Öğrenmede Güdülenmiş Stratejiler Anketi hem deney grubuna hem de kontrol grubuna ön-test ve son-test olarak verilmiştir.

Çoklu Varyans Analizi (MANOVA) yoluyla örnek olaya dayalı öğrenme yönteminin çalışmanın değişkenlerine etkisine bakılmıştır. Sonuçlar örnek olaya dayalı öğrenmenin öğrencilerin akademik başarılarını ve güdülenmelerini arttırdığını göstermiştir.

Anahtar Kelimeler: İnsanda Üreme Sistemi, Örnek Olaya Dayalı Öğrenme, Geleneksel Öğrenme yöntemi, Akademik Başarı, Motivasyon

TO MY FAMILY,

For Their Great Support, Tolerance and Love

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CBL : Case Based Learning.

TDBI : Traditionally Designed Biology Instruction.

HRSAT : Human Reproductive System Achievement Test.

MSLQ : Motivated Strategies for Learning Questionnaire.

AA : Academic Achievement

IGO : Intrinsic Goal Orientation

EGO : Extrinsic Goal Orientation

TV : Task Value

DF or df: Degrees of freedom

χ^2 : Chi-square

CHAPTER 1

INTRODUCTION

This chapter tries to make it clear for the readers that what is case based learning with its theoretical background. Then, it argues about the value of case based learning in terms of teaching science with this method and why case based learning was studied in particularly human reproductive system in terms of its effect on academic achievement and affective variables chosen. The significance of the study will be given in last part of the chapter.

1.1 Background of the Study

Students differ from each other in many aspects but they are all identical in that they have the capacity to learn from their experience naturally (Caine & Caine, 2006). Piaget proposed (1952) that children construct their own beliefs and understandings from their experiences and pull them together into an integrated view of how the world operates. In the constructivist view of cognition, learning is a constructive process in which the learner builds an internal representation of knowledge, a personal interpretation of experience. Because of emphasis on active role of students in their own learning, constructivist strategies are often called student-centered instruction. Constructivism heavily depends on works of Piaget and Vygotsky both of whom emphasized the social nature of learning, and suggested the use of mixed ability groups. Case based learning is an authentic learning approach that allows students to construct their own knowledge. In case based learning, students explore, discover, discuss, and meaningfully construct concepts and relationships in contexts that involve real world problems. Students socially interact with each other in group discussions while teacher guides learning with scaffolding (Kreber et. al., 2007; Wellington, 2006).

Case-based learning (CBL) has been used in science education since 1949 (Herreid, 1994). The usage of method goes even back to late of ninetieth century in

medicine. It is also widely used in law and business from the beginning of the twentieth century. Case method teaching in the secondary schools was pioneered by Centennial School in British Columbia, Canada and applied widely almost in all subject area including mathematics, biology, general science, English etc. (Wassermann, 1994). Many faculties realized the inadequacies of lecture method in science and case study method was imported from business, law and medical schools when come to the middle of twentieth century (Herreid, 1994).

What case based learning offers has already been stated by Wassermann (1994):

> ……Students learn to communicate their ideas more effectively. They are able to examine complicated issues in more critical ways. There is dramatic change in students' ability to make good decisions. Students become more curious; their general interest in learning is increased. There is increased respect for the different views, attitudes, and beliefs held by other students. Students are more motivated to read material beyond that presented in class. Discussion of issues that began in class extends beyond that presented in class, to the lunchroom, and to the dinner table. Students enjoy classes more and find school more challenging and more interesting. (p. 10)

Case based learning generates experiences that students would not otherwise have so it is considered as a useful method by many researchers while understanding the rules operating in the universe in science courses. Cases are appropriate in such information-driven courses as they are in the social sciences and humanities (Wassermann, 1994). Participants in CBL are asked to apply their previous experience toward solving real-world problems (Mayo, 2002). In this

characteristic, case studies show the link between theory and actual occurrences by using examples from real experiences (Naumes & Naumes, 2006).

Case-based exercises and examples of relevance to real life were offered to use to make contemporary biology and its techniques accessible to all students whether they plan tertiary study or not (Moore, 2008). For most of the people, schools are the only way of having opportunity to learn about scientific advances of relevance to their lives. Understanding the scientific developments and their effects on their lives is not an easy subject even for educated people. Teaching science by forming links between research and every day life may provide a holistic approach in science education in secondary schools. Hoskin (1998) defines learners in traditional pedagogy as atomized individuals who depend on textbooks and notes and gears to get grades on ritualized, rote-learned testing. On the other hand, she advocates case study as an effective means of learning by engaging learners, as a group, with real-world problems. In case based learning, students actively participate in realistic problem situations and reflect the kind of experiences typically encountered in the discipline under study. Case based learning increases students' performance and students like learning with cases (Bridges & Hallinger, 1999; Mayo, 2004)

Çakır (2002) stresses that although case based learning is widely used in world especially in USA; only a few medical faculties use this method in Turkey. She also introduces case based learning as a necessity in biology education to substitute traditional pedagogy depending on rote memorization for contemporary learning methods. Being opposite of most of the European country, the biology curriculum in Turkey includes systems biology in detail and the second part of the university entrance examination (ÖSS) largely depends on the questions in systems biology. The Human Reproductive System is included in level ten in Turkish Biology curriculum. To better understand unit of human reproductive system, students should also be competent in the unit of cell division covered in level nine and in the unit of evolution covered in level ten just before the reproduction unit. Besides, human reproductive system serves as a basis for endocrine system, which is covered in level eleven. In a study whose subjects are eleventh grade students,

most of the students and majority of the teachers reflect human reproductive system as both an important and a difficult topic (Kablan, 2007). The biology questions of university entrance examination on the unit of human reproductive system require constructing relationships between these three units. Constructing such relationships is not easy for the students that are not familiar with thinking in this manner. Case based learning promotes development of such critical thinking skills that are required to connect knowledge from different areas (Wassermann, 1994). Human Reproductive System like all other physiology subjects in biology is suitable to implement case based instruction in classrooms (Walters, 1999).

Case based method offers a student-centered learning environment although the degree to which learning is student-centered may vary depending on which type of case based method will be used and who will be use the method (Çakır, 2002; Herreid, 1998; Hoskin, 1998; Naumes & Naumes, 2006; Wassermann, 1994). Generally, students' interest and enjoyment toward learning increase in case based learning environment (Bridges & Hallinger, 1999; Mayo, 2004; Naumes & Naumes, 2006; Wassermann, 1994). When individuals are interested in learning and enjoy learning they are more likely to be motivated to engage in a learning task. Intrinsic interest or enjoyment, importance of the task to the personality or self-schema, usefulness of task for the future goals give students some reasons to engage in a task so whatever the reason they value the task and as a result they might be motivated in doing the task. Additionally, if the motivation is high on the selected task, they effort more and persist to work on the task for a longer time even if they encounter the difficulties. The result will be raised achievement (Pintrich & Schunk, 2002). Therefore, achievement can be thought as an indirect index of motivation (Pintrich & Schunk, 2002; Schunk, 1991).

Ryan & Patrick (2001) found that classroom environment influences students' motivation and engagement. Ames (1992) argues for an identification of classroom structures that can contribute to the mastery orientation and she presents four dimensions of classrooms that can influence students' orientation toward different achievement goals: task, evaluation, recognition, and authority. Both classroom differences and individual differences are found to be effective on

motivation by Anderman & Young (1994). They suggested that ability-focused instructional practices are related to lower levels of motivation in science classes and added that the extent to which students are learning-focused in science depends on the instructional practices used in their science classrooms. Particularly they put emphasis on that innovative programs and instructional methods like CBL and many others may be undermined by the use of ability-focused instructional practices. Therefore, how case based method is implemented in classes and which educational outcomes are received at the end is important to make such innovative methods as successful tools of education.

There are several journals routinely publish articles with cases and there are numerous web sites that have many cases with teaching notes available for teachers. In USA thousands of faculties and teachers has been trained through workshops and conferences to learn case based method. In spite of the long history and being widely used, the research in case based method is limited. However, problem-based learning (PBL), which is only one form of case instruction, has been intensively studied. The results revealed that PBL positively affect students' skill development and improve knowledge retention when compared with standard lectures. But, the impact of case based instruction on students' learning needs to be studied as there is little research in this area (Herreid, 2005; Lundeberg & Yadav, 2006; Yadav et. al. 2008). The situation is similar in Turkey where there are a few research on case based learning and PBL (Çakır, 2002; Sungur, 2004; Morgil, 2004, Adalı, 2005; Özkan & Azar, 2005; Kemahlı, 2005).

1.2 Significance of the Study

How should science teaching be is continuously being discussed through out the world. Many educators agree in that curriculum content and instructional strategies in science should undergo changes. There is a need to include newly arisen information by making the knowledge meaningful for the students. For this purpose, school science should need to relate real life with scientific information.

Information accumulates in science and especially in biological sciences incredibly fast and reaching information is easy as it never be before. Instead of memorizing information, the skills that are required to manage this information will make the individuals of future as preferable employees and citizens. In this manner science education can be thought as an interface both in teaching complex cognitive science concepts and skills like to communicate more effectively, to examine complicated issues in more critical ways, to be intrinsically engaged in learning, to share ideas and to value ideas of others, to draw required data from a complex knowledge organization, and etc.

Research studies say that case based learning promotes learning, increase understanding of problems. CBL also has positive impact on obtaining knowledge and skills to solve problems. In case based learning, students explore, discover, discuss, and meaningfully construct concepts and relationships in contexts that involve real world problems. But do all these abilities have a practical meaning? To know the effect of CBL on academic achievement would be important to students, parents and educators as academic achievement in high school is an important indication of attending university after high school whether there is an university entrance examination like it is in Turkey or not. While trying to set link between scientific knowledge and every-day life, providing real-world experiences to the students are we successful enough to teach basic cognitive scientific concepts? This study is important in this aspect as it studied the effect of CBL on academic achievement versus traditionally designed lectures. The academic achievement was measured on human reproductive system that was seen as an important and difficult subject by both students and teachers, and suitable to implement case based learning.

As mentioned above, science education is not just about teaching some cognitive concepts but it should be thought to provide ways to students in gaining basic affective and motivational skills like; to communicate well with others, to value learning process, to develop positive attitudes toward science and learning, to develop interest and to persist on studying on a specific task, and to be intrinsically motivated to learning. There are evidences in literature that students engage in

specific tasks more in classes that are assigned with CBL. Students become more motivated to read material beyond that presented in class when they are exposed to CBL. Students also enjoy classes more and find school more challenging and more interesting. To enjoy doing a task and to find the task interesting is related with task value that is a component of motivation and an important predictor of academic achievement. This study will try to reveal whether CBL promotes task value or not which will be important to provide insights into specific elements of case based learning that lead to increased learning. This is worth to study as to find a task valuable to engage in promotes achievement. As educators, we want our students to focus on deep understanding of task instead of just focusing on getting the best grades or being the best performer by believing that these will come after deep understanding of the task. We also want them to value challenging tasks, and to persist on study due to intrinsic and personal meaning of activity; instead of just valuing to be the best performer according to the criteria of others, performing tasks that demonstrate others' worth, and winning at all costs. CBL is seen as an educational tool by many educators that provide opportunity to achieve these mastery goals of education. This study also provides information about whether CBL makes a considerable difference in terms of students' perception of intrinsic goal orientation and extrinsic goal orientation. Therefore, we have evidence to say that these components of motivation can be considered as another element of case based learning or not.

CHAPTER 2

LITERATURE REVIEW

This study examines the effect of case based learning on students' academic achievement and their motivation. This chapter discusses how CBL and constructivism are related as constructivism is seen as the theoretical background of CBL. The characteristics of CBL and its effectiveness in science classes are given in this part related with CBL. In the next part, motivation is discussed. The motivation part specifically argues expectancy- value theory and goal orientation theory on the basis of social-cognitive theory of motivation because the present study focuses on value components of motivation that deal with the reasons why students engage in an academic task. Lastly, a summary tries to combine constructivism, CBL, and motivation shortly.

2.1. Constructivism as Theoretical Base of CBL

Constructivism is seen as a form of realism in the sense that the existence of a reality is acknowledged from the environment. According to constructivists, we can only know about reality in a personal and subjective way. Our knowledge of reality is both individual and social. Through negotiation, agreement is reached within our social system and a model of reality is constructed. This model of reality is viable in that the model fits experience. But it cannot be claimed that this is absolute truth. As all knowledge evolves, the model has evolved because of that our experiences have changed. Due to this nature of reality, science does not exist as a body of knowledge separate from knowers and their social environment. Scientific knowledge changes over time because goals and problems of society changes and the scientists as individuals continually change (Tobin & Tippins, 1993).

Constructivist theory of learning is rooted mainly in the study of Piaget and Vygotsky. Although there is not a single constructivist theory of learning, most constructivists share two main ideas: learners must actively construct knowledge in their own minds and social interactions are important in knowledge construction. In this manner, constructivist theory of learning reflects nature of learning process mentioned above. Being in the roots of constructivist learning theories as two important persons, Piaget put emphasis more on individuality in construction of own reality, say knowledge; on the other hand, Vygotsky emphasizes importance of social environment that provide tools to support construction of self-understanding of the physical and social worlds (Driscoll,2005; Glaserfeld,1993; Parsons, Hinson & Brown, 2001; Tobin, 1993;).

Piaget (1952) proposed four cognitive stages that all humans pass through: sensorimotor, preoperational, concrete operational and formal operational. He believed that all children are born with an innate tendency to interact with and make sense of external environment. While passing through all developmental stages by their individual rate but without skipping any of the stages, children organize and process information coming from the external environment as cognitive structures. Piaget called these cognitive structures as *schemes* and proposed that new schemes or knowledge is abstracted from old schemes or knowledge. Adjusting the old schemes in response to the environment by means of assimilation and accommodation is called as *adaptation*. *Assimilation* is the process of understanding a new object or event in terms of an existing scheme. If the old scheme does not work with the new information or a new experience existing scheme might be modified by the child, a process called *accommodation*. When the student or child deals with situations that can not be fully explained by existing schemes this creates a state of *disequilibrium*, or imbalance between what is understood and what is handled. People naturally try to reduce such imbalances by developing new schemes or adapting old ones until *equilibrium* is restored. This process of restoring balance is called as equilibration. Piaget thought learning depends on that when the equilibrium is upset; child has the opportunity to grow and develop. Piaget believed that experiences and manipulation of environment are

critical to development to occur. However, he also believed that social interactions with peers, arguments and discussions help to make thinking more logical. Therefore to face with experiences or data that do not fit into their current view of how world operates improves students' cognitive development (Driscoll, 2005; Gallagher, 1993; Glaserfeld, 1993; Parsons, Hinson & Brown, 2001; Tobin, 1993;)

One of the important criticisms that are made on Piaget's theory is that it underestimates the effect of social environment that a child lives (Glaserfeld, 1993). On the other hand, Vygotsky believed that human activities take place in cultural settings and cannot be understood apart from these settings. This sociocultural perspective of constructivist learning says that children learn the culture of their community by cooperative dialogues between peers and with more experienced adults. Piaget suggested that development precedes learning because specific cognitive structures need to be developed before learning can take place. Vygotsky's theory suggests that learning precedes development. Development first occurs in social level and than in individual level. At first, higher mental processes are *co-constructed* during shared activities between child and another person; then, child internalizes these processes as a part of cognitive development. From the view of Vygotsky, development depends on the *sign systems* that individual grow up with and intellectual development of individuals cannot be understood without considering early experiences with these sign systems. Sign systems are symbols that cultures create to help people to think, communicate and to solve problems; culture's language, writing system, or counting system are examples. Vygotsky suggested a mechanism of development from social level to individual level, from shared knowledge to personal knowledge: *private speech*. Children first use speech of others to regulate the behaviors of others and than use that speech to regulate their own behaviors. Private speech is self-talk that guides learning. He believed that learning takes place when children are working in their zone of proximal development. *Zone of proximal development* are the range of tasks that a child cannot yet do alone but can do with the help and guidance of more competent peers or adults. Vygotsky proposed that children learn very little from performing tasks they can already do independently. Instead, actual development occurs in

zone of proximal development when they try to perform tasks they accomplish only in collaboration with a more competent individual. Easy tasks are boring while difficult tasks are frustrating as the learner is not yet ready or able to learn, and both easy and difficult tasks result in little or no learning. The assistance provided by more competent peers or adults while trying tasks in zone of proximal development is called as *scaffolding* by Jerome Bruner. This guidance could be clues, reminders, and encouragement, breaking the problems into steps, providing an example, asking a critical question, or anything else that allows students to build their own knowledge. Vygotsky's theories support the use of *cooperative learning strategies* in which students will more easily complete a difficult task as they work together to help one another, to talk with each other about the problems. Talking about the problems makes students' inner speech available to others, so they can observe how others think and process information (Driscoll, 2005; Gallagher, 1993; Glaserfeld, 1993; Parsons, Hinson & Brown, 2001)

To sum up, both Piaget and Vygotsky emphasized that cognitive changes take place only when previous conceptions of students go through a process of disequilibration in the light of new information. The student by herself/himself constructs her/his own knowledge on her/his previous experiences. Glaserfeld (1993) emphasizes that students are not 'blank slates' and says that a basis of knowledge that is formed by the students' themselves while dealing with their environment is needed to build more knowledge. For this reason, the teacher should have some idea about the level of knowledge students have. According to Glaserfeld (1993), teachers can activate the minds of their students to construct their own knowledge if they let the students deal with the problems of their choice and help them only when they ask for help. Therefore, constructivists define students as active learners and their instructional strategies are *student-centered*. In student centered classrooms teacher guides students to discover their own meaning instead of lecturing and controlling all classroom activities. In this student centered classrooms, mixed ability learning groups are used to promote conceptual change as both Piaget and Vygotsky suggested (Driscoll, 2005; Gallagher, 1993; Glaserfeld, 1993; Parsons, Hinson & Brown, 2001)

Although there is not a single constructivist theory, many constructivists agree on dimensions of teaching:

Complex, realistic learning environments and authentic tasks are recommended to use by educators instead of stripped-down, simplified problems and basic skills drills. Complex problems are not necessarily difficult rather there are multiple, interacting elements to deal with. These complex problems should be embedded in authentic tasks and activities, which give the opportunity to be involved in real-world experiences. Students apply knowledge in diverse and authentic contexts. Students may need scaffolding while handling these complex authentic tasks.

Social negotiation and interaction are crucial to construct meaning because students establish and defend their positions while respecting the position of others when they are working together. In this cooperative learning environment, students should talk and listen to each other to build shared meaning by finding a common ground and exchanging their point of view.

Multiple perspectives and representations of content must be included in resources for class otherwise, students will learn only one way to deal with different issues. This single approach may not be smart enough to solve the problems under different circumstances. Jerome Bruner's spiral curriculum is in consistent with this idea; because a subject is introduced early in the school years, then the same subject is revisited in more and more complex forms over time.

Understanding the knowledge construction process is important to students because constructivists assume that our beliefs, our experiences, our social environment shape our knowledge about world around us. Students should be aware of their roles in constructing knowledge. If students are aware of the influences that shape their thinking, they will be able understand that different experiences lead to different knowledge and be able to evaluate themselves and others in a more critical way.

Students are the owner of the learning but it does not mean that the teacher abandons responsibility for instruction. The design of student-centered instruction will determine the way that the teacher will guide learning (Driscoll, 2005; Gallagher, 1993; Glaserfeld, 1993; Parsons, Hinson & Brown, 2001)

Gallagher (1993) defined the dominant paradigm in secondary (and tertiary) science teaching and claimed that transmitting information to students was equated as teaching and acquiring that information most frequently by memorizing was equated with learning. However, under the impact of constructivist ideas, teacher-centered classes based on behaviorism has changed into student-centered classes. In student-centered classes, students actively construct their knowledge usually in cooperative group works that provide environment for social interactions, interpersonal relationships, and communication with others. Students are incorporated into authentic tasks, either case based or problem based, in student-centered classes because in authentic tasks students can see the relevance of knowledge and skills they learn to their lives. Students also have the opportunity to experience that knowledge and skills they learned can be applied to problems they see as important. Students motivate to learn in authentic tasks because such tasks are interesting and relevant to the student (Wellington, 2006; Yadav et. al., 2008).

In student-centered classrooms, teacher manipulates environment and guides learning as facilitator rather than controlling all class circumstances and transmitting knowledge assuming that students will assimilate. As a facilitator, teacher provide tasks, ask questions, provide explanations, make suggestions, evaluate students' ideas etc.; in another words, teacher provides enough and appropriate scaffolding while her/his students are working in their zone of proximal development (Jakubowski, 1993; Driscoll, 2005).

2.2 Case Based Learning (CBL)

According to constructivists, meaning is rooted in experience. Each experience has an idea and this idea is a part of an environment. Experience in

which an idea is embedded is critical to understand and to use of this idea. But the experience with concepts and relations in school is quite different from experience with them in real world. Therefore, constructivist instructional design selects tasks that are embedded in a real-world context to promote understanding and use of idea. In such authentic activities, individuals experience and make sense the environment by themselves that is known as self-construction of knowledge. In this view of learning, teacher provides access to the tools, which can be used to better understand or construct solutions to the problems instead of directly transmitting knowledge assuming that the students will assimilate. Case based learning gives the opportunity to analyze content by first introducing a core knowledge domain and encouraging the students to search for other knowledge domains that may be relevant to the issue given in the case. By searching, discussing, and sharing for ideas, and cooperating with friends, and asking help from teacher; students analyze cases and construct their own knowledge in a constructivist case based learning environment (Duffy & Jonassen, 1992; Kreber et.al., 2007; Sudzina, 1997).

Case-based instructional methods engage students to learning by using realistic narratives. These narratives provide opportunities for students to integrate multiple sources of information in an authentic context (Dori, 1999; Herreid, 1994; Hoskin, 1998; Kreber, 2007; Wellington, 2006; Yadav et. al., 2008).

Many educators think that storytelling permeates the human experience and case study teaching is the formal educational device of telling stories. Although there are many ways of implanting case-based learning in the classroom, the interrupted case method was used in the present study. The case is delivered in parts and students discuss both data given in each part of case and questions given after each part. Each part builds on the information and data presented in the previous part and is followed by questions that drive students' learning. In the interrupted case based method, the cases include a series of carefully developed scenarios drawn from students' texts and recent literature. At each part, students are given information and asked to predict what might happen if such and such were done or might happen. The method resembles what real scientists experience while working on a problem as students point out the key questions, develop

hypothesis, design ways to test them, collect data and draw conclusions and re-thinking about how to handle the problem as more information becomes available. This method of teaching cases is reported to be successful in small classes at first but later educators achieved to apply the interrupted case method successfully in large classes as well. It is the most popular type of case based method among science faculty (Brickman, 2006; Herreid, 2005; Herreid, 2006). This method also has the basic principles of the case based method teaching described by Wassermann (1994). These are:

1. Cases: are educational instruments that appear in the form of narratives. Narratives bring real life situations into the classroom. The class and the teacher work over these real life problems collectively. If interrupted case based method is intended to use the case are given in parts.

2. Study Questions: a list of study questions that is presented at the end of each case. Study questions promote understanding as they encourage students to apply what they know in analyzing data and in proposing solutions rather than simply remembering facts, names, labels, formulas, definitions, etc. In interrupted method, each section/part has its own discussion questions.

3. Small Group Work: students discuss their responses to the study questions in small study groups. Students have opportunities to discuss the cases and questions with each other prior to the whole class discussions. Each part is studied and discussed in small groups in interrupted case method. As a part is studied and the possible solutions are discussed, next part of the case is given to the students.

4. Class Discussion: requires the learner's active involvement in the learning activity. "Big ideas" of the case are examined and teacher works to help students to extract meaning. Teacher always treats students and their ideas respectfully, that is why students feel safe to voice their ideas. Teacher manages the discussion period in such a way that he or she promotes students' critical analysis of the real life problems by letting them to make their own meaning rather than injecting his or her

own meaning. Students are encountered in whole-class discussion session after examining each part in interrupted method of case based learning.

5. Follow-up Activities: sometimes students need to know more because class discussion stimulates this need. Motivation is high to read and learn more. Follow-up activities may be carried out by individually or in groups and which activities are used is a matter of teacher judgment about students' need. Textbooks, articles from newspapers and magazines, tables, data charts, research reports, videos and other written and visual information can be the resources.

Whatever the way a case-based method teaching is implemented in the classroom, there must be a case written to achieve certain curriculum objectives. While choosing cases for class, teachers should look for the relationship of the case to course issues, quality of narrative, readability, and the ability of the case to generate feelings about the issues and provoke discussion about the dilemma (Wassermann, 1994). What makes a good case can be summarized as follows:

A good case has a big idea**.** It must have an interesting 'big idea' that relates to the experience of the students. The big idea is the central issue that will be discussed throughout the case examination.

A good case focuses on something controversial. It must have a dilemma that forces students to discuss and to solve. If the dilemma is perceived by the students to be real and students are able to project themselves into a similar situation this adds great power to the case.

A good case is something new to the students. Students feel the problem is important if the case deals with a current problem especially while teaching in science. New methods, results of a new research, a new environmental problem, a new ethical discussion on scientific developments or a new virus that spreads through out the world etc. may be the subject of a case.

A good case creates empathy with the central characters. Writer should give the characters personality to give the case appearance of being real. The writer

should also avoid creating too many characters otherwise readers may get lost among them.

A good case includes quotations. Quotations add life and drama to the case so the students gain the empathy for the characters. This is a good way to understand a situation.

A good case is relevant to the reader. Cases should involve the situations that students know or likely to face in their future lives.

A good case must have a pedagogic utility. Teacher must state the educational objectives to determine the type of skills are to be developed and/or what concepts/knowledge is to be introduced.

A case is decision forcing. A good case introduces a problem that is expected to be solved by the students.

A good case is short. Case must be long enough to introduce the facts of the case but must be short enough to hold someone's attention. Complex issues may be given in stages. Some data may be given at first instance and then a series of questions can be introduced before more information is given. In the present study, the cases were divided into several pieces. The first case has two parts and the second case contains three parts. Each individual part has its own discussion questions at the end. (Herreid, 1998; Naumes & Naumes, 2006; Wassermann, 1994)

Yadav et al. (2008) revealed that most of the faculty members (58%) preferred to write their own cases, some (35%) preferred to use modifying cases, and only a few (7%) used their own cases. Moreover, these researchers investigated faculty perceptions of the challenges and benefits of using case studies in science courses. Faculty's perceptions of the benefits of case-based instruction were investigated on student learning, critical thinking, and motivation. The main difficulties were asked to the science faculty to implement case based instruction in their own learning. Although the respondents of this survey had self-selected to

learn- by attending workshops and conferences, how to implement case based instruction in their own classes, and the students' perceptions were not surveyed; the results are still valuable. 84% of faculty reported afterward that they had used case studies in teaching. But the incidence of using case based learning was not so frequent, most (88%) of these faculty used between one and five cases per semester. Majority of these cases took one hour or less to complete. The faculty reported that students in classes using case studies demonstrated stronger critical-thinking skills (88.8%), were able to make connections across multiple content areas (82.6%), and developed a deeper understanding of concepts (90.1%). Most of the faculty also agreed that when they used case study teaching, students were better able to view an issue from multiple perspectives (91.3%). The two prejudices about case based learning was refuted by this study as the majority of the faculty disagreed with the statement that students using cases retained less from class (87.5%) and that students did worse on tests (65.1%). Faculty also thought that student participation increased when using case studies in their classroom. The majority (93.8%) of the faculty using case-study teaching also agreed that students were more engaged in the class when using cases.

Similarly, McNaught et. al.(2005) tried to learn the opinions of the students about case based learning to determine a suitable process for converting traditional science courses into case-based learning ones in two universities of Hong Kong. In this work, they collected data on the current level of students' conceptual understanding and also students' perceptions about the traditional courses. Thirty-eight students from two faculties were participated in the study and data came from examination results, the Study Process Questionnaire, a course-end survey and a focus group meeting; teachers also kept reflective journals. The results indicated that students showed motivation to pursue in-depth learning and wanted to see the connection of knowledge to real life issues. However, students thought that it was the teachers' teaching that resulted in learning while the basic assumption of the case based learning was that construction of knowledge could be accomplished only by students themselves on their previous knowledge and experience, the teacher could only guide this process. Another frustrating result of the study was about

small-group discussion, which is generally associated with a deep approach to learning; students did not value the discussions as a mean of learning. But in here, it must be noted that students were not experienced a debriefing session (e.g.; whole-class discussion) after small group discussion as they were not instructed via case based learning during the study. Instead, their opinions about the separate processes like group discussion that are related with case based learning and their present situation in terms of their need of case based learning was investigated. That means, students answered the questions without knowing what a real case based learning environment looks like and without experiencing a debriefing session that is seen as "sine qua non" of case method teaching by Wassermann (1992, p.5). As a result, students seemed to value the practical relevance of cases but they might not value the active learning strategies that are highly linked with case based learning.

Like Yadav et al (2008) and McNaught et. al.(2005), there are many other research studies, which reported ideas of students that exposed to the case based instruction and teachers that used this method in their classes in the related literature (Brickman, 2006; Brickman, et.al., 2008; Gallucci, 2006; Heid et. al., 2008; Herreid, 2006; Hoskin,1998; Jackson, 1998; Parilla, 2007; Ribbens, 2006; Sudzina, 1997; Walters, 1999;). When consider these studies, there is a general agreement on that case based learning (1) improves interest of students by actively engage them in tasks, (2) improves active involvement of students as students need to search, discuss, evaluate and reflect to complete the task, (3) improves ability to work with others as group work, as a part of case study, provides multiple ways of communicating with others, share of ideas, gain insight into others' point of view and co-construct meaning in multiple layered context of cases, (4) increases understanding, (5) improves reasoning ability, (6) successfully connects science concepts with real-life, (6) helps learn by episodic or long-term memory by telling stories.

Empirical studies about CBL generally include comparison of two groups one instructed via cases and the other instructed traditionally or with another instructional method like PBL. The attitudes or motivational beliefs of the

participants are also taken into account generally by questionnaires including Likert-type items. Students' performances or understanding or reasoning ability skills are studied mostly in cognitive domain. These are examined via multiple-choice, true/false or open-ended questions. There is a unique study that studied question posing capabilities of students exposed to CBI and suggested that if students could question the quality of data given then it was a sign of improved science literacy. Therefore, analysis of question posing capability can be used to evaluate case based method. In this study, it was found that CBI enhanced the students' question posing capability (Dori, 1999).

An empirical study (Rybarczyk et.al., 2007) investigated learning outcomes of non-biology and biology majors instructed by case based method on cellular respiration in undergraduate general biology or introductory cell biology courses. In this experimental study, non-identical but similar pre and post tests composed of multiple choice, short answer, open-ended, and true/false questions were assigned to both control group and experimental group. The tests were designed to access comprehension of content. Students exposed to case study, relative to students who were not exposed to case study, exhibited a significantly greater learning gain. A post-activity survey measured students' perceptions of the learning experience and level of collaboration with other students. On this survey, composed of Likert type items, a greater proportion of students in the experimental group exposed to case based instruction reported usage of higher-order thinking skills such as critical thinking and problem solving skills and the ability to apply concepts learned from class when compared with the control group that was not exposed to case based instruction. A greater proportion of the students in experimental group recognized that case study allowed hands-on interactivity and opportunity to connect course content with real-life scenario. Although the study indicated that case based study addressed students' misconceptions in the unit of cellular respiration, a better testing was suggested to say that case-based learning could clarify misconceptions effectively.

Mayo (2002) investigated the effectiveness of CBI to connect class learning with the reality outside by studying with 136 college students of an introductory

psychology course. The researcher formulated and used a hypothetical case narrative to teach conceptual analysis and application of six major theories in his introductory psychology classes. An independent two-group design was used to compare participants' academic performance. Classes were randomly assigned to receive either CBI or traditional lecture-based instruction. The only difference between experimental group and control group was that experimental group analyzed cases formulated by researcher. The researcher lectured conceptual foundations of theories for three hours at the beginning of each course section; later, a hypothetical case narrative was distributed as a part of a 50-minute, in-class exercise, in CBI condition. The class was then divided into groups of 5–7 students, assigning each group to discuss the case's relation to one of the theories presented previously in class. Each group discussed and analyzed the case for 15-20 minutes, and reported its conclusions to the entire class for peer feedback and critique. In each course section of the control condition, researcher lectured similarly for three hours on the same psychological theories, however; instead of giving a case, researcher required students to submit 150–250 word synopses of important characteristics of each of the six psychological theories and at the end of each course section, while CBI classes were studying on case, control group discussed and reviewed the theories. Both groups assigned with the same exam that required higher-level conceptual analysis and application of the six major psychological theories. The exam was held over two, 50-minute class periods and consisted of short, fictional, and problem-centered situations of six psychological theories introduced in the course. The students were asked (1) identify the theory that most closely fits the situation, and (2) provide a brief, explanatory rationale for their selection. The performances of the students on exam were compared by t-test and the results revealed that CBI condition outperformed those in the control with respect to theoretical comprehension and application. The students exposed to CBI analyzed real life examples better and applied concepts learned in class to these real-life problems better than the students exposed to traditional conditions. Students' attitudes toward case-based pedagogy were also assessed by two Likert type rating scales. Overall, students viewed CBI not only as realistic and helpful in the learning process, but also as challenging, creatively stimulating, interesting, and

enjoyable. Later, Mayo (2004) extended his study and confirmed the results of previous study that CBI developed students' comprehension and application of important course principles by integrating content, process and application.

A similar result has come from a study by Çakır (2002) in which CBL is implemented in high school biology course in Turkey. In this quasi-experimental design, one group learned the human nervous system via CBL and other group learned the same subject via traditional learning. The study analyzed the effects of case based learning, learning styles, and gender on students' performance skills, higher-order thinking skills, attitude toward biology, and academic knowledge. Statistical analysis of data by Multivariate Analysis of Variance (MANOVA) supported that case based learning caused significant improvement in students' performance skills and increase in academic knowledge. However, no significant effect of case based learning was shown on attitude toward biology and higher-order thinking skills.

Another similar experimental study by Sungur, Tekkaya, and Geban (2006) extended the findings of Çakır (2002) to human excretory system in high school biology course. In this case, PBL-a kind of case based learning was implemented in experimental group versus traditionally designed biology course in the control group. Two groups were instructed by the same teacher and they were statistically similar in their previous knowledge on human excretory system, which was measured by a test developed by researchers. The two groups were post-tested with the same test after the treatment. The test had 25 multiple choice items and an essay type question. Multiple-choice questions tended to measure academic achievement and essay question was prepared to measure performance skills. The essay type question was designed to see the development of abilities such as: use of relevant data in addressing the problem; articulate uncertainties; organize concepts; and interpret information. A PBL evaluation form was administered to the experimental group after the study to learn the opinions of students about PBL. The experimental group worked in small groups to solve the ill-structured problems related with the same patient but assigned in an interrupted manner. Group discussion provided a suitable environment to actively participate in group work, to

share their ideas, to negotiate and to reach a common conclusion to present in class discussion session. Apart from group work, students also expected to study individually and evaluate their own learning both individually and as a member of group. Students were given a kind of authority to some extend (e.g.; they select their own learning issues and decide upon the appropriate depth of the study). At the end of treatment, students evaluated each other with respect to participation, preparation, interpersonal skills, and contribution to group progress. MANOVA was used to analyze data collected by pre and post-human excretory system achievement test. Results revealed that students instructed via PBL significantly better understood the scientific conceptions than the students instructed via traditionally designed biology course. PBL students were also better in constructing knowledge and extracting better conclusions as they used and organized the relevant information more efficiently. However, there were not significant mean difference between experimental group and control group on items requiring simple recall. This finding contrasts with the study of Çakır (2002), which has found significant increase in academic knowledge in the group instructed by case based learning.

2.3. Motivation in Academic Achievement

Motivation has defined in many ways in literature. Actually, the term motivation is derived from the Latin verb *movere* (to move) and thought as a process rather than a product. As it is a process rather than a product, it cannot be directly observed but its presence can be understood by observing such behaviors as "choice of tasks, efforts, persistence, and verbalizations (e.g., "I really want to work on this")" (Pintrich & Schunk, 2002, p.5). The different definitions of motivation are usually originated from the idea of move. Individuals usually have something in mind that where they are trying to go. Goals are specific targets that determine direction where an individual will go. To attain their goals students engage in activities either mental or physical. Such motivated activities are energized and sustained. Expectations, attributions, and affects help people to

overcome difficulties and sustain motivation (Driscoll, 2005; Eccles & Wigfield, 2002; Pintrich & Schunk, 2002).

A classic distinction in motivation, depending on the source of desire that directs behavior, is between intrinsic and extrinsic. Intrinsic motivation is defined as motivation to engage in an activity for its own sake (Pintrich & Schunk, 2002). When we are intrinsically motivated to do something, we do not need rewards or punishments, because the activity itself is rewarding. We are motivated to do this activity because the outcomes of behavior are intrinsically valuable. In contrast, when we are motivated to work on a task in order to earn something such as a reward, teacher praise, or avoidance of punishment, we experience extrinsic motivation (Pintrich & Schunk, 2002). Driscoll (2005) indicated that intrinsically motivated students achieve higher than extrinsically motivated ones.

Social cognitive theory of motivation generally emphasizes intrinsic motivation because in cognitive theories people are viewed as active and curious learners, searching for information to solve personally relevant problems (Driscoll, 2005; Pintrich & Schunk, 2002). The research efforts of Bandura helped to establish the conceptual foundation of social cognitive theory. Social cognitive theory sees the influence of social models more critical and the effects of reinforcing and punishment less critical on learning and behavior (Pintrich & Schunk, 2002). People form expectations due to their previous experiences. When a particular response is reinforced every time, people think that they will be reinforced if behave in the same way. Similarly, when a response frequently leads to punishment, people think that they will be punished again and become least likely to perform this particular behavior. Therefore, the expectations about what things will be reinforced and punished largely depend on personal experiences and may not always be stated on the basis of hard data. For example, one student may believe that by getting high test scores, he will gain the respect of classmates (Driscoll, 2005; Pintrich & Schunk, 2002; Urdan, & Pajares, (2002).

Cognitive view of motivation put emphasis on learners' thoughts, beliefs, and emotions. This theory holds that instructional and social variables affect not only

what students do, but also their thoughts. Opposite of behavioral theories, which says people are motivated by environmental events on the basis of rewards and punishments, cognitive theories say that motivation is internal and its products can be observed. Motivation results from mental structures and the processing of information and beliefs. Social comparisons, values, goals, affects, perceptions of competence, and attributions are processes that are related with motivation. Teachers need to consider these processes as they are important in formation of students' beliefs, thoughts and emotions (Pintrich & Schunk, 2002). The Motivated Strategies for Learning Questionnaire (MSLQ) is a self report instrument and is based on cognitive view of motivation and learning strategies that sees students' thoughts as important as what they do. This questionnaire was developed by Pintrich, Smith, Garcia, and McKeachie (1993) and translated into many other languages and used by many researchers since then. The questionnaire has two main parts one was designed to assess college students' motivational orientations and the other was designed to assess their use of different learning strategies. The motivational scales were based on social-cognitive model of motivation and measure three main constructs of this model: (1) expectancy, (2) value, (3) affect. Expectancy components are about students' beliefs that they can accomplish a task. Value components assess reasons why students engage in an academic task. Affect construct has been worked in terms of responses to test anxiety.

Students' expectancies to succeed and the value of this success to them are seen as basis of motivation in current expectancy-value theory of motivation (Atkinson, 1964; Eccles, et al., 1993a; Eccles, et al., 1993b; Meece, Wigfield, and Eccles, 1990). Expectancy construct of the model refers to the question, "Am I able to do this task?" Students' beliefs about how well they will do on an upcoming task are their expectancies for success (Pintrich & Schunk, 2002; Wigfield & Tonks, 2002). According to Pintrich & Schunk (2002) values refer to "the different beliefs students have about the reasons they might engage in a task" (p.53). Therefore, values are individuals' "beliefs about desired end state" (Wigfield & Tonks, 2002, p.58). A learner's motivation is determined by how much they value the goal and whether they expect to succeed. Researchers see students' expectancy beliefs and

their values of academic success together as more important than their actual ability in predicting their achievements (Eccles & Wigfield, 2002; Wigfield & Eccles, 2000; Yumuşak, 2006). Expectancies for success are tied most directly to performance and achievement task values most closely to the choice of which activities individuals do. Individuals' competency beliefs are important to engage in task and persist at it. However, individuals may feel that they can accomplish a given activity but if they do not value the task, they will not engage in it (Eccles & Wigfield, 2002; Pintrich & Schunk, 2002; Wigfield, Hoa, & Klauda, 2008; Wigfield & Tonks, 2002).

The values that individuals have for specific tasks are called task value. The subjective value of a task depends on the nature of task and on the needs, goals, and broader personal values held by the individuals. There are four major components of task values: attainment value or importance, intrinsic interest, extrinsic utility value, and cost (Pintrich & Schunk, 2002; Wigfield, Hoa, & Klauda, 2008; Wigfield & Eccles, 2000; Wigfield & Tonks, 2002).

The importance of doing well on a task defines the importance construct of task value. Students' importance values for a task increase to the degree to which a task confirms the students' central self-schemas. Feather's (1988) study showed that the task value for math and English was related to different types of personal values: "students who were high in restrictive control personal values (high importance ratings of clean, obedient, polite, responsible, and self-controlled personal values) were more likely to have higher task value for math. In contrast, students who were high in prosocial concern (high importance ratings of forgiving, helpful, and loving personal values) were more likely to have higher task value for English". Which values are central to the individuals' self-schema, that means; which value is very important for individual because of that this value may be an important aspect of individual's identity plays a major role in determining the attainment value of a specific task. For example, if biology is stereotyped as a subject important for environmental issues, students who see being a person respectful to the environment as an important aspect of their identities will have a higher attainment value for biology.

Wigfield & Tonks (2002) define intrinsic value-second construct of task value, as "the enjoyment one gains from doing the task" and it is similar to intrinsic motivation in that when intrinsic value is high, students will be more engaged in the task and persist longer in doing the task (p.58). On the other hand, utility value is more similar to some of the extrinsic reasons for doing a task because if individuals find a task useful for their future goals then they will be more likely to be interested in doing the task. For example, a high school student may not have much intrinsic interest in mathematics, but because she wishes to become a medical doctor and she need to get high test scores to go university, this course has a high utility value for her.

Tasks may also have negative consequences that might follow from doing the task such as one can not engage in other activities at the same time. Such perceived negative aspects of task are called as cost. Costs include the perceived amount of effort required for the task as well as anticipated emotional states (e.g., performance anxiety, fear of failure). For example, a student might not choose to take a high level biology course even if she is intrinsically interested in subject because she perceives that the cost in terms of the effort required are too much for her as she need time to do other things such as sports, and social events and studying other courses and keeping her grades high (Pintrich & Schunk, 2002).

This achievement task value model takes both personal and environmental influences in consideration. Researchers found that values are positively correlated with actual achievement although they are not significant predictors of achievement for future. In contrast, in terms of future choices values are better predictors than are expectancy beliefs (Eccles, et al., 1993a; Eccles, et al., 1993b; Meece, Wigfield, and Eccles, 1990).

On the contrary, the study of McClendon (1996), provided evidence that task value is a predictor of course grades. In his study, he attempted to estimate the construct validity of Motivated Strategies for Learning Questionnaire (MSLQ) and to examine the cognition, motivation, and use of learning strategies by preservice teachers. Subjects were all teacher education majors enrolled in educational

psychology course. Data were collected over three semesters. Results of the analysis of covariance indicated that variables of the MSLQ account for approximately 18% of the variance in predicting grade in the course and the best predictor of grade in the course for this sample of education majors was task value.

Similarly, in a recent study of Durik, Vida, & Eccles (2004), the power of task value was studied as a predictor of individuals' choices to engage in literacy activities. The study investigated three motivational predictors of students' choices to involve themselves in leisure activities, high school courses, careers that exercise literacy skills. Specifically, expectancy-value model of achievement choices was also tested focusing on to which extent ability beliefs and subjective task values predict high school literacy-related choices. In this longitudinal, correlational study, data were collected from students when they were in 4th grade and later in 10th grade during school time in the spring of each year of data collection. Children's self-concept of ability and expectancies for success, their intrinsic value, and task importance were assessed in reading in 4th grade and in English in 10th grade. Schools provided student grade reports. Researchers used children's 3rd-grade reading grades to assess early reading performance, and 8th-grade English grades to assess later language arts performance. In 10th grade, participants reported the time per week they spent reading for fun. From record data provided by each high school, they calculated the average number of language arts classes that students took per year. The participants' career aspirations were also assessed in 12th grade. It should be noted that intrinsic value is the same with intrinsic interest and task importance combines both attainment and utility dimensions in this study. Correlations and descriptive statistics revealed that participants' 10th grade English importance predicted both high school courses and career aspirations related to literacy. Fourth-grade reading importance also predicted high school courses. Intrinsic value only predicted leisure activities and course choices, interestingly not career aspirations. As career aspirations were not related to intrinsic value, researchers suggested that "at least in high school, students might be thinking about their future careers at a very practical level and placing less emphasis on what they enjoy doing"(p.390). On the other hand, importance did not predict the

time per week participants spent reading for leisure. The other important finding was that intrinsic value of reading in 4th grade was a unique predictor of leisure time reading in 10th grade. Accordingly, the researchers noted that:

> ……..Youngsters who found reading fun when they were in elementary school gravitated toward reading in high school. This provides further evidence that early childhood experiences can shape lifelong leisure activities and highlights the effects that parents and elementary school teachers might have in guiding children's early beliefs about literacy. (p390)

As a summary, the results supported that ability beliefs positively predicted career aspirations, course choices, and leisure time reading, importance predicted career aspirations and course choices, and intrinsic value predicted leisure time reading and high school courses.

Another interesting finding, which was emphasized by Wigfield & Tonks (2002), was that the different components of task value are less differentiated during elementary school years and become differentiated during early adolescence. Accordingly, students' attainment, interest, and utility value form distinct but related constructs by adolescence. In addition to this, Wigfield & Tonks (2002) also reported that "students who value different academic activities likely will study harder and more effectively (p.73). They also should continue to pursue goals they have set even if they encounter difficulties". Task values affect individuals' choices more than competence beliefs because even if individuals feel competent at a given activity they may not engage in it because it has no value for them. As a summary, students especially when they are in high school may have different reasons to value a task and in turn, if they find a task valuable they study harder and effectively (Wigfield& Tonks, 2002).

Husman et. al. (2004) focused particularly on instrumentality, another construct of motivation that is found separate but closely related with task value

and intrinsic motivation. The researchers define instrumentality as "the perception that completion of a task will directly increase probability of achieving a future goal". For example, studying an academic task may not seem important in an adolescent's present, but may seem very important for student's future if s/he is future-oriented. The study stresses that although there are four differentiated types of task value as mentioned before, researchers has usually measured task value as a single, undifferentiated construct. The study indicates that although researchers put emphasis on future orientation of utility value while defining, it has been measured either without a time signature or with items that have mixed time orientations. The results of the study claimed that future oriented endogenous instrumentality is an independent construct and have different motivational function than task value and intrinsic motivation as measured by the MSLQ although they are related. In that manner, this study emphasizes the requirement to consider the potential for motivational differences between an activity's value for the present and value for the future.

People have different needs and goals. To satisfy these needs and goals people engage or avoid participating in different activities. Some goals (e.g., "I want to go swimming today") are short- term, others (e.g.; "I want to be a biologist") are long-term. Actually, a goal is an outcome an individual is trying to accomplish. To do well in school, students should take responsibility for action and outcome and chose to act in a certain way. Goals direct students' attention to the task. More challenging tasks require more effort but if students have clear goals, they are less likely to give up until reaching the goal. Whenever they fail along the way, they need change their strategies to reach their goals, which results in development. Two main achievement goals are defined in the literature: mastery goals and performance goals. Mastery goals are also called as learning goals because the students with mastery goals focus on deep understanding of task at hand and are not worried about their performances according to others. On the other hand, performance goals are also called as ability goals or ego goals because the students with performance goals worried more about evaluation of their performance by others instead of what they learn. However, there are two dimensions for these goals.

Students may either approach mastery or avoid misunderstanding. A student may also have performance-approach goals or performance-avoidance goals, the former wants to look good and receive favorable judgments from others and the latter wants to avoid looking bad and unfavorable judgments. Achievement goals are used to predict achievement related processes and outcomes (Ames, 1992; Elliot, 1999; Pintrich, 2000; Eccles, 2002; Pintrich & Schunk, 2002).

Eccles & Wigfield (2002) put emphasis on proliferation of different terms and measures for similar constructs in motivation area. The problem is apparent in terms with goals and goal orientation. Goal-orientation theories concern why and how students approach and engage in a specific academic task. Goal orientation not only includes the purposes for achievement but also reflects how individuals will judge their success or failure in the way of reaching their goals. The goal orientation research has suggested that there are two general goal orientations: a learning goal orientation (intrinsic-goal orientation) where the student is focused on mastery and learning of the material and a performance or ability orientation (extrinsic-goal orientation) where the student is focused on demonstrating his/her ability and performance in relation to other students. The difference between them is similar to the difference between intrinsic and extrinsic motivation. However, two goal orientation constructs are more situational and context dependent when compared to more general intrinsic and extrinsic motivation constructs. Students with mastery goals tend to engage in activities that will help them to learn. They are more likely to take difficult courses and to select challenging tasks. On the other hand, students with performance goals focus more on getting good grades, praises from teacher, favorable judgments from others, rewards, etc. When they face with a difficulty, performance-oriented students become more easily discouraged, and their performances are damaged. In contrast, when learning-oriented students encounter difficulties, they keep trying, and their motivation and performance might even increase (Ames, 1992; Pintrich & Schunk, 2002). Arlin & Webster (1983) showed that mastery students had significantly higher achievement, learning rate, and retention than nonmastery students but, used significantly greater amounts of time. Therefore, it can be said that it is possible to raise achievement level of students

through mastery learning procedures; but, it takes more time than nonmastery learning.

While summarizing developments in the study of achievement motivation, Kaplan & Maehr (2002) reported that having performance goals does not result in similar behavior in all individuals. Performance-oriented individuals who have high perceived ability are predicted to be primarily demonstrating their high ability. In contrast, those who have low perceived ability are predicted to be primarily oriented toward avoiding demonstrating their lack of ability. This difference leads to a mastery pattern of behavior for the individuals with high perceived ability and a helpless pattern of behavior for those with low perceived ability. Although performance-oriented students with high perceived ability and low perceived ability have considered as having same motivational orientation, under the light of newly coming information some researchers interested in the importance of having multiple goals and tried to understand the relations between them. One of such studies divided the participants into four groups: (1) high mastery/high performance approach, (2) high-mastery/low-performance approach, (3) low mastery/high performance approach, and (4) low-mastery/low-performance approach (Shıh, 2005). On the basis of this framework, the researcher explored relations between achievement goals and students' use of cognitive strategies and motivational processes. The data were analyzed by regression and MANOVA analyses. Taiwanese six-grade children in the high-mastery/high-performance approach group showed more adaptive patterns of learning, that is, more effective use of strategies and higher levels of intrinsic value concerning learning. In this study, the effects of both mastery and performance approach goals on a single learning outcome were found to be independent. Accordingly, positive effects of performance-approach goals on learning can be said to be not dependent on a high level of mastery goals at least for that group of Taiwanese students. Performance-approach goals also positively predicted each variable of interest except for the negative relation to students' reported test anxiety. This unexpected result that students with performance- approach goals did not report high levels of anxiety was attributed to the students' high self-confidence on their academic performance by the researcher.

Although the mastery goals were the best predictor of children's reported cognitive strategy use and intrinsic value, performance-approach goals also positively predicted Taiwanese students' effective strategy use and intrinsic motivation. The positive effects of performance-approach goals on Taiwanese students' motivation and strategy use implied that emphasis on competition or performance does not necessarily undermine students' learning as long as they are oriented to the approach rather than to avoidance strivings. On the other hand, as expected, performance-avoidance goals were found to be associated negatively with children's effective strategy use and intrinsic value, on the contrary, this type of goal predicted test anxiety positively. However, the researcher pointed out the danger that when students perceived classroom goal context as performance oriented, performance-approach and performance-avoidance goals tend to co-exist.

Classroom context is important in shaping students' goal orientation. Tasks and learning activities effect student motivation and cognition. Taş (2008) found that classroom mastery goal structure was positively related to mastery goal orientation. The higher the students perceived their classes as mastery goal structured, the higher levels of mastery goals they adopted. Students' goal orientation is often seen as a context-dependent or classroom-situated construct. Students' goal orientation is very open to changes depending on the environmental cues and presses. There are six dimensions of classrooms that affect motivation: task design, distribution of authority, recognition of students, grouping arrangements, evaluation practices, and time allocation (Eccles & Wigfield, 2002; Pintrich & Schunk, 2002).

Ames (1992) examined classroom structures that can contribute to a mastery orientation. She argued that "tasks that involve variety and diversity are more likely to facilitate an interest in learning and a mastery orientation". When students find the task personally relevant and the content of the task meaningful they are more likely engage in learning in a manner consistent with a mastery orientation. The tasks should be challenging and interesting and give students a sense of control over either the process or product. In such enriched task structure, students will find less opportunity or need to engage in social comparison. As a

consequence, performance differences are seen as requirement of task and less attribution will be made on perceived ability differences. If this motivational environment is supported by specific short-term goals, students' beliefs that they can accomplish the task with reasonable effort can be enhanced. Authority dimension involves giving control of some classroom settings to the students with the assistance of teacher. When students are given some choice and control in classroom, they will be more interested in task and intrinsically oriented toward learning. For example, student may decide when work will be done and which materials will be used. However, without assistance, trying to manage long-term assignments does not enhance motivation.

2. 4 Summary

Scientific knowledge changes over time (Tobin & Tippins 1993) and learners must actively construct knowledge in their own minds, and social interactions are important in knowledge construction (Driscoll, 2005). Case-based instructional methods provide opportunities for students to integrate multiple sources of information in an authentic context where students actively construct their own knowledge while socially interacting with peers and teacher (Dori, 1999; Herreid, 1994; Hoskin, 1998; Kreber, 2007; Wellington, 2006; Yadav et. al., 2008). Student participation was thought to increase when using case studies in classrooms. The majority of the faculty using case-study teaching agreed that students were more engaged in the class when using cases (Yadav, et al. 2008). Students exposed to case study, relative to students who were not exposed to case study, exhibited a significantly greater learning gain (Rybarczyk et.al., 2007). Students viewed CBL not only as realistic and helpful in the learning process, but also as challenging, creatively stimulating, interesting, and enjoyable (Mayo, 2002). Case based learning caused significant improvement in students' performance skills and increase in academic knowledge (Çakır, 2002).

This study specifically focused on value components of social-cognitive view of motivation. Value constructs deal with reasons why students engage in an academic task, and include task value, intrinsic goal orientation, and extrinsic goal orientation.

The subjective value of a task depends on the nature of task and on the needs, goals, and broader personal values held by the individuals (Pintrich & Schunk, 2002 Feather, 1988). The specific task value is a predictor of course grades (Durik, Vida, & Eccles 2004; McClendon, 1996). Students who value different academic activities likely will study harder and more effectively which in turn increases academic achievement (Araz & Sungur, 2007; Wigfield & Tonks, 2002). A task may not seem important in an adolescent's present, but may seem very important for student's future if s/he is future-oriented (Husman, et. al. 2004).

People have different needs and goals. To satisfy these needs and goals people engage or avoid participating in different activities. Achievement goals are used to predict achievement related processes and outcomes (Ames, 1992; Elliot, 1999; Pintrich, 2000; Eccles, 2002; Pintrich & Schunk, 2002). Students with mastery goals tend to engage in activities that will help them to learn. On the other hand, students with performance goals focus more on getting good grades, praises from teacher, favorable judgments from others, rewards, etc. When they face with a difficulty, performance-oriented students become more easily discouraged, and their performances are damaged. In contrast, when learning-oriented students encounter difficulties, they keep trying, and their motivation and performance might even increase (Ames, 1992; Arlin & Webster,1983; Pintrich & Schunk, 2002).

Classroom environment and individual differences influence students' motivation and engagement (Ryan & Patrick 2001). Classroom structures that contribute to the mastery orientation have four dimensions: task, evaluation, recognition, and authority (Ames, 1992). Grouping and time dimensions were added later (Pintrich & Schunk 2002). Both classroom differences and individual differences are found to be effective on motivation. CBL changes teacher-centered classrooms to student-centered classrooms. However, how student-centered classroom

environment will be shaped depends on how the teacher applies the method in classroom rather than the CBL method itself. For example, ability-focused instructional practices are related to lower levels of motivation in science classes (Anderman & Young 1994).

Case based learning method increases motivation of students by showing the relevance of subject to the real life circumstances. CBL is also effective on improving academic knowledge. But, there is still little empirical investigation about the impact of CBL on learning (Adalı, 2005; Azar, 2005; Çakır, 2002; Herreid, 2005; Lundeberg & Yadav, 2006; Morgil, 2004, Özkan & Kemahlı, Sungur, 2004; 2005Yadav et. al. 2008). To reveal the effect of CBL on different cognitive and motivational variables on different grade levels and on different subjects will provide opportunity to better apply the method in classrooms. This study will empirically provide data whether case based learning increases academic achievement and perceived motivation of students. Specifically, the interrupted case based method will be used to teach human reproductive system in a secondary school biology classroom.

CHAPTER 3

PROBLEMS AND HYPOTHESES

This chapter presents main problems and sub-problems of the current study and the hypotheses tested in Chapter 5

3.1 Main Problem

What is the effect of case based learning on 10^{th} grade students' academic achievement in the unit of human reproductive system and their perceived motivation (Intrinsic Goal Orientation, Extrinsic Goal Orientation and Task Value)?

3.2. Sub-Problems

1. Is there a significant population mean difference between the groups exposed to case based instruction and traditionally designed biology instruction with respect to students' academic achievement in the unit of human reproductive system?

2. Is there a significant population mean difference between the groups exposed to case based instruction and traditionally designed biology instruction with respect to students' perceived Intrinsic Goal Orientation?

3. Is there a significant population mean difference between the groups exposed to case based instruction and traditionally designed biology instruction with respect to students' perceived Extrinsic Goal Orientation?

4. Is there a significant population mean difference between the groups exposed to case based instruction and traditionally designed biology instruction with respect to students' perceived motivation Task Value?

3.3. Hypotheses

1. There is no statistically significant mean difference between the groups exposed to case based instruction and traditionally designed biology instruction with respect to students' academic achievement in the unit of human reproductive system.

2. There is no statistically significant mean difference between the groups exposed to case based instruction and traditionally designed biology instruction with respect to students' perceived Intrinsic Goal Orientation.

3. There is no statistically significant mean difference between the groups exposed to case based instruction and traditionally designed biology instruction with respect to students' perceived Extrinsic Goal Orientation.

4. There is no statistically significant mean difference between the groups exposed to case based instruction and traditionally designed biology instruction with respect to students' perceived Task Value.

CHAPTER 4

DESIGN OF THE STUDY

This chapter presents definition of variables, sample of the study, instruments used and description of the treatment, expression of methods to analyze data, and assumptions, and limitations.

4.1 The Experimental Design

In this study, the nonequivalent control group design was used, Gay & Airasian (2000). In such kind of quasi-experimental designs, entire classrooms not the individuals were assigned to the treatments. In this nonequivalent control group design, two treatment groups were pre-tested, administered a treatment, and post-tested. In this design, the more similar the intact groups are, the stronger the study, so the researcher made the every effort to use groups that were as equivalent as possible. Table 4.1 shows the research design of the study.

Table 4.1 Research Design of the Study

Groups	*Pre-tests*	*Treatment*	*Post-tests*
EG	SPST HRSAT MSLQ	CBI	HRSAT MSLQ
CG	SPST HRSAT MSLQ	TDBI	HRSAT MSLQ

In this table, EG represents the experimental group receiving case based instruction, and CG represents the control group receiving traditionally designed biology instruction. HRSAT is the Human Reproductive System Achievement Test and MSLQ is the Motivated Strategies for Learning Questionnaire. CBI represents Case Based Instruction while TDBI is the Traditionally Designed Biology Instruction. In this study, HRSAT was administered to experimental and control groups before the instruction to determine whether there was a significant mean difference between two groups with respect to previous knowledge on the unit of human reproductive system. Before the instruction, two groups were also compared in terms of their previous motivation obtained from MSLQ, and their science process skills based on the scores of, Science Process Skills Test (SPST). After the instruction, HRSAT and MSLQ were again administered to both groups to determine the effect of case based learning on students' understanding of the unit of reproductive system and students' motivation, respectively. MANOVA was used again to analyze post test results getting from the scores of HRSAT and MSLQ.

4.2 Definition of Variables

1. Academic Performance: The performance of students on the Human Reproductive System Achievement Test developed by the researcher

2. Motivation: Students' goals and value beliefs for biology measured by corresponding scales (Intrinsic Goal Orientation, Extrinsic Goal Orientation, Task Value) of the Motivated Strategies for Learning Questionnaire developed by Pintrich, Garcia, & McKeachie (1991).

3. Traditionally Designed Biology Instruction: The instruction based on teacher explanation, biology notes available in school's web site prepared by biology

teachers of the school under study, textbooks, and some other visual teaching resources like OHP's, videos and animations.

4. Case Based Learning: The instructional strategy with the following distinct characteristics:

Cases – are educational instruments that appear in the form of narratives. Narratives bring real life situations into the classroom. The class and the teacher work over these real life problems collectively.

Study Questions – a list of study questions that is presented at the end of each case. Study questions promote understanding as they encourage students to apply what they know in analyzing data and in proposing solutions rather than simply remembering facts, names, labels, formulas, definitions, etc.

Small Group Work – students discuss their responses to the study questions in small study groups. Students have opportunities to discuss the cases and questions with each other prior to the whole class discussions.

Class Discussion – requires the learner's active involvement in the learning activity. "Big ideas" of the case are examined and teacher works to help students to extract meaning. Teacher always treats students and their ideas respectfully, that is why students feel safe to voice their ideas. Teacher manages the discussion period in such a way that he or she promotes students' critical analysis of the real life problems by letting them to make their own meaning rather than injecting his or her own meaning.

Follow-up Activities – sometimes students need to know more because class discussion stimulates this need. Motivation is high to read and learn more. Follow-up activities may be carried out by individually or in groups and which activities are used is a matter of teacher judgment about students' need. Textbooks, articles from

newspapers and magazines, tables, data charts, research reports, videos and other written and visual information can be the resources Wassermann (1994).

4.3 Subjects of the Study

Target population of the study is all the 10th grade students in Ankara. Accessible population of the study is all the 10^{th} grade students attending Private High Schools in Ankara. Accordingly, the subjects of this study consisted of eighty tenth grade students (48 males and 32 females) instructed by two biology teachers in a private high school in Ankara in 2007-2008 spring semester. Teaching experiences of both teachers are nine years and their ages are 31 and 32, respectively. Two classes of each teacher were participated in the study. One class of each teacher was assigned as control group and the other class of the same teacher was assigned as experimental group to sustain randomization. Table 4.2 shows the assignment configuration of classes with respect to teachers and instruction type.

Table 4.2 Distributions of Classes with Respect to Teachers and Instructional Design

	Experimental Group **CBI**	**Control Group** **TDBI**
Teacher 1	Class A	Class B
Teacher 2	**Class C**	**Class D**

Two instructional methods (CBI and TDBI) were randomly assigned to the experimental and the control groups. Number of students in both experimental and control group was 40. The mean age of the students in the experimental group and control group was 16.20 and 16.18, respectively. The biology grade of the students in both groups was similar: 4.25 over 5 in the experimental group and 4.10 over 5 in the control group.

4.4 Variables

4.4.1 Independent Variables

The independent variables in this study were treatment (CBI and TDBI) and science process skills. Treatment was considered as a categorical variable and science process skills were considered as continuous variable.

4.4.2 Dependent Variables

The dependent variables in this study were students' academic achievement in the unit of reproductive system measured by HRSAT and students' intrinsic goal orientation, extrinsic goal orientation, and task value measured by the MSLQ.

4.5 Instruments

4.5.1 Human Reproductive System Achievement Test (HRSAT)

This test was developed by the researcher in order to measure academic achievement of the students. There were 21 multiple choice items with one correct answer and four distracters in the test. During the development stage of the test, instructional objectives related to human reproductive system were determined depending on national curriculum and biology textbooks. This step helped to define the content of the test. The test covered the topics related to the structure and function of both male and female reproductive systems. Each item in the Human Reproductive System Achievement Test (see Appendix A) was examined by a group of experts in the field of science education, and by biology teachers regarding content validity and format. HRSAT was piloted by administering to 205 11th grade students in the private high school where the study was carried out. At the beginning, there were 29 items in the test. Difficulty and discriminating power of the items was determined by ITEMAN statistical program. Only the items that have the discriminating power above .40 were selected except item-1. The discriminating power of item-1 was .338, still good, therefore it was also covered in the test as it measures an important ability (see Appendix B for taxonomy of items). The distracters were also examined and some little changes were done in some items or distracters in order to minimize ambiguity. This revised form of the test was also checked by the experts. Final form of the test was administered to experimental group and control group before and after instruction to measure students' academic performance on the human reproductive system. The reliabilities of HRSAT were .70 and .64 as pre-test and post-test respectively.

4.5.2 Motivated Strategies for Learning Questionnaire (MSLQ)

It is a self-report questionnaire developed by Pintrich, Garcia, & McKeachie (1991). The questionnaire has two main parts one was designed to assess college

students' motivational orientations and the other was designed to assess their use of different learning strategies. Only the value components of the motivational scales were used in this study to assess reasons why students engage in an academic task. In this questionnaire, students rate themselves on a seven point Likert scale from "not at all true of me" to very true of me" concerning different aspects of their learning in affective domain. The MSLQ was translated and adapted into Turkish by Sungur (2004). Subscale reliabilities of the translated version ranges from 0.68 to 0.93 equal or above the original version (see Appendix C). In this study, all three value components of the motivation section (intrinsic goal orientation, extrinsic goal orientation, and task value) were used to measure the students' motivational beliefs. The responses were scored on a 7-point Likert scale, where 1 point was given to "not at all true of me" and 7 points were given to "very true of me". The scores for each subscale under study were calculated as mean scores of each subscale. The reliability of posttest scores of these subscales were .78 for intrinsic goal orientation, .69 for extrinsic goal orientation and .86 for task value while those of post scores were .78, .69, .83 respectively.

4.5.3 Science Process Skills Test (SPST)

Okey, Wise and Burns (1982) originally developed this test to measure the science process skills of the students. It was translated and adopted into Turkish by Geban, Aşkar, and Özkan (1992). This instrument contains 36 four-alternative multiple-choice questions and measures five subsets of intellectual abilities, these are: identifying variables, identifying and stating hypotheses, operationally defining, designing investigations, and graphing and interpreting data (see Appendix D). The correct answers were assigned as 1 and the wrong answers as 0; therefore, the total possible score of the SPST was 36. The test was given to all students before the study to see whether there was a difference between students in terms of their science process skills. The reliability of the test was found to be 0.84.

4.5.4 Peer Evaluation Form

This evaluation form contains twelve items, which intend to make the students be aware of their behavior as individuals and as a group through out the case study. Ten items of the form were adapted from the peer evaluation form that were translated and adapted by Sungur (2004). The format and two of the items were adapted by the researcher from the self and peer evaluation form that is formed by seminar faculty in California University, Davis (Self and Peer Rating Form, n.d.). The resultant form was examined by an expert in science education from science education department (see Appendix E). After the treatment, students in the experimental group evaluated each other with respect to participation, preparation, interpersonal skills, and contribution to group progress. In this way, it was expected that students become aware of to what extent they behaved as intended individually and as a group. Results of the peer evaluation were not used in the statistical analysis.

4.5.5 Case based learning evaluation form

This form was adapted from Sungur (2004) by the researcher to learn the opinions of students about case based learning. The form contains nine open-ended items (see Appendix F). There are questions that intend to assess whether students understand the role of teachers and students in case based method. The students' perceptions about which opportunities were presented by the case based learning were also asked. Some questions intended to assess students' ideas about what went good and what went bad during the treatment. Results of the case based learning evaluation form were not used in the statistical analysis.

4.6 Treatment (CBL vs. TDBI)

This study was carried out over seven weeks during 2007-2008 spring semester at a Private High School in Ankara. A total of 80 students from four biology classes of two different teachers were involved in the study. One class of a teacher was assigned as the experimental group and the other class of the same teacher was assigned as the control group and vice versa. Experimental group was instructed by case-based learning while control group was taught by traditionally designed biology instruction. The topics related to human reproductive system were covered as part of regular classroom curriculum in the biology course. The classroom instruction was three 45-minute sessions per week. In the first week, SPST, HRSAT, and MSLQ were administered as pre-tests to both control groups and experimental groups. At the end of the study, HRSAT and MSLQ were assigned as post-test to both groups again.

The traditionally designed biology instruction involved lessons with lecture/questioning methods to teach concepts. Teaching strategies relied on teacher explanation, web notes prepared by their own department, and worksheets. The students studied the web notes on their own before the class hour. The teaching strategies of two teachers were similar as there was a consensus among teachers in the details of the course. Their ages and year of teaching experience were also similar. Therefore, the following strategies mentioned below can be considered common for both of them.

First lesson, the teacher explained structure of male reproductive system on OHP by explaining structures one by one. They asked questions about spermatogenesis and linked it by the structure of male reproductive system. Later, they grouped the structures that are responsible for semen formation and explained the function of semen. It was also explained that the urethra is the common canal for both discharge of semen and urine by emphasizing the mechanism that prevents mixing of two. The teacher started next class hour by showing a figure on OHP that shows hormones of hypothalamus, pituitary gland and testicles that are related with formation of secondary male characteristics and sperm formation. They explained

importance of feedback mechanism between these structures in secretion of androgens mainly testosterone. Functions of FSH and LH were also explained and it was emphasized that these hormones were also secreted in females. They asked what secondary male characteristics mean. A few students answered the question but none of them could completely list the entire characteristics. The teacher explained complete characteristics.

In the next lesson, the teacher asked them to draw the structure of male reproductive system in their notebooks and label the parts. They asked to draw and label both lateral view and front view. The teacher moved around the classroom and answered the questions of students and warned them to correct some parts of the figures. At that session, students studied mostly by their own but sometimes they shared their ideas and questions with their friends. During this session, students especially had difficulty in drawing lateral view while demonstrating the structures that are used by both excretory system and reproductive system. The teacher asked questions about the functions of the structures while moving around the classroom. By this way, students recalled and summarized what were mentioned in the previous lesson. At the end of the lesson, the teacher asked students to study female reproductive system as it would be the next subject of the course.

In the next lesson, the teacher started by showing the structures of female reproductive system on OHP. The teacher reminded oogenesis and number of oocytes found in ovaries at birth and asked them to think about possible consequences of decreasing number of oocytes in ovaries. Only a few students had the ability to link decreasing number of oocytes by menopause in females. After that, the teacher simply interpreted the events taking place during menstrual cycle without giving the name of any hormones and the phases of menstrual cycle. At the end of the lesson, the teacher wanted them to read the menstrual cycle and regulation of menstrual cycle with hormones. At the beginning of the next lesson, the teacher draw a series of figures to explain the changes taking place in the structure of follicle during menstrual cycle and at the same time; s/he listed and explained important events of the menstrual cycle. Later, the teacher used OHP to show the changes in blood levels of pituitary and ovarian hormones during

menstrual cycle. The effects of FSH and LH on ovaries were explained by questioning/answering method. The teacher emphasized that when LH peaks, ovulation occurs. The effect of ovarian hormones-estrogen and progesterone on uterus was also discussed and the teacher explained how these hormones prepare uterus to a possible pregnancy in detail. The teacher reviewed whole class session by asking questions to the selected students. The lesson was teacher-centered and teacher behaved like the source of the information while students had been taking notes and posing questions when they did not understand well. At the beginning of the next lesson, the teacher wrote a question on board: what would be the possible results if fertilization occurs? The usual, naive answer came from the students: a baby. Teacher did not continue to ask further questions; instead, began to explain the results of fertilization on menstrual cycle and uterus. S/he also linked changes in menstrual cycle and uterus with changes in ovarian and pituitary hormones and again used OHP to show the blood hormone levels during pregnancy. Teacher asked students to explain the structure and function of the placenta. A few volunteers made some incomplete explanations. After that, the teacher put OHP to show the detailed structure of the placenta on the figure, s/he also explained the function of it. Later, the teacher asked students to guess what organ systems were not functioning in fetus. Many answers came; the teacher asked the students possible reason of their thoughts and the teacher her/himself summed up all the answers and gave the correct answer. Delivery was also explained simply on OHP. Next hour, various animations were presented to the students by the teacher in the biology lab via an internet connected computer. The teacher made review by pausing and replaying during this lab session. The teacher distributed a worksheet about human reproductive system and wanted them to complete it for the next class hour. Next class hour, the questions assigned in worksheet were answered by different students. Another student or the teacher corrected wrong or incomplete answers. So, in the control group, lecture on the human reproductive system was completed and it took eight-class hours to be completed. In general, in the control group, where the traditionally designed biology instruction was used, although some contemporary materials and devices were included, the primary underlying principle

was that knowledge resides with the teacher and it is the teacher's responsibility to transfer that knowledge as fact to the students.

In case based learning, cases were used to engage students in higher order mental processing suggested by Wassermann (1994). Two cases were written by the researcher in this study (see Appendix G and H). The first case was about male reproductive system and composed of two parts. The second case was about female reproductive system and included three parts; each part of the cases was almost a page long. Although all parts of the individual case were related with a single subject-for example; female reproductive system, dividing the cases into several parts would be helpful in handling the case in a single 45-minute class hour. By doing so, it was also intended to support self-confidence of the early adolescents while dealing with a new and different learning technique without being lost in many details at once. Many sources including textbooks and web sites were used while writing these two library cases. At the end, the cases were examined by a native speaker linguistic to make them fluent in English and by a medical doctor for content evaluation. The cases can be categorized as evaluative or analytical teaching cases that have the readers analyze and evaluate the events described in the cases. The cases can also be classified as interrupted cases as they have divided into parts and distributed in an interrupted pattern. A teaching case enhances the pedagogical experience of our students. The cases were directed to the curriculum especially by discussion questions because learning the subject and achieving the curriculum objectives by open ended cases would be very difficult for the standard high school students. Like all other cases; these two cases described real events and tried to make students see the link between theory and practice. These evaluative cases were written so that students were expected to weigh and interpret what they read in the cases and to discriminate relevant and important information from irrelevant and unimportant information. Sometimes, incomplete data were presented in the cases, so; students had the opportunity to develop skills in considering what information they might need. To support this purpose, a computer laboratory was used by the experimental group through out the treatment to reach the required knowledge easily. A small library was also constructed in this

lab by bringing biology and physiology books from school library and biology department library. In this way, a suitable environment was to be prepared for what is called "learn how to learn". The cases were written from the perspective of an objective observer (Wassermann, 1992; Herreid, 2005; Naumes & Naumes, 2006).

Before implementing the case based learning, the teachers were trained about case-based learning by the researcher. The cases were given teachers with a teacher's guide during training (see Appendix I). The stages of case based learning were discussed at first instance and then the cases were examined throughout the answers of the discussion questions. The possible answers of the students were tried to be guessed while discussing how they would keep the class discussion in track. The researcher and teachers also discussed the lesson plans prepared by the researcher to make the new method clear for the teachers. They agreed on these lesson plans. Later, they studied on formation of groups (see Appendix J and K). Five groups were formed and there were 4 students in each group. Groups were formed so that students' academic performances, their participation to class discussions and gender were taken into consideration to maximize heterogeneity of the groups.

In the first lesson of experimental groups that were exposed to case based learning, the teacher explained what the case based learning was and described the roles of students and teacher in detail. Later, the teacher arranged the class for small group discussion and made groups of size 4 as discussed with the researcher before. 'Students' guide for case based learning' was distributed to the students and one person was chosen to read the guide loudly (see Appendix L). The first part of the case-1 was given and the case was read in small groups by the readers. After reading the case teacher wanted them to make a 'what do we know/what should we know' chart which would allow them to set their own learning goals (see Appendix M). This time students asked to research and collect materials at home (from web, books, experienced persons etc.) to use next lesson while discussing the case in their small groups.

The first part of the case-1 was not so complicated; it had just talked about complaints of Mr. Saruhan who was the main character of the story. The readers were directed to think that these complaints were the symptoms of hernia but the information was incomplete or/and reader had not known whether the information was complete or not. It was asked in discussion question part whether there was enough information in the text to diagnose the complaints of Mr. Saruhan. To answer this question, students would need to know the symptoms of hernia. While searching for the symptoms of hernia, they would certainly recognize that there were many types of hernia and would need to categorize the complaints of Mr.Saruhan. This also would lead that the students needed to learn the concepts by themselves. Some factors that contribute development of hernia were also described in the case by a dialog between Mr. Saruhan and his doctor friend Rıdvan. The students were asked to draw these symptoms from the text and they were also asked that what other factors might have been related with development of hernia. The question would promote need for further investigation. The other question gave the clue that there was more than one type of hernia and asked whether there was enough evidence in the case to determine the type of Mr. Saruhan's hernia. This question would also stimulate higher order thinking skills as the answer required comparison of evidences or symptoms given in the text with the real symptoms of many types of hernia. The next question was asking relationship between age and the development of hernia. Now, the students could explain the relationship by using the concepts they learned by themselves. The last question required further explanation so further research by asking why.

Next lesson, the students came class with many ideas most of them were written and some were in their mind. A hot discussion session started in their small groups; as they were not all agree about the type of the hernia. They shared their answers to the questions they stated together in previous lesson while constructing 'what do we know/what should we know' chart and to discussion questions in this small group discussion session. The teacher gave extra time to research more about the questions that remained unclear and need further information. A volunteer student was assigned as the speaker of the group and a whole-class discussion

session started. Scribes wrote the ideas of their groups on the board. It was obvious that the students interested about the case. One of them said 'please let's finish this discussion session quickly, I really curious about what happened to that man' while debriefing the case in whole class discussion session. All of the groups clearly defined the types of hernia but most of them did not be sure about the type of Mr. Saruhan's hernia. All types of hernia were understood well but as they were not familiar with inguinal canal only a few group could clearly defined the inguinal hernia. These groups were the ones who asked for help from their teachers during small group discussion. The teacher did not give the answer directly but s/he wanted them to search more about the function of inguinal canal. They reached the answer by themselves finally. While stating the relationship between age and hernia, some groups generalized the old age to all types but the groups who defined the inguinal hernia warned them that there might be baby boys who were born with inguinal hernia. All groups could define the other factors that were not presented in the case but were effective on the formation of hernia. Finally, they explained the conditions that require immediate call for a doctor. This first part of the case-1 was a good preference as a warm-up activity for the case based learning because it was not seem to contain too much lesson like material and the analysis of the case was not difficult as there were little information in the case. But, it still gave the clues for what a case based learning looks like by asking questions that stimulated higher order thinking.

The teacher gave the second part of case-1 in the third lesson. The case was red loudly in small groups. The teacher wanted them to make a 'what we know/ what should we know' chart to determine the group's learning goals. They asked to research for both group's learning goals and discussion questions by providing materials in computer lab where the required materials were present as mentioned above. Generally, one or two of the students made the research on the internet and the others told their ideas about the information they found and one of them- scribe took notes. They especially discussed about question three because it was not an easy question as it required usage of old ideas to create a new one, which corresponds to synthesis stage in Bloom's taxonomy. They first expected to learn

why testicles move from abdominal cavity into scrotum via inguinal canal and than use this information to explain why testicles move back into abdominal cavity during non-reproductive season. Focusing on the question itself was worthless for this time. A mastery goal orientation would lead them to solve the problem, so; teacher warned them to focus on the reason why testicles move from abdominal cavity into scrotum and possible results of failure in this movement. To solve the fifth and sixth questions students needed to compare the structures of male and female reproductive systems. The students wanted to solve the problems quickly but that was impossible without a detailed comparison of male and female reproductive systems. The teacher reminded the students that the main purpose was not to solve the discussion questions but to learn the structure and function of the male and female reproductive systems and also said them not to worry about the time. Then, the students began to spend more time on understanding the structure of human reproductive system and some reached the figures that show the similar pattern of embryonic development of male and female reproductive systems. Some of the groups interested in and asked the address of the web site. Although they shared their ideas, they still competed for reaching the better sources and answering the questions better than the others.

Next lesson, the teacher gave students ten minutes to recall and sum up their ideas and answers for the class discussion session. After this short group discussion session, scribes wrote their answers on the board. Groups began to present their ideas and answers one by one for each question. It was difficult to reach a certain answer for the first question. Almost all of the groups relate age factor with the hernia development in Mr. Saruhan. The teacher asked why old age might have been contributed to the hernia development. By asking so, she intended to reveal that weakness in inguinal canal might result in a rupture due to increased weakness in tissues by age, which requires synthesis of knowledge by combining two concepts: some weak points may remain in inguinal membrane after movement of testicles to the scrotum and tissues may become weaker and easily be ruptured even due to little strain on them by increasing age. Instead, the students used a lower level of thinking skill-analysis and tried to connect the reasons of inguinal

hernia they learned before with the life style and given symptoms of Mr. Saruhan, they did not think about why these caused inguinal hernia. The teacher asked again, what the relationship between age and hernia development was. They discussed in their groups. A few of the speakers raised their hands. Teacher wanted them to write their answers on the board. All of them wrote that some weak points might remain in inguinal membrane after movement of testicles to the scrotum, by age these weak points might have been ruptured. They also related Mr. Saruhan's age with the knowledge given in the text that extending his own limits was a life style for Mr. Saruhan, which means extra strain on inguinal membrane. After discussing the first question, students revised their answers to the question two and three. All of the groups correctly answered these two questions and the question four, which was very closely related with the question three. By this way, they had learned the importance of temperature on sperm production. For the question five, there was some missing information about the structure of male reproductive system in their answers. The teacher asked them what information was required to answer this question. They said they had to know the anatomical structure of male reproductive system. The teacher wanted them to draw the structure of male reproductive system both from lateral view and front view and to label the abdominal cavity, inguinal canal and scrotum besides other structures. The students easily connected the answer of question six with their drawings. The structure of female reproductive system was drawn without any warning from the teacher and they recognized the complete separation of excretory and reproductive system in females. The last question answered by the groups correctly at the end and they were given peer evaluation form to be completed for all group members.

The teacher started next lesson by writing the objectives of case-1 on the board and continued to talk about the hormones that are responsible for sperm production and formation of secondary male sexual characteristics as missing curriculum content. Although hormones related with male reproductive system were covered by the national curriculum, case-1 had no information or questions related with those hormones. Actually, it is not a necessity for a case to cover all the objectives of a unit, Naumes & Naumes (2006). As there was no part about

hormones that are responsible for formation of secondary male sexual characteristics in case-1, no questions were put in HRSAT related with those hormones by keeping the fact in mind that similar teaching strategies in both control group and experimental group might effect results. Teaching session of hormones related with male reproductive system lasted for ten minutes. Later teacher gave the scenario-1 of the second case, which was about female reproductive system. The case was red aloud in their small groups. Teacher asked them to write what the case was about and wanted them to set what they need to know. Individual groups began to research for both group's learning goals and discussion questions via provided materials in computer lab. Similar to the first part of the case-1, the first scenario of the second case was like an introduction to the story and the answers of the questions could be found by examining the case carefully. Only a brief research was necessary about the secondary amenorrhea and its possible reasons. The groups seemed more comfortable about what they need to do. They were familiar with the web sites, so; they reached the information easily. They began to discuss about Elif's problem. They focused on functional hypothalamic amenorrhea and wondered about the results of bad eating habits and excess exercising. Some groups were interested more about polycystic ovarian syndrome as they heard some things about this situation before. They also examined functional hypothalamic amenorrhea. Teacher moved around the class and sometimes warned them not to link irrelevant websites. The discussion questions were designed so that they provide a detailed definition of Elif's problem but the reason was not clear due to incomplete information in the text. The students discussed about possible reasons of Elif's problem in their small groups.

Next lesson, the teacher started the class discussion session after giving students a few minutes to be prepared. All questions were answered with a relative ease and it was thought that the problem of Elif is functional hypothalamic amenorrhea. The teacher distributed the second part of the case-2, which revealed that they were right. The students read the case in their small groups and prepared a 'what do we know/what should we know' chart. This part of the case was extremely important in terms of learning menstrual cycle and the hormonal regulation of it. The teacher moved around the class and looked at their learning

goals. To learn normal anatomy of the female reproductive system, the normal length of menstrual period, calendar method, basis of pregnancy tests, what the ovulation was, and the relationship between GnRH and LH were the goals they set. There was no group that needs to learn what the menstrual period was. The teacher asked them whether they know what the menstrual period was or not. They said it was the bleeding of females each month. The teacher replied "did you realize that there are two words very similar to each other in the story: menstruation and menstrual period. Do you think that they are the same things?". Some of the students said simultaneously that they were the same things. Some of them wrote these names on search bar quickly and tried to reach the answer in web. A few minutes later, a student said menstruation was a phase of menstrual period. Another one told ovulation was also a phase of the menstruation. The teacher said "Now, you can think about the cause and result of lack of menstruation. Does it also mean lack of menstrual period or what? I think you can start by looking at what is happening in menstruation". There were too much things to do. Students were reading their findings about menstrual period in their small groups and discussed what could be the possible reason of lack of menstruation. One of them said that during menstruation the unfertilized egg was discharged from the female body therefore no egg might had been produced or there might be some mechanism that prevented the discharge of egg. Another one contradicted with his friend and said "the egg is a small cell, it might be produced and expelled from the body but there may not be detoriation of uterus and therefore bleeding". The things became even more complicated for them. The teacher asked them what they needed to know to decide which one of these ideas was true. They answered that they had to know the reason of lack of menstruation and continued to collect information. There was little time left, teacher wanted them to continue to research at home to come up with more ideas to share with group members for the next lesson. Group members divided the work roughly among themselves.

Students started seventh lesson of the treatment by sharing their ideas with the group members. They asked for additional time to research a little bit more. The teacher gave ten minutes to complete their work. At the end of ten minutes, the

teacher wanted them to complete the study and sum up their answers in five minutes. Another class discussion was started by discussing the procedure that is followed by the clinician while evaluating Elif's problem. The groups outlined the procedure without giving any reason for the procedure followed. The teacher asked which part of the procedure followed by clinician was for detecting sign of any tumor. Answer came from only a group: "she asked about impaired vision and headache which can be a sign of tumor in the brain". The next question was asking about normal female anatomy. The students were familiar with this question and they all had drawn the structure correctly. They gave the normal range of menstrual period and discussed about the normality of lack of menstruation in the third question. Some groups talked only about the reasons of lack of menstruation for example polycystic ovarian syndrome, changes in life style, tumor in the brain etc. but they did not mention about the consequence of lack of menstruation. They thought lack of menstruation was a problem because these malfunctions cause lack of menstruation. Two of the five groups saw this relationship that lack of menstruation means not producing egg therefore loosing ability of being pregnant. Students had realized that what ever the reason the consequence was the same: disruption of normal menstrual cycle. The teacher asked them to work in their groups to explain the events taking place during menstrual period and gave them five minutes. At the end, s/he randomly selected three speakers to explain the phases of menstrual cycle. The teacher did not interrupt the explanation of these two students instead want other students to find and write the incomplete or wrong explanations. After that, speaker of another group completed the answers. The teacher asked the speaker of the last group to sum up the cycle. Whenever needed, the teacher directed the summary. The class concluded at the end of the second question that lack of menstruation could be considered as an advantage unless the couples want a baby. All groups succeeded to prepare a calendar to track the time of ovulation. The teacher asked why the possibility of being pregnant during corpus luteum phase was too low although there was an egg in the fallopian tube. They talked about the life span of egg and when teacher asked about sperms' life span, they also answered quite well. The fifth question was about pregnancy test and actually directly asking the HCG (Human Chorionic Gonadotropin). The students

explained the mechanism of the pregnancy test and function of the HCG. The teacher drew a graph on the board that shows the corresponding levels of HCG, estrogen and progesterone during pregnancy and explained the hormonal changes that lead to delivery. At the end of the lesson the menstrual cycle, pregnancy and the hormonal changes during the pregnancy had been discussed but there were two questions left unanswered.

At the beginning of next lesson, the teacher gave the students two minutes to recall their answers to last two questions of second part of case-2. While discussing sixth question, the teacher asked whether the students studied feed-back mechanism between hypothalamus, pituitary gland and ovaries. There were a few groups that did not pay attention to this mechanism although they studied the relationship between GnRH and LH. The teacher gave students additional five minutes to study the mechanism while checking the studies of other groups. Later, the groups talked about their findings related with both feed-back mechanism and relationship between GnRH secretion and LH secretion. They concluded that Elif's LH level might have been low due to the low secretion of GnRH. The teacher asked the reason of low GnRH secretion in Elif. Because they did not know the other functions of the hypothalamus yet, they did not answer this question. The teacher remained this question unanswered. Seventh question, which was about clinician examination, caused no argument as they all agree about the procedure. The teacher gave third scenario of the case-2. The students read the case and made 'what do we know/what should we know' chart. The rest of the lesson was used to research about the case.

The last lesson of the treatment started with the examination of findings in previous lesson. Group members tried to recall their learning goals and answers to the discussion questions for ten minutes. Scribes write the answers of the questions on the board. For the first question, they needed to know the functions of hypothalamus but this was not among the learning goals of any group. Only a single group needed to know about the biological reason of functional hypothalamic amenorrhea. Although this was among their goals they were not be able to suggest any explanation. The teacher postponed discussion of this question and wanted

students to continue with the second question. Groups explained the working mechanism of contraceptive pills. They explained how decreased secretion of LH due to increased amount of estrogen and progesterone or any one of them inside the pills results in anovulation. The students discussed and concluded that usage of these pills was not suitable for Elif as she and her husband want a baby. They also talked about the risks of using such pills. The students could link the usage of calcium and vitamin D with each other and treatment of functional hypothalamic amenorrhea. The reason why hormone replacement therapy can not restore egg production had already been discussed while talking about the pills in the second question. The teacher wanted them make a brief research about functions of hypothalamus and link functions of hypothalamus with eating disorders to answer the first question. After doing what the teacher said, the groups saw the relationship between monitoring function of hypothalamus and eating disorders. The teacher gave the students peer evaluation form and finished this lesson.

After nine class hour long treatment, the experimental groups were given HRSAT and MSLQ as post tests to measure the academic achievement in the unit of human reproductive system and students' intrinsic goal orientation, extrinsic goal orientation, and task value.

4.7 Analysis of Data

Mutivariate analysis of variance (MANOVA) was used to investigate the effect of case based learning on students' understanding of the unit of human reproductive system; and students' motivation.

4.8 Assumptions and Limitations

4.8.1 Assumptions

1. The teacher was not biased during the treatments.

2. Tests were administered under standard conditions.

3. Students answered test questions seriously.

4. Students in control and experimental groups did not interact with each other.

4.8.2 Limitations

1. The subjects of this study were limited to 80 tenth grade students at a Private High School in Ankara during 2007-2008 spring semesters. Their experiences and expectations may not reflect the typical students enrolled in State or Anatolian High Schools in Ankara or in other parts of the country. Therefore, the results may not be reliable if generalized beyond students experiencing similar situations.

2. This study was limited to unit of "human reproductive system" in biology.

3. Students in the experimental group worked in groups. This might have led to the violation of independency of observations assumption of MANOVA.

4.9 Threats to Internal Validity of the Study

The school involved in the study was selected by convenience sampling. Intact classes instead of individual students were assigned to the treatment since the classes were already formed. However, the control and the experimental groups were randomly assigned to the classes.

The inability to randomly assign individuals to the treatments, adds validity threats such as regression and interactions between selection maturation, history, and testing. To strengthen the study, the groups that were as equivalent as possible were used. The students in experimental and control groups were similar in terms of their previous year biology grades and ages. The classes of two different teachers were used but, one class of each teacher assigned as experimental group and the other class of the same teacher was assigned as control group. The year of teaching experience of the teachers was also the same. The teachers were trained before the treatment. The groups were not selected according to their high scores or low scores on pretest. Actually, the groups were found statistically similar in terms of their achievement scores and motivation scores before the treatment, which eliminated statistical regression factor as a threat. The equivalency of experimental group and control group was also checked in terms of their science process skills as this was thought as a factor that may contribute to the results of the experiment, and both groups were found to be equivalent.

The classes were faced with the same events during the study in the school environment, and these events were not a threat on academic achievement and motivation of the students. Since the study lasted only seven weeks, maturation cannot be considered as an important threat.

The same tests were used as pre-test and post-test, and there was enough time between pre and post tests to eliminate pre-test sensitization. The tests were given by the teachers that participated in the study under standard conditions.

CHAPTER 5

RESULTS AND CONCLUSIONS

The results of the study are presented into four sections. In the first section, the results of preliminary analysis based on the scores of SPST, HRSAT and MSLQ that were applied to groups before the treatment were presented. As HRSAT and MSLQ were given twice, first applications were named as pre-HRSAT and pre-MSLQ and second applications were named as post-HRSAT and post-MSLQ respectively. In the second section**,** statistical analyses of the hypotheses stated in Chapter 3 based on posttest scores are displayed. The third section gives the students' opinions about the case based learning. Finally, the last section summarizes the results of the study and gives conclusions. Statistical analyses were performed at 0.05 significance level using Statistical Package for Social Sciences (SPSS).

5.1 Preliminary Analysis

One-Way MANOVA was conducted to determine whether there was a statistically significant mean difference between control and experimental groups with respect to students' academic achievement on the unit of human reproductive system, their perceived motivation and science process skills. The experimental and control groups were assigned as independent variables whereas SPST scores, HRSAT scores, and the mean scores that were obtained from the three subscales of MSLQ were assigned as dependent variables; these were intrinsic goal orientation (IGO), extrinsic goal orientation (EGO) and task value(TV). Before proceeding with the main MANOVA analysis, univariate normality, multivariate normality and homogeneity of the variance-covariance matrices assumptions were checked. Skewness and kurtosis values for the individual dependent variables were checked for univariate normality. The acceptable skewness and kurtosis values range from +2 to -2. For multivariate normality assumption, Mahalanobis distances were

calculated. In addition, Box's M test results were also taken into consideration for both multivariate normality and homogeneity of variance-covariance matrices. A significant Box's M test value indicates that the data violates the assumption of homogeneity of variance-covariance matrices, so; Box's M test results can indirectly give an idea about multivariate normality assumption Stevens (2002). Equality of variances assumption was tested by Levene's Test as any significant value less than .005 would indicate that the equality of variance assumption for that variable was violated.

5.1.1 Checking Assumptions of MANOVA

Descriptive statistics of SPST scores, pre-HRSAT scores, and pre-MSLQ scores including skewness and kurtosis values across groups were presented in Table 5.1 In the table, CG refers to control group, while EG refers to experimental group. IGO, EGO and TV are the three subscales of MSLQ. Skewness and Kurtosis values in this table can be considered as an indication of univariate normality for the individual dependent variables across experimental and control groups, which are in acceptable ranges for a normal distribution.

Table 5.1 Descriptive Statistics of SPST, pre-HRSAT and subscale scores of pre-MSLQ with respect to experimental and control groups

	Mean		Standard Deviation		Skewness		Kurtosis	
	EG	CG	**EG**	CG	**EG**	CG	**EG**	CG
SPST	27.88	28.30	5.23	5.51	-.459	-.764	-.364	-.193
HRSAT	11.78	10.93	3.97	3.47	-.116	-.019	-.846	-.679
IGO	4.29	3.85	1.18	1.01	-.233	.241	-.510	-.192
EGO	4.48	4.57	1.22	1.14	-.234	-.228	-.852	-.130
TV	4.91	4.42	1.01	1.24	.106	-.181	-.603	-.618

To check multivariate normality, maximum value for Mahalanobis distance, 17.231, was compared to critical value λ^2, 20.515, when degrees of freedom (df) was 5 and alpha value was 001. As Mahalanobis distance did not exceed the critical value, it was assumed that there were no substantial multivariate outliers, therefore; multivariate normality assumption was met. Furthermore, nonsignificant Box's M test result proposed that multivariate normality was met and variances and covariance among the dependent variables were the same across groups (F (15, 24496) = 1,111, $p>.05$). These results revealed that two of the assumptions of MANOVA, multivariate normality, and homogeneity of variance and covariance matrices, were met.

Equality of variances assumption was tested by Levene's Test. It was assumed that each dependent variable had the same variance across the groups as the probability of having equal variances was greater than critical alpha value 0.05 for all five dependent variables. Table 5.2 displays statistics of Levene's Test of Equality of Variances.

Table 5.2 Levene's Test of Equality of Error Variances for pre-test scores

	F	df1	df2	Sig.
SPST	.433	1	78	.513
HRSAT	.868	1	78	.355
IGO	.713	1	78	.401
EGO	.658	1	78	.420
TV	1.764	1	78	.188

5.1.2 MANOVA Results for Pretest Scores

Having met the assumptions, MANOVA was run to investigate whether there was a significant mean difference between groups with respect to students' science process skills, academic achievement (AA), and perceived IGO, EGO and TV before the treatment. MANOVA results obtained from pre-test scores were displayed in Table 5.3

Table 5.3 MANOVA results of pretest scores

Source	Wilks' Lambda Value	Multivariate F	Significance (p)
Treatment*	.936	1.018	.413

The results given in the table 5.3 indicated that there was no statistically significant mean difference between experimental and the control groups with respect to science process skills, academic achievement on human reproductive system and perceived motivation before the treatment. To control whether experimental and control groups are similar for all five variables separate analyses were to be examined, but; first of all a higher alpha level was set by what is called Bonferroni adjustment by dividing original alpha level .005 by the number of analysis to reduce the chance of Type 1 error. The newly set alpha level became .001, so only the results that have the probability value (sig.) less than newly set alpha .001 would be considered as significant. The following Table 5.4 lists each of five different dependent variables with their associated univariate F, DF and Sig. values. Because there were no dependent variable that had the probability value (sig.) less than Bonferroni adjusted alpha level of .001, it was concluded that the experimental and control groups were the similar in terms of five dependent variables (SPST, HRSAT, IGO, EGO and TV scores) at the beginning of the treatment.

Table 5.4 Results of ANOVA analyses for dependent variables before the treatment

	F	Hypothesis df	Error df	Sig. (p)	Partial Eta Squared	Observed Power
SPST	.125	1	78	.724	.002	.064
HRSAT	1.042	1	78	.311	.013	.172
IGO	3.261	1	78	.075	.040	.430
EGO	.126	1	78	.724	.002	.064
TV	3.769	1	78	.056	.046	.483

Section 5.2 presents the results concerning the effect of case based learning on these variables.

5.2 Main Analysis

The hypotheses that were stated in Chapter 3 were tested by running one-way MANOVA where the treatment was independent variable and academic achievement (AA), intrinsic goal orientation (IGO), extrinsic goal orientation (EGO), and task value (TV) were dependent variables.

5.2.1 Checking Assumptions of MANOVA for Posttest Scores

Descriptive statistics for the dependent variables across the experimental (n=40) and control groups (n=40) are displayed in Table 5.5.

Table 5.5 Descriptive statistics for post test scores with respect to AP, IGO, EGO, and TV

	Mean		**Std. Dev.**		**Skewness**		**Kurtosis**	
	EG	CG	**EG**	CG	**EG**	CG	**EG**	CG
AA	**17.02**	15.05	**2.64**	3.14	**- 1.660**	-0.082	**3.97**	0.234
IGO	**4.58**	4.09	**1.11**	1.33	**0.062**	-0.202	**-0.685**	0.291
EGO	**4.75**	4.60	**1.04**	1.10	**- 0.072**	-0.187	**-0.345**	-0.465
TV	**5.21**	4.40	**0.98**	1.20	**- 0.083**	-0.653	**-0.872**	0.578

Table 5.5 showed that experimental group had the higher mean scores on all of the dependent variables. Moreover, skewness and kurtosis values expressed in the table can be considered as tolerable values indicating a univariate normality for the individual dependent variables across experimental and control groups. In general, a high positive kurtosis value indicates an abnormally 'peaky' distribution, while a high negative kurtosis value indicates abnormally flat distribution. In a symmetric distribution, the value of kurtosis and skewness is zero, Gay & Airasian (2000). Accordingly, the skewness and kurtosis values for all four variables of present study can be considered as a sign of univariate normality, which may be an indication of multivariate normality. Multivariate normality assumption was also tested by Mahalanobis distances, which is a good way to determine multivariate outliers. Maximum Mahalanobis distance value was compared against a critical value obtained by using a chi-square critical value table. As maximum Mahalanobis distance (11.650) did not exceed the critical λ^2 value (18.47) when DF was 4 and alpha value was 0.001, the multivariate normality assumption was met. The homogeneity of variance-covariance matrices was assessed by Box's M Test, result of which suggested that homogeneity of variance and covariance matrices assumption was met $F(10, 29087) = .721$, $p > 0.001$.

Results of Levene's Test presented in Table 5.6 revealed that each dependent variable had the same variance across groups as there was not any value in the significance column less than 0.05.

Table 5.6 Levene's test of equality of error variances

	F	df1	df2	Sig.
AA	3,626	1	78	,061
IGO	,231	1	78	,632
EGO	,129	1	78	,720
TV	,681	1	78	,412

5.2.2 MANOVA Results for Posttest Scores

After checking the assumptions, one-way MANOVA was conducted. Results of the analysis were shown in Table 5.7

Table 5.7 MANOVA results with respect to combined dependent variables of AA, IGO, EGO, and TV

Source	Wilks' Lambda	Hypothesis df	Error df	Multivariate F	Sig.	Partial-Eta Squared	Observed power
Treatment	.802	4.0	75.0	4.628	.002	.198	.935

Wilks' lambda value of .802 with a significance value of .002 was obtained. As the significance level is less than .05 it was concluded that there was a statistically significant mean difference between experimental group and control group in terms of AA, IGO, EGO and TV. The multivariate Partial-Eta Squared based on Wilk's Lambda was strong, 0.198, implying that the magnitude of the difference between the groups was not small. This value indicated that 19.8 % of multivariate variance of the dependent variables could be explained by the treatment. Another important statistics; power, which is the probability of detecting a significant effect when the effect truly does exist in nature, was found to be .935. These findings implied that the difference found between the experimental and control groups arouse from the treatment effect and this difference had practical value.

To see whether experimental and control groups differ on all of these dependent measures or not, the tests of between subjects' effects were examined by follow-up analysis of variance (ANOVA). Because a number of separate analyses would be considered, a higher level of alpha was set to reduce the chance of Type 1 error- finding a significant result when in fact there is not really one Hinkle et. al. (2003). For this purpose, the original alpha level of .05 was divided by the number of analyses, which were 4, and the new alpha level was set as .0125. When the results for the dependent variables were considered separately, two statistically significant differences were detected by using a Bonferroni adjusted alpha level of .0125; these were AA and TV as can be examined from the table 5.3.4: $F(1,78)=9.29$, $p<.0125$ and $F(1,78)= 10.81$, $p<.0125$, respectively. In addition, 10.6 % of the total variance in the achievement scores and 12.2 % of the total variance in the task value scores could be explained by the treatment. The probabilities of detecting these two significant effects when the effects truly do exist in nature were found to be .853 and .0901, for achievement and task value respectively. As can be examined from Table 5.5, the mean score of experimental group on each dependent variable was higher than control group but only the scores on academic achievement and task value were significant.

Table 5.8 Tests of between subjects effects

	F	Hypothesis df	Error df	Sig. (p)	Partial Eta Squared	Observed Power
AP	9.29	1	78	.003	.106	.853
IGO	3.16	1	78	.079	.039	.419
EGO	.39	1	78	.533	.005	.095
TV	10.81	1	78	.002	.122	.901

5.3 Students' Opinions about CBL

The opinions of students about CBL (see Appendix N for a sample) were grouped under three main titles. The opinions that were belong to 60 percent and more of the students were grouped as the answers of "most of the students", the opinions that were belong to the 20 percent to 60 percent of the students were classified under the title of "some of the students", and the opinions that were belong to 20 percent and less of the students were grouped under the title of "few of the students".

Most of the students:

- could see the incomplete characteristic of data given in the cases
- understood their active roles in completing the data
- thought that an efficient teacher in CBL is the one who is competent in the content knowledge

- liked working on web while searching
- found the cases interesting
- liked working with peers
- found all components of CBL useful and necessary and wanted to change nothing about CBL

Some of the students:

- thought that CBL was helpful them for their future career
- reported that they have learned useful things not may be for their present but for their future lives
- wanted their teachers to help them more while searching for the problems
- thought the timing of the CBL was not good (it was the last of the semester)
- reported that because cases had several parts they felt as if they were talking on the same topic repeatedly, which was boring

A few students:

- reported that they had learned nothing
- said that sometimes they did not find enough time to search about the problem at home

5.4 Summary of the Results and Conclusions

To sum up, results of this study indicated that there was a statistically significant mean difference between experimental group exposed to case based learning and control group exposed to traditionally designed biology instruction in terms of their academic achievement and perceived task value. But, there was no significant difference between CBL group and traditional group in terms of students' perceived intrinsic goal orientation and extrinsic goal orientation.

Many other studies present evidences that case based methods improve academic achievement, but; this study specifically provides evidence that CBL significantly increases academic achievement of high school students in the unit of human reproductive system when compared to control group, which was learned the topic by traditional teaching method. It should be noted that the interrupted case based method that is the most famous one among science faculty was assigned in human reproductive system.

Case based learning also significantly improved high school students' perceived task value in experimental group in the unit of human reproductive system when compared to control group students that learned the topic via traditional biology course as defined in this study. But, we do not know the reasons why students' perceived value increased as this study worked overall task value instead of specifically focusing on four constructs of task value: importance, interest, utility, and cost.

On the other hand, students' conception of success and their reasons for engaging in an academic task did not change due to case based learning at least for that specific group of high school students because no significant increase was detected in both students' perceived intrinsic goal orientation and extrinsic goal orientation.

CHAPTER 6

DISCUSSION AND IMPLICATIONS

This chapter includes discussion, instructional implications, and implications for further research.

6.1 Discussion

The aim of the study was to investigate the effect of case based learning on students' academic achievement specifically in the unit of human reproductive system and students' perceived motivation (intrinsic goal orientation, extrinsic goal orientation, task value).

At the beginning of the study, the students in both experimental group and control group were examined in terms of equality of their academic achievement and motivation before the treatment. For this purpose, the HRSAT and the MSLQ were administered to students both in the experimental and the control groups to determine whether two groups differed with respect to the collective dependent variables of the study. MANOVA results revealed that there were no preexisting differences between two groups with respect to students' academic achievement in the unit of human reproductive system; and students' perceived motivation. Two groups were also similar in demographic factors (e.g., age and gender), previous year biology grades and their science process skills.

During the treatment, experimental group was implemented in case based learning environment where two cases were assigned in an interrupted manner, while students in control group received traditional instruction. Results showed that case based learning improved students' academic achievement (M_{EG}=17.02; M_{CG} =15.05). This result is consistent with the findings of other researchers that

compare CBL conditions with traditional learning conditions reporting that CBL improves academic achievement, performance skills, learning gain, and academic knowledge when compared to traditional learning conditions (Çakır, 2001; Mayo, 2002; Mayo, 2004; Sungur, 2004; Rybarczyk et.al., 2007).

The study also supported that CBL not only increased academic achievement but also students' perceived task value. Students engage in tasks that are valuable to them and study harder and effectively on these tasks (Wigfield & Tonks, 2002). The task value is one of the two most important predictor of achievement behavior. Students also value the tasks they think they do well (Pintrich & Schunk, 2002). The MSLQ and achievement test were assigned to the students almost at the same time and they had no idea about their achievement scores while answering the MSLQ. On the other hand, they had some idea how they were successful in completing the task they assigned during the treatment. However, it can be said that almost all groups were completed the tasks successfully and little emphasis was put on social comparison by the teachers. In case based learning environment, besides main scientific concepts, the students have learned about health of the system while trying to solve the health problems of the characters in the cases. By this way, case based learning linked the lesson material into real-life circumstances in this study. Providing opportunities to experience real-life situations are seen as one of the most important characteristics of case based method (Kreber, et. al., 2007; Mayo, 2002; Naumes & Naumes, 2006; Rybarczyk, et.al., 2007; Wassermann, 1994; Wellington, 2006). In turn, when the activities are authentic, are meaningful to students, and are connected to other things they do, students' valuing of the task is facilitated (Brophy, 1999). The authentic context of the case based learning showed the relevance of the human reproductive system to the real life situations. Students, both individually and as a group, dealt with real life problems presented in these authentic cases. They discussed the possible solutions together as if they are talking on a problem in their families, with their friends, or with their doctors. Camill (2006) supports that students value lectures, readings and discussions for their learning in case based learning environments. It is known that values are positively correlated with actual achievement (Eccles, et al., 1993a; Eccles, et al., 1993b; Meece,

Wigfield, and Eccles, 1990) and if students find a task valuable they study harder and effectively (Wigfield& Tonks, 2002).

In this sense, the high school students that were exposed to case based learning might have valued the lesson, in turn, they studied harder and effectively, and consequently might have scored higher in achievement test when compared to the students that were exposed to traditional biology instruction.

Wigfield & Tonks (2002) argue that 'when an activity is valued, students likely attend more carefully to how they are doing, invest more time, and try to understand why they obtained the outcome they did' (p.74). Due to opportunities that are offered by authentic characteristics of CBL environment, students valued the human the human reproductive system. Once they valued the task they studied carefully and more and when they failed to solve the problem(s) given in the cases or exposed by them, they evaluated and revised what they did. These strategies, in turn helped students to learn the topic well.

Other question that comes to mind after examining the results of the study is that why students exposed to CBL perceived the task significantly more valuable than the students in traditional condition. The reasons may be very different for each student because individual differences affect motivation in science (Anderman & Young, 1994). In addition, different components of task value become more differentiated during early adolescence although they are less differentiated during elementary school years (Wigfield & Tonks, 2002). Accordingly, students' perceived task value may increase because they may find the task important to their personality, interesting and enjoyable or useful for their future. Additionally, if students feel that the cost of engaging in the task is not so high then they may chose to engage in it and persist on studying (Ames, 1988; Pintrich & Schunk, 2002; Wigfield, Hoa, and Klauda, 2008; Wigfield & Eccles, 2000; Wigfield & Tonks, 2002).

Although the present study did not concentrate on these separate constructs of task value, there are numerous studies and reports which say that students perceive CBL as enjoyable and interesting (Brickman, et.al., 2008; Heid, 2008;

Herreid, 2006; Hoskin,1998; Jackson, 1998; Mayo, 2002; Parilla, 2007; Ribbens, 2006; Walters, 1999). Teachers also report that their students' engagement in class activities increase in CBL environments (Yadav, et. al., 2008). During the present study, it was apparently observed that students interested in the cases and they were curious to learn about what really has happened to the characters of the cases. Students themselves also reported in case based evaluation form assigned in this study that the cases were interesting. Therefore, it can be concluded that students' perceived task value might have been enhanced in the experimental group because students found the task interesting and enjoyable.

During the study, neither in the experimental group nor in the control group the utility value of the topic for the future career was emphasized specifically by the teachers. But some students reported in case based evaluation form that they found the case based method helpful because they want to be a medical doctor. Future-oriented students may engage in a task even if they are not interested in it but perceive the achievement important in that task for their future career (Husman, et. al. 2004). For example, studying human reproductive system may not seem important in an adolescent's present, but may seem very important for student's future if s/he is future-oriented and planning to become a medical doctor and/or to get a high score from the university entrance exam. However, students in control group may also find the task valuable in terms their future career as students both in experimental group and control group were science students that are planning to science related areas in university. But, in case based learning environment relatedness of the task to the medical sciences and students future lives was more apparent when compared to traditional environment, because the task had been discussed through the health of the system in case based learning environment. Case based learning is an efficient instructional method to link theory into real life circumstances (Naumes & Naumes, 2006). Consequently, it can be said that the students in CBL condition might have seen the contribution of case based method to their future careers and future lives. Therefore, case based method might have been perceived by such future oriented students as a useful tool to reach their long term goals. The importance of utility value for the students increases when they

move from middle school to the high school (Durik, Vida, & Eccles ,2004; Wigfield & Tonks, 2002). Students become more likely to engage in activities they are not interested in but perceive as important for their future career.

Task value involves reasons to engage in a task. Students may engage in a task because they may find the task interesting and enjoyable, or important to their personal agencies, or useful for their future goals, or they may take all three reasons in consideration together. Whatever the reason it is apparent that CBL is a useful instructional method to improve students' task value, at least for that group of high school students in human reproductive system topic. In this manner, the present study may reduce the suspicion of the educators that want to implement CBL in their classes but worry about that students may not value the CBL although that finding task valuable does not exactly mean that students value the CBL (McNaught, et. al. 2005). This current study presents significant evidence that students in CBL environment find the task more valuable than students in traditional learning environment.

In this study, no significant difference was detected in both students' perceived intrinsic goal orientation and extrinsic goal orientation after the treatment. However, it is worth to say that both intrinsic goal orientation scores and extrinsic goal orientation scores of students who exposed to CBL were higher than those of students who were exposed to traditional biology instruction.

The classroom structures affect learning orientation of students (Ames, 1992; Anderman & Young, 1994). The tasks that emphasize personal relevance and meaningfulness of the content are more likely to facilitate interest in learning and a mastery orientation. The tasks that are presented in this study efficiently achieved this function as the students reported that the cases were 'realistic and interesting'. However, the tasks should also contain variety and diversity to lead a mastery orientation (Ames, 1992). This function was weakly displayed because the same concept was used while examining two cases. The first case had two sections and the second case had three sections. While studying on cases the same approach was used: students red the cases, discussed what had been given in the cases and

what is needed to learn to solve the dilemma, searched from the sources to learn the basic concepts to solve the problems, and discussed their solutions at the end. Some of the students reported that it was boring to use case based method repeatedly. Instead of using the same method for each case or section, lecturing or the other instructional methods could be used, and then again, a case could be given to the students to let them apply what they have learned from the lesson. During this treatment, students learned the topic via cases without any previous lecturing. This is not an easy job for students who face with the case based method for the first time. The intensity of the cases could be reduced or different types of case based method could be used to decrease boredom (Herreid, 1994, 1998, 2005). Another approach could be that different follow-up activities might be used after each case or sections of the cases to increase variety and diversity. Using follow-up activities, which is a characteristic of the case based learning but not a necessity, may also allow the development of a sense of independence and control over learning activities. The more learning-focused instructional strategies are used by the teachers in science classes the more students tend become learning oriented (Ames, 1992; Anderman & Young, 1994). During the treatment, some students felt stress in finishing the task on time and they focused on just answering the discussion questions given after each section of cases instead of deep learning. But, when the teacher realized that, she emphasized deep learning of task instead of finishing the answers on time and promised to give extra time when they needed. This let the students feel comfortable to learn the task deeply so develop a mastery goal orientation. Although teachers tried to decrease stress due to timing there was a general time shortage in terms of finishing the course content in line with other classes of the school in which this study was run. This might prevent to develop a mastery goal orientation as suggested by Arlin & Webster, (1983) and Pintrich & Schunk, (2002).

As a result, how CBL is implemented in the classroom is very important to benefit the advantages of CBL. It is more powerful than CBL itself that how CBL is applied in the class, which instructional strategies used, and which goals made salient by the teachers. CBL provides a valuable way to increase students'

engagement and achievement in classes, however, it is the teacher who will guide the students and arrange classroom circumstances in such a way that students will intrinsically orient themselves toward learning of the subject.

6.2 Instructional implications

- Case based learning can be used as an efficient method to increase academic achievement in biology classes.
- Students value the task more when they are exposed to the case based learning.
- How case based learning is implemented in class is important to be benefited from CBL as a student-centered approach to learning. In this sense, to get optimum benefit, teachers should arrange their classes by considering these dimensions of classes: task, authority, recognition, grouping, evaluation, and time.
- The teachers must be sure that the tasks they assigned to the students include variety and diversity to reduce boredom.

6.3 Implications for Further Research

- This study can be replicated in different school types with a larger sample size to increase generalizability.
- The effect of case based learning on students' academic achievement other than human reproductive system can be determined.
- The effect of case based learning on different constructs of task value can be investigated specifically.
- The effect of case-based learning at different grade levels can be searched for.
- The effect of case based learning on students' expectancy beliefs together with the variables of the present study can be studied.

- The duration of the implementation to the success of case-based learning with respect to the variables of the present study can be investigated.

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APPENDIX A

HUMAN REPRODUCTION ACHIEVEMENT TEST

This test was designed to test your academic achievement on the subject of Human Reproduction. It is composed of four pages and contains 21 multiple choice items. Choose the most appropriate item and circle. Duration of the test is 45 minutes.

Name:

Class:

Previous Year's Biology Grade:

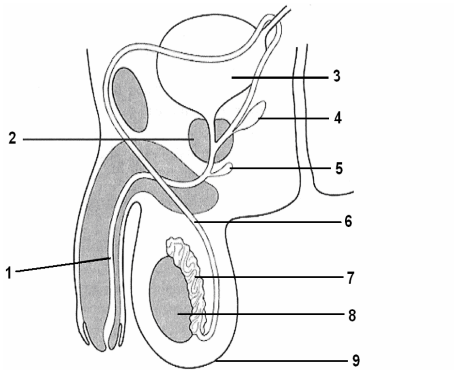
Gender: Girl □ Boy □

1. Why it is necessary for sperms to be produced in large numbers when only one sperm is required to bring about fertilization?

I. The temperature of the female body is not suitable for sperms to live for a long period of time.
II. Many of the sperms die when they are moving through female reproductive canal.
III. Sometimes pH of the female reproductive canal may not be suitable for the sperms.

A) I only
B) II only
C) I and III only
D) II and III only
E) I, II and III

The figure below shows the structure of male reproductive system. Use this figure to answer



the questions 2, 3, and 4:

2. The structure that produces sperm is ……..
A) 1 B)3 C) 6 D) 8 E) 9

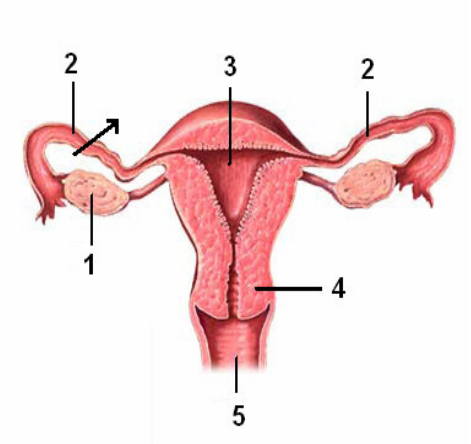
3. The structure that is used by both reproductive system and excretory system is ...…..……

A) 1 B) 3 C) 4 D) 5 E) 9

4. Removal of structure 8 prior to puberty would …….……

A) stimulate development of secondary sexual characteristics
B) prevent proper urinary function
C) stimulate sperm production
D) prevent sexual maturity
E) stimulate testesterone secretion

Use the below drawing of the female reproductive system to answer the questions 5,6, and 7.



5. If structure 2 were cut or tied off at the arrow what would have happened?

A) eggs would not reach uterus
B) the corpus luteum could not produce progesterone
C) thickness of uterine wall could not be increased
D) a pregnancy in progress would be distrupted
E) eggs could not be produced

6. The human embryo implants in .....

A) 1 B) 2 C) 3 D) 4 E) 5

7. Where does development of the embryo begin?

A) 1 B) 2 C) 3 D) 4 E) 5

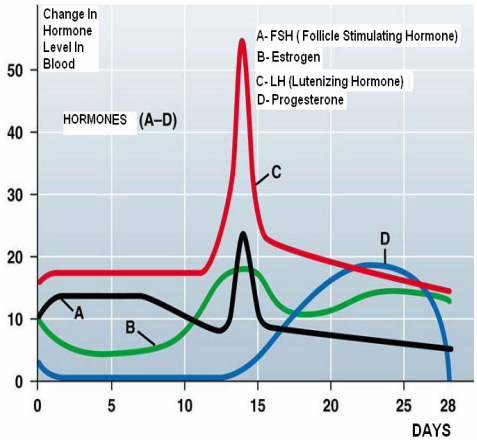
8. Which of the followings are required for fertilization to occur inside the female body?

I. Sperm must swim into one of the Fallopian tube (oviduct).
II. An egg must be present in the Fallopian tube.
III. The nucleus of a sperm must enter the egg cell.

A) II only B) III only C) II and III only
D) I and II only E) I, II and III

<u>Use the below graph to answer the questions 9, 10, and 11.</u>

The graph represents the human menstrual cycle. The amounts of four hormones on the graph are plotted: estrogen, progesterone, FSH and LH.



9. In this cycle the release of an egg to the oviduct occurs .....

A) between the 5th and 10th day
B) between the 16th and 26th day
C) between the 1st and 7th day
D) between the 14th and 16th day
E) on the 28th day

10. After ovulation, the egg lives only a few days and if it is not fertilized, it disintegrates. **Knowing this, you could predict that the greatest possibility of pregnancy is between…..**

A) 0 to 16 days B) 14 to 16 days
C) 6 to 10 days D) 22 to 28 days
E) 0 to 6 days

11. Menstruation begins when the activity of ……..

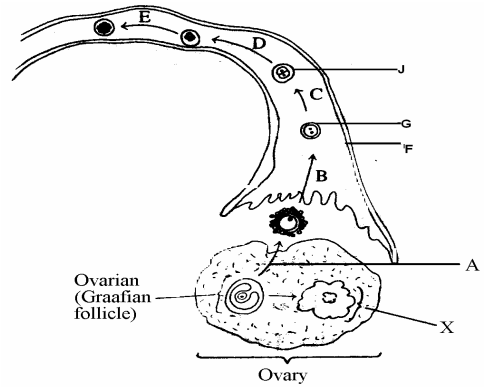
A) LH is at its peak
B) Estrogen reaches its peak
C) Progesterone is at its highest
D) Progesterone and estrogen are both decreasing
E) FSH is at its peak

12. The hormone levels in menstrual cycle are controlled by the .....

A) pituitary and ovaries
B) ovaries only
C) placenta only
D) uterus and ovaries
E) ovaries, pituitary, and hypothalamus

Use the following information to answer the questions 13,14,15 and 16:

The diagram below shows some of the events which take place in the ovary and oviduct (Fallopian tube) around the time of fertilisation.



13. What is the name of the process labelled A?

A) Fertilization
B) Mitosis
C) Ovulation
D) Embryonic development
E) Growing of follicle

14. Which structure is responsible for secretion of progesteron during early pregnancy, before the development of placenta?

A) Follicle B) Structure X
C) Embryo D) Uterine wall
E) Fallopian tubule

15. Which structure(s) secrete(s) the hormone that is responsible for thickening of the uterine wall and increased secretion of mucus to prepare uterus to a possible pregnancy?

A) Structure X
B) Ovarian follicle and structure X
C) Structure F and structure G
D) Structure G and structure J
E) Structure J

16. Which one is the part of the female reproductive system where fertilisation took place?

A) Ovary B) Structure X
C) Structure F D) Structure G
E) Structure J

17. If sperms are present in female reproductive system, which of the followings describe the situation when chance of fertilization is the highest?

A) when an egg is in a Fallopian tube.
B) when a woman is menstruating.
C) When progesterone level is increasing.
D) when estrogen and progesterone are decreasing suddenly.
E) when a zygote is already present in the fallopian tubule.

18. When the pituitary gland is removed from immature female rabbits, their ovaries do not develop normally. **When the pituitary gland is removed from mature female rabbits, the ovaries and uterus stop functioning. What do these observations indicate(show)?**

A) The ovaries influence the uterus.
B) The pituitary gland influences both the ovaries and the uterus
C) The ovaries and uterus influence the pituitary gland
D) There is a feedback of hormones from the ovary to the pituitary gland
E) The uterus influences the ovaries.

19. Which of the following is a function of the placenta?

A) mixing the blood of the mother and the fetus
B) protecting the fetus from any drugs or alcohol in the mother's body
C) providing nutrients to the fetus
D) cushioning and protecting the fetus
E) storing waste substances

20. Which one of the followings is true **if menstruation occurs?**

I. uterine lining thickens.
II. estrogen level falls.
III. progesterone level falls.
IV. egg is fertilized.

A) Only IV B) I and II
C) II and III D) II, III and IV
E) III and IV

21. When the woman's reproductive life ends, the levels of FSH and LH in her blood rise. **Which of the following events are related with this high levels of FSH and LH at the end of the reproductive phase?**

I. Decreased levels of ovarian hormones due to decreased number of Follicles.
II. Less ovulation.
III. Decreased number of menstrual period per year.

A) I only B) I and II only
C) I and III only D) II and III only
E) I, II, and III

Key:

1.E	**2.D**	**3.A**	**4. D**
5. A	**6.C**	**7. B**	**8. E**
9. D	**10.B**	**11. D**	**12.E**
13.C	**14.B**	**15.B**	**16.C**
17.A	**18.B**	**19.C**	**20.C**
21.E			

APPENDIX B

BLOOMS' TAXONOMY FOR HUMAN REPRODUCTION ACHIEVEMENT TEST

Table. B.1 Blooms' taxonomy for human reproduction achievement test

	Knowledge	Comprehension	Application	Synthesis
Item1				√
Item2	√			
Item3	√			
Item4				√
Item5				√
Item6	√			
Item7	√			
Item8		√		
Item9			√	
Item10		√		
Item11			√	
Item12	√			
Item13		√		
Item14	√			
Item15	√			
Item16	√			
Item17		√		
Item18			√	
Item19	√			
Item20				√
Item21				√

APPENDIX C

ÖĞRENMEDE GÜDÜSEL STRATEJİLER ANKETİ

Bu ankette biyoloji dersine karşı tutumunuzu, motivasyonunuzu belirlemeye yönelik ifadeler yer almaktadır. Cevap verirken aşağıda verilen ölçeği gözönüne alınız. **Eğer ifadenin sizi tam olarak yansıttığını düşünüyorsanız, 7' yi yuvarlak içine alınız. Eğer ifadenin sizi hiç yansıtmadığını düşünüyorsanız, 1' i yuvarlak içine alınız. Bu iki durum dışında ise 1 ve 7 arasında sizi en iyi tanımladığını düşündügünüz numarayı yuvarlak içine alınız.** Unutmayin Doğru ya da Yanlış cevap yoktur; yapmanız gereken sizi en iyi tanımlayacak numarayı yuvarlak içine almanızdır.

1 --- 2 --- 3 --- 4 --- 5 --- 6 -- 7

beni hiç yansıtmıyor — beni tam olarak yansıtıyor

A. Motivasyon (Güdülenme)	**beni hiç yansıtmıyor**						**beni tam olarak yansıtıyor**
1. Biyoloji dersinde yeni bilgiler öğrenebilmek için, büyük bir çaba gerektiren sınıf çalışsmalarını tercih ederim.	1	2	3	4	5	6	7
4. Biyoloji dersinde öğrendiklerimi bşska derslerde de kullanabileceğimi düşünüyorum.	1	2	3	4	5	6	7
7. Benim için şu an biyoloji dersi ile ilgili en tatmin edici şey iyi bir not getirmektir	1	2	3	4	5	6	7
10.Biyoloji dersindeki konuları öğrenmek benim için önemlidir	1	2	3	4	5	6	7
11. Genel not ortalamamı yükseltmek şu an benim için en önemli şeydir, bu nedenle biyoloji dersindeki temel amacım iyi bir not getirmektir.	1	2	3	4	5	6	7
13. Eğer başarabilirsem, biyoloji dersinde sınıftaki pek çok öğrenciden daha iyi bir not getirmek isterim	1	2	3	4	5	6	7
16. Biyoloji derslerinde öğrenmesi zor olsa bile, bende merak uyandıran sınıf çalışmalarını tercih ederim.	1	2	3	4	5	6	7
17. Biyoloji dersinin kapsamında yer alan konular çok ilgimi çekiyor.	1	2	3	4	5	6	7
22. Biyoloji dersinde beni en çok tatmin eden sey, konuları mümkün olduğunca iyi ögrenmeye çalışmaktır.	1	2	3	4	5	6	7
23. Biyoloji dersinde öğrendiklerimin benim için faydalı olduğunu düşünüyorum.	1	2	3	4	5	6	7
24. Biyoloji dersinde, iyi bir not getireceğimden emin **olmasam** bile öğrenmeme olanak sağlayacak ödevleri seçerim.	1	2	3	4	5	6	7
26. Biyoloji dersindeki konulardan hoşlanıyorum.	1	2	3	4	5	6	7
27. Biyoloji dersindeki konuları anlamak benim için önemlidir.	1	2	3	4	5	6	7
30. Biyoloji dersinde başarılı olmak istiyorum çünkü yeteneğimi aileme, arkadaslarıma göstermek benim için önemlidir.	1	2	3	4	5	6	7

APPENDIX D

BİLİMSEL İŞLEM BECERİ TESTİ

AÇIKLAMA: Bu test, özellikle Fen ve Matematik derslerinizde ve ilerde üniversite sınavlarında karşınıza çıkabilecek karmaşık gibi görünen problemleri analiz edebilme kabiliyetinizi ortaya çıkarabilmesi açısından çok faydalıdır. Bu test içinde, problemdeki değişkenleri tanımlayabilme, hipotez kurma ve tanımlama, işlemsel açıklamalar getirebilme, problemin çözümü için gerekli incelemelerin tasarlanması, grafik çizme ve verileri yorumlayabilme kabiliyetlerini ölçebilen sorular bulunmaktadır. Her soruyu okuduktan sonra kendinizce uygun seçeneği yalnızca cevap kağıdına işaretleyiniz.

1. Bir basketbol antrenörü, oyuncuların güçsüz olmasından dolayı maçları kaybettiklerini düşünmektedir. Güçlerini etkileyen faktörleri araştırmaya karar verir. Antrenör, oyuncuların gücünü etkileyip etkilemediğini ölçmek için aşağıdaki değişkenlerden hangisini incelemelidir?

a. Her oyuncunun almış olduğu günlük vitamin miktarını.
b. Günlük ağırlık kaldırma çalışmalarının miktarını.
c. Günlük antrenman süresini.
d. Yukarıdakilerin hepsini.

2. Arabaların verimliliğini inceleyen bir araştırma yapılmaktadır. Sınanan hipotez, benzine katılan bir katkı maddesinin arabaların verimliliğini artırdığı yolundadır. Aynı tip beş arabaya aynı miktarda benzin fakat farklı miktarlarda katkı maddesi konur. Arabalar benzinleri bitinceye kadar aynı yol üzerinde giderler. Daha sonra her arabanın aldığı mesafe kaydedilir. Bu çalışmada arabaların verimliliği nasıl ölçülür?

a. Arabaların benzinleri bitinceye kadar geçen süre ile.
b. Her arabanın gittiği mesafe ile.
c. Kullanılan benzin miktarı ile.
d. Kullanılan katkı maddesinin miktarı ile.

3. Bir araba üreticisi daha ekonomik arabalar yapmak istemektedir. Araştırmacılar arabanın litre başına alabileceği mesafeyi etkileyebilecek değişkenleri araştırmaktadırlar. Aşağıdaki değişkenlerden hangisi arabanın litre başına alabileceği mesafeyi etkileyebilir?

a. Arabanın ağırlığı.
b. Motorun hacmi.
c. Arabanın rengi
d. a ve b.

4. Ali Bey, evini ısıtmak için komşularından daha çok para ödenmesinin sebeplerini merak etmektedir. Isınma giderlerini etkileyen faktörleri araştırmak için bir hipotez kurar. Aşağıdakilerden hangisi bu araştırmada sınanmaya uygun bir hipotez değildir?

a. Evin çevresindeki ağaç sayısı ne kadar az ise ısınma gideri o kadar fazladır.

b. Evde ne kadar çok pencere ve kapı varsa, ısınma gideri de o kadar fazla olur.

c. Büyük evlerin ısınma giderleri fazladır.

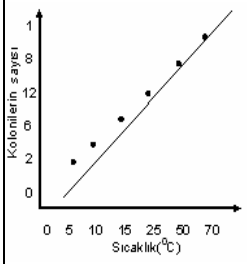
d. Isınma giderleri arttıkça ailenin daha ucuza ısınma yolları araması gerekir.

5. Fen sınıfından bir öğrenci sıcaklığın bakterilerin gelişmesi üzerindeki etkilerini araştırmaktadır. Yaptığı deney sonucunda, öğrenci aşağıdaki verileri elde etmiştir:

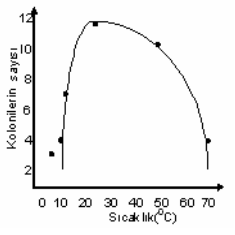
Deney odasının sıcaklığı (^{0}C)	Bakteri kolonilerinin sayısı
5	0
10	2
15	6
25	12
50	8
70	1

Aşağıdaki grafiklerden hangisi bu verileri doğru olarak göstermektedir?

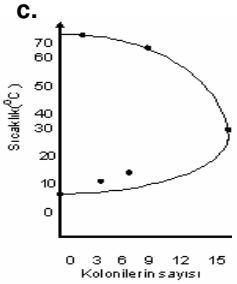
a.



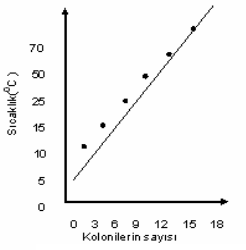
b.



c.



d.



6. Bir polis şefi, arabaların hızının azaltılması ile uğraşmaktadır. Arabaların hızını etkileyebilecek bazı faktörler olduğunu düşünmektedir. Sürücülerin ne kadar hızlı araba kullandıklarını aşağıdaki hipotezlerin hangisiyle sınayabilir?

a. Daha genç sürücülerin daha hızlı araba kullanma olasılığı yüksektir.

b. Kaza yapan arabalar ne kadar büyükse, içindeki insanların yaralanma olasılığı o kadar azdır.

c. Yollarda ne kadar çok polis ekibi olursa, kaza sayısı o kadar az olur.

d. Arabalar eskidikçe kaza yapma olasılıkları artar.

7. Bir fen sınıfında, tekerlek yüzeyi genişliğinin tekerleğin daha kolay yuvarlanması üzerine etkisi araştırılmaktadır. Bir oyuncak arabaya geniş yüzeyli tekerlekler takılır, önce bir rampadan (eğik düzlem) aşağı bırakılır ve daha sonra düz bir zemin üzerinde gitmesi sağlanır. Deney, aynı arabaya daha dar yüzeyli tekerlekler takılarak tekrarlanır. Hangi tip tekerleğin daha kolay yuvarlandığı nasıl ölçülür?

a. Her deneyde arabanın gittiği toplam mesafe ölçülür.

b. Rampanın (eğik düzlem) eğim açısı ölçülür.

c. Her iki deneyde kullanılan tekerlek tiplerinin yüzey genişlikleri ölçülür.

d. Her iki deneyin sonunda arabanın ağırlıkları ölçülür.

8. Bir çiftçi daha çok mısır üretebilmenin yollarını aramaktadır. Mısırların miktarını etkileyen faktörleri araştırmayı tasarlar. Bu amaçla aşağıdaki hipotezlerden hangisini sınayabilir?

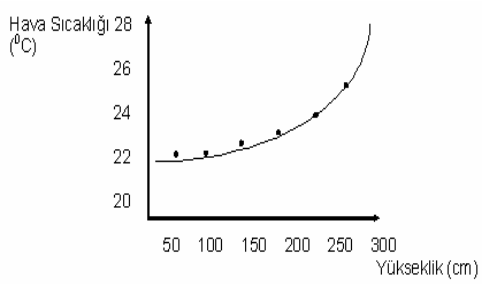
a. Tarlaya ne kadar çok gübre atılırsa, o kadar çok mısır elde edilir.

b. Ne kadar çok mısır elde edilirse, k**a**r o kadar fazla olur.

c. Yağmur ne kadar çok yağarsa , gübrenin etkisi o kadar çok olur.

d. Mısır üretimi arttıkça, üretim maliyeti de artar.

9. Bir odanın tabandan itibaren değişik yüzeylerdeki sıcaklıklarla ilgili bir çalışma yapılmış ve elde edilen veriler aşağıdaki grafikte gösterilmiştir. Değişkenler arasındaki ilişki nedir?



a. Yükseklik arttıkça sıcaklık azalır.

b. Yükseklik arttıkça sıcaklık artar.

c. Sıcaklık arttıkça yükseklik azalır.

d. Yükseklik ile sıcaklık artışı arasında bir ilişki yoktur.

10. Ahmet, basketbol topunun içindeki hava arttıkça, topun daha yükseğe sıçrayacağını düşünmektedir. Bu hipotezi araştırmak için, birkaç basketbol topu alır ve içlerine farklı miktarda hava pompalar. Ahmet hipotezini nasıl sınamalıdır?

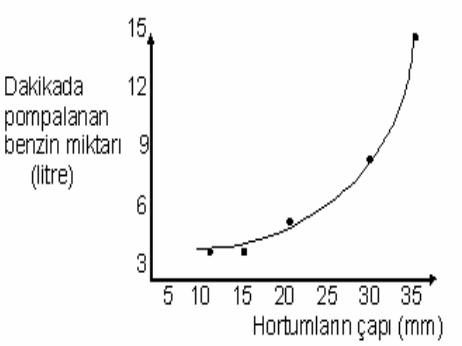
a. Topları aynı yükseklikten fakat değişik hızlarla yere vurur.

b. İçlerinde farlı miktarlarda hava olan topları, aynı yükseklikten yere bırakır.

c. İçlerinde aynı miktarlarda hava olan topları, zeminle farklı açılardan yere vurur.

d. İçlerinde aynı miktarlarda hava olan topları, farklı yüksekliklerden yere bırakır.

11. Bir tankerden benzin almak için farklı genişlikte 5 hortum kullanılmaktadır. Her hortum için aynı pompa kullanılır. Yapılan çalışma sonunda elde edilen bulgular aşağıdaki grafikte gösterilmiştir.



Aşağıdakilerden hangisi değişkenler arasındaki ilişkiyi açıklamaktadır?

a. Hortumun çapı genişledikçe dakikada pompalanan benzin miktarı da artar.
b. Dakikada pompalanan benzin miktarı arttıkça, daha fazla zaman gerekir.
c. Hortumun çapı küçüldükçe dakikada pompalanan benzin miktarı da artar.
d. Pompalanan benzin miktarı azaldıkça, hortumun çapı genişler.

Önce aşağıdaki açıklamayı okuyunuz ve daha sonra 12, 13, 14 ve 15 inci soruları açıklama kısmından sonra verilen paragrafı okuyarak cevaplayınız.

Açıklama: Bir araştırmada, bağımlı değişken birtakım faktörlere bağımlı olarak gelişim gösteren değişkendir. Bağımsız değişkenler ise bağımlı değişkene etki eden faktörlerdir. Örneğin, araştırmanın amacına göre kimya başarısı bağımlı bir değişken olarak alınabilir ve ona etki edebilecek faktör veya faktörler de bağımsız değişkenler olurlar.

Ayşe, güneşin karaları ve denizleri aynı derecede ısıtıp ısıtmadığını merak etmektedir. Bir araştırma yapmaya karar verir ve aynı büyüklükte iki kova alır. Bunlardan birini toprakla, diğerini de su ile doldurur ve aynı miktarda güneş ısısı alacak şekilde bir yere koyar. 8:00 – 18:00 saatleri arasında, her saat başı sıcaklıklarını ölçer.

12. Araştırmada aşağıdaki hipotezlerden hangisi sınanmıştır?

a. Toprak ve su ne kadar çok güneş ışığı alırlarsa, o kadar ısınırlar.
b. Toprak ve su güneş altında ne kadar fazla kalırlarsa, o kadar çok ısınırlar.
c. Güneş farklı maddeleri farklı derecelerde ısıtır.
d. Günün farklı saatlerinde güneşin ısısı da farklı olur.

13. Araştırmada aşağıdaki değişkenlerden hangisi kontrol edilmiştir?

a. Kovadaki suyun cinsi.
b. Toprak ve suyun sıcaklığı.
c. Kovalara koyulan maddenin türü.
d. Her bir kovanın güneş altında kalma süresi.

14. Araştırmada bağımlı değişken hangisidir?

a. Kovadaki suyun cinsi.
b. Toprak ve suyun sıcaklığı.
c. Kovalara koyulan maddenin türü.
d. Her bir kovanın güneş altında kalma süresi.

15. Araştırmada bağımsız değişken hangisidir?

a. Kovadaki suyun cinsi.
b. Toprak ve suyun sıcaklığı.
c. Kovalara koyulan maddenin türü.
d. Her bir kovanın güneş altında kalma süresi.

16. Can, yedi ayrı bahçedeki çimenleri biçmektedir. Çim biçme makinesiyle her hafta bir bahçedeki çimenleri biçer. Çimenlerin boyu bahçelere göre farklı olup bazılarında uzun bazılarında kısadır. Çimenlerin boyları ile ilgili hipotezler kurmaya başlar. Aşağıdakilerden hangisi sınanmaya uygun bir hipotezdir?

a. Hava sıcakken çim biçmek zordur.
b. Bahçeye atılan gürenin miktarı önemlidir.
c. Daha çok sulanan bahçedeki çimenler daha uzun olur.
d. Bahçe ne kadar engebeliyse çimenleri kesmekte o kadar zor olur.

17, 18, 19 ve 20 inci soruları aşağıda verilen paragrafı okuyarak cevaplayınız.

Murat, suyun sıcaklığının, su içinde çözünebilecek şeker miktarını etkileyip etkilemediğini araştırmak ister. Birbirinin aynı dört bardağın her birine 50 şer mililitre su koyar. Bardaklardan birisine 0 ^{0}C de, diğerine de sırayla 50 ^{0}C, 75 ^{0}C ve 95 ^{0}C sıcaklıkta su koyar. Daha sonra her bir bardağa çözünebileceği kadar şeker koyar ve karıştırır.

17. Bu araştırmada sınanan hipotez hangisidir?

a. Şeker ne kadar çok suda karıştırılırsa o kadar çok çözünür.
b. Ne kadar çok şeker çözünürse, su o kadar tatlı olur.
c. Sıcaklık ne kadar yüksek olursa, çözünen şekerin miktarı o kadar fazla olur.
d. Kullanılan suyun miktarı arttıkça sıcaklığı da artar.

18. Bu araştırmada kontrol edilebilen değişken hangisidir?

a. Her bardakta çözünen şeker miktarı.
b. Her bardağa konulan su miktarı.
c. Bardakların sayısı.
d. Suyun sıcaklığı.

19. Araştırmanın bağımlı değişkeni hangisidir?

a. Her bardakta çözünen şeker miktarı.
b. Her bardağa konulan su miktarı.
c. Bardakların sayısı.
d. Suyun sıcaklığı.

20. Araştırmadaki bağımsız değişken hangisidir?

a. Her bardakta çözünen şeker miktarı.
b. Her bardağa konulan su miktarı.
c. Bardakların sayısı.
d. Suyun sıcaklığı.

21. Bir bahçıvan domates üretimini artırmak istemektedir. Değişik birkaç alana domates tohumu eker. Hipotezi, tohumlar ne kadar çok sulanırsa, o kadar çabuk filizleneceğidir. Bu hipotezi nasıl sınar?

a. Farklı miktarlarda sulanan tohumların kaç günde filizleneceğine bakar.
b. Her sulamadan bir gün sonra domates bitkisinin boyunu ölçer.
c. Farklı alanlardaki bitkilere verilen su miktarını ölçer.
d. Her alana ektiği tohum sayısına bakar.

22. Bir bahçıvan tarlasındaki kabaklarda yaprak bitleri görür. Bu bitleri yok etmek gereklidir. Kardeşi "Kling" adlı tozun en iyi böcek ilacı olduğunu söyler. Tarım uzmanları ise "Acar" adlı spreyin daha etkili olduğunu söylemektedir. Bahçıvan altı tane kabak bitkisi seçer. Üç tanesini tozla, üç tanesini de spreyle ilaçlar. Bir hafta sonra her bitkinin üzerinde kalan canlı bitleri sayar. Bu çalışmada böcek ilaçlarının etkinliği nasıl ölçülür?

a. Kullanılan toz ya da spreyin miktarı ölçülür.
b. Toz ya da spreyle ilaçlandıktan sonra bitkilerin durumları tespit edilir.
c. Her fidede oluşan kabağın ağırlığı ölçülür.
d. Bitkilerin üzerinde kalan bitler sayılır.

23. Ebru, bir alevin belli bir zaman süresi içinde meydana getireceği ısı enerjisi miktarını ölçmek ister. Bir kabın içine bir litre soğuk su koyar ve 10 dakika süreyle ısıtır. Ebru, alevin meydana getirdiği ısı enerjisini nasıl ölçer?

a. 10 dakika sonra suyun sıcaklığında meydana gelen değişmeyi kaydeder.
b. 10 dakika sonra suyun hacminde meydana gelen değişmeyi ölçer.
c. 10 dakika sonra alevin sıcaklığını ölçer.
d. Bir litre suyun kaynaması için geçen zamanı ölçer.

24. Ahmet, buz parçacıklarının erime süresini etkileyen faktörleri merak etmektedir. Buz parçalarının büyüklüğü, odanın sıcaklığı ve buz parçalarının şekli gibi faktörlerin erime süresini etkileyebileceğini düşünür. Daha sonra şu hipotezi sınamaya karar verir: Buz parçalarının şekli erime süresini etkiler. Ahmet bu hipotezi sınamak için aşağıdaki deney tasarımlarının hangisini uygulamalıdır?

a. Her biri farklı şekil ve ağırlıkta beş buz parçası alınır. Bunlar aynı sıcaklıkta benzer beş kabın içine ayrı ayrı konur ve erime süreleri izlenir.
b. Her biri aynı şekilde fakat farklı ağırlıkta beş buz parçası alınır. Bunlar aynı sıcaklıkta benzer beş kabın içine

ayrı ayrı konur ve erime süreleri izlenir.

c. Her biri aynı ağırlıkta fakat farklı şekillerde beş buz parçası alınır. Bunlar aynı sıcaklıkta benzer beş kabın içine ayrı ayrı konur ve erime süreleri izlenir.

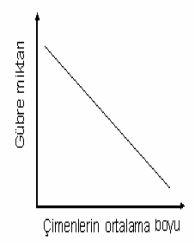
d. Her biri aynı ağırlıkta fakat farklı şekillerde beş buz parçası alınır. Bunlar farklı sıcaklıkta benzer beş kabın içine ayrı ayrı konur ve erime süreleri izlenir.

25. Bir araştırmacı yeni bir gübreyi denemektedir. Çalışmalarını aynı büyüklükte beş tarlada yapar. Her tarlaya yeni gübresinden değişik miktarlarda karıştırır. Bir ay sonra, her tarlada yetişen çimenin ortalama boyunu ölçer. Ölçüm sonuçları aşağıdaki tabloda verilmiştir.

Gübre miktarı (kg)	Çimenlerin ortalama boyu (cm)
10	7
30	10
50	12
80	14
100	12

Tablodaki verilerin grafiği aşağıdakilerden hangisidir?

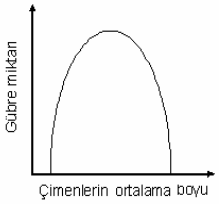
a.



b.

c.

d.



26. Bir biyolog şu hipotezi test etmek ister: Farelere ne kadar çok vitamin verilirse o kadar hızlı büyürler. Biyolog farelerin büyüme hızını nasıl ölçebilir?

a. Farelerin hızını ölçer.

b. Farelerin, günlük uyumadan durabildikleri süreyi ölçer.

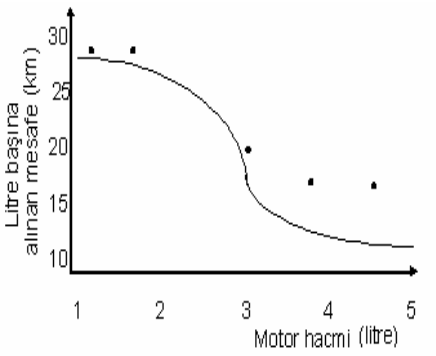
c. Her gün fareleri tartar.

d. Her gün farelerin yiyeceği vitaminleri tartar.

27. Öğrenciler, şekerin suda çözünme süresini etkileyebilecek değişkenleri düşünmektedirler. Suyun sıcaklığını, şekerin ve suyun miktarlarını değişken olarak saptarlar. Öğrenciler, şekerin suda çözünme süresini aşağıdaki hipotezlerden hangisiyle sınayabilir?

a. Daha fazla şekeri çözmek için daha fazla su gereklidir.
b. Su soğudukça, şekeri çözebilmek için daha fazla karıştırmak gerekir.
c. Su ne kadar sıcaksa, o kadar çok şeker çözünecektir.
d. Su ısındıkça şeker daha uzun sürede çözünür.

28. Bir araştırma grubu, değişik hacimli motorları olan arabaların randımanlarını ölçer. Elde edilen sonuçların grafiği aşağıdaki gibidir:



Aşağıdakilerden hangisi değişkenler arasındaki ilişkiyi gösterir?

a. Motor ne kadar büyükse, bir litre benzinle gidilen mesafe de o kadar uzun olur.
b. Bir litre benzinle gidilen mesafe ne kadar az olursa, arabanın motoru o kadar küçük demektir.
c. Motor küçüldükçe, arabanın bir litre benzinle gidilen mesafe artar.
d. Bir litre benzinle gidilen mesafe ne kadar uzun olursa, arabanın motoru o kadar büyük demektir.

29, 30, 31 ve 32 inci soruları aşağıda verilen paragrafı okuyarak cevaplayınız.

Toprağa karıştırılan yaprakların domates üretimine etkisi araştırılmaktadır. Araştırmada dört büyük saksıya aynı miktarda ve tipte toprak konulmuştur. Fakat birinci saksıdaki torağa 15 kg., ikinciye 10 kg., üçüncüye ise 5 kg. çürümüş yaprak karıştırılmıştır. Dördüncü saksıdaki toprağa ise hiç çürümüş yaprak karıştırılmamıştır.

Daha sonra bu saksılara domates ekilmiştir. Bütün saksılar güneşe konmuş ve aynı miktarda sulanmıştır. Her saksıdan elde edilen domates tartılmış ve kaydedilmiştir.

29. Bu araştırmada sınanan hipotez hangisidir?

a. Bitkiler güneşten ne kadar çok ışık alırlarsa, o kadar fazla domates verirler.
b. Saksılar ne kadar büyük olursa, karıştırılan yaprak miktarı o kadar fazla olur.
c. Saksılar ne kadar çok sulanırsa, içlerindeki yapraklar o kadar çabuk çürür.
d. Toprağa ne kadar çok çürük yaprak karıştırılırsa, o kadar fazla domates elde edilir.

30. Bu araştırmada kontrol edilen değişken hangisidir?

a. Her saksıdan elde edilen domates miktarı
b. Saksılara karıştırılan yaprak miktarı.
c. Saksılardaki torak miktarı.
d. Çürümüş yapak karıştırılan saksı sayısı.

31. Araştırmadaki bağımlı değişken hangisidir?

a. Her saksıdan elde edilen domates miktarı
b. Saksılara karıştırılan yaprak miktarı.
c. Saksılardaki torak miktarı.
d. Çürümüş yapak karıştırılan saksı sayısı.

32. Araştırmadaki bağımsız değişken hangisidir?

a. Her saksıdan elde edilen domates miktarı
b. Saksılara karıştırılan yaprak miktarı.
c. Saksılardaki torak miktarı.
d. Çürümüş yapak karıştırılan saksı sayısı.

33. Bir öğrenci mıknatısların kaldırma yeteneklerini araştırmaktadır. Çeşitli boylarda ve şekillerde birkaç mıknatıs alır ve her mıknatısın çektiği demir tozlarını tartar. Bu çalışmada mıknatısın kaldırma yeteneği nasıl tanımlanır?

a. Kullanılan mıknatısın büyüklüğü ile.
b. Demir tozlarını çeken mıknatısın ağırlığı ile.
c. Kullanılan mıknatısın şekli ile.
d. Çekilen demir tozlarının ağırlığı ile.

34. Sibel, akvaryumdaki balıkların bazen çok hareketli bazen ise durgun olduklarını gözler. Balıkların hareketliliğini etkileyen faktörleri merak eder.Balıkların hareketliliğini etkileyen faktörleri hangi hipotezle sınayabilir?

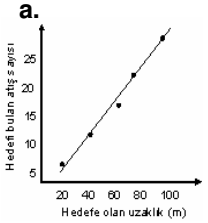
a. Balıklara ne kadar çok yem verilirse, o kadar çok yeme ihtiyaçları vardır.
b. Balıklar ne kadar hareketli olursa o kadar çok yeme ihtiyaçları vardır.
c. Su da ne kadar çok oksijen varsa, balıklar o kadar iri olur.
d. Akvaryum ne kadar çok ışık alırsa, balıklar o kadar hareketli olur.

35. Bir hedefe çeşitli mesafelerden 25 er atış yapılır. Her mesafeden yapılan 25 atıştan hedefe isabet edenler aşağıdaki tabloda gösterilmiştir.

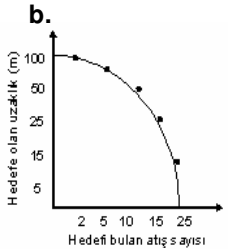
Mesafe(m)	Hedefe vuran atış sayısı
5	25
15	10
25	10
50	5
100	2

Aşağıdaki grafiklerden hangisi verilen bu verileri en iyi şekilde yansıtır?

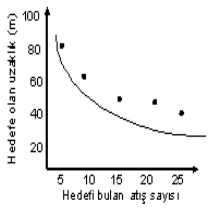
a.



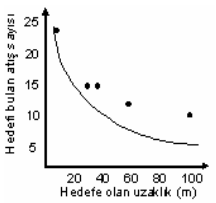
b.



c.



d.



36. Murat Bey'in evinde birçok elektrikli alet vardır. Fazla gelen elektrik faturaları dikkatini çeker. Kullanılan elektrik miktarını etkileyen faktörleri araştırmaya karar verir. Aşağıdaki değişkenlerden hangisi kullanılan elektrik enerjisi miktarını etkileyebilir?

a. TV nin açık kaldığı süre.

b. Elektrik sayacının yeri.

c. Çamaşır makinesinin kullanma sıklığı.

d. a ve c.

Cevap anahtarı

SORU	A	B	C	D	E
1				X	
2		X			
3				X	
4				X	
5		X			
6	X				
7	X				
8	X				
9		X			
10		X			
11	X				
12			X		

SORU	A	B	C	D	E
13				X	
14		X			
15			X		
16			X		
17			X		
18		X			
19	X				
20				X	
21	X				
22				X	
23	X				
24			X		

SORU	A	B	C	D	E
25			X		
26			X		
27				X	
28			X		
29				X	
30			X		
31	X				
32		X			
33				X	
34				X	
35				X	
36				X	

APPENDIX E

GRUP ÇALIŞMASI DEĞERLENDİRME FORMU

Öğrencinin Adı:
Öğrencinin Sınıfı:
Grup Adı/No:
Aşağıda grup çalışması sırasında gösterdiğiniz performansı katılım, hazırlık, katkı ve kişilerarası beceriler boyutları açısından belirlemeye yönelik ifadeler verilmiştir. Dikkatlice düşünüp grubunuzdaki diğer öğrenciler ve kendiniz için aşağıdaki derecelendirmelerden size en uygun gelen ifade ilgili rakamı her bir ifadenin karşısına ve arkadaşınızın adına karşılık gelecek şekilde yazınız.

1 = Kesinlikle Katılıyorum
2 = Katılıyorum
3 = Çok az katılıyorum
4 = Katılmıyorum
5 = Kesinlikle katılmıyorum

	Kendim:	**Grup Arkadaşımın Adı:**	**Grup Arkadaşımın Adı:**	**Grup Arkadaşımın Adı:**	**Grup Arkadaşımın Adı:**
Her zaman grubun aktif bir üyesi oldu					
Öğrenilmesi gereken konular belirlenirken her zaman önerilerini belirtti ve aktif rol oynadı.					
Grup çalışmasında belirlenen konuya/ örnek olaya uygun olarak her zaman hazırlıklı geldi.					
Örnek olayla ilgili fikir alışverişi, tartışma ortamı yaratacak sorular hazırladı.					
Ortaya atılan düşüncelere açıklık getirerek, özetleyerek ya da düşünceler arasında bağ kurarak grup üyeleri arasındaki iletişime sıklıkla yardımcı oldu.					
Konu dışına çıkıldığında grubu tekrar konuya yönlendirmek için her zaman çaba gösterdi.					
Bir fikri savunurken ya da bir konuyu açıklarken sürekli olarak kaynak gösterdi.					
Diğer grup üyelerinin düşüncelerine her zaman saygı gösterdi.					
Grup performansını geliştirmek için büyük çaba gösterdi.					
Kendisi hakkındaki yapıcı eleştirileri her zaman saygıyla karşıladı.					
Yapılması kararlaştırılan görevleri doğru ve tam yerine getirdi.					
Yapılması gereken ödevleri/işleri/çalışmaları zamanında yerine getirdi.					

http://dhc.ucdavis.edu/html/rubrics.htm ve Sungur, S. (2004)'dan uyarlanmıştır.

APPENDIX F

ÖRNEK OLAYA DAYALI ÖĞRENME MODELİNE İLİŞKİN GERİBİLDİRİM FORMU

Adı-Soyadı:
Sınıfı:
Aşağıda verilen sorular Örnek Olaya Dayalı Öğrenme Modeline ilişkin görüşlerinizi belirlemek için hazırlanmıştır. Görüşleriniz, bu model doğrultusunda yeni ders planları hazırlanırken göz önüne alınacaktır. Bu nedenle verdiğiniz cevaplar örnek olaya dayalı öğrenme modelinin ileride etkili bir şekilde uygulanabilmesi için büyük önem taşımaktadır. Lütfen her soruyu dikkatlice okuyarak, görüşlerinizi içtenlikle belirtiniz. Teşekkürler.

1. Örnek Olaya Dayalı Öğrenme Modelini nasıl tanımlarsınız? Sizce Örnek Olaya Dayalı Öğrenme Modelinin karakteristik özellikleri nelerdir?

2. Yukarıda belirttiğiniz karakteristik özelliklerden hangisinin öğrenmenize en çok katkısı oldu?

3. Örnek Olaya Dayalı Öğrenme Modelindeki hangi özellikleri kesinlikle değiştirmek isterdiniz?

4. Örnek Olaya Dayalı Öğrenme Modelindeki hangi özellikler kesinlikle uygulanmaya devam edilmelidir?

5. Örnek Olaya Dayalı Öğrenme Modelinin uygulanması sırasında ne tür zorluklarla karşılaştınız?

6. Sizce Örnek Olaya Dayalı Öğrenme Modelinde ideal bir öğretmen ne tür özellikler taşımalıdır? (Alan bilgisi, grup çalışmasına katkı vb. açılardan)

7. Örnek Olaya Dayalı Öğrenme Modelinin uygulandığı sınıflarda iyi bir öğrencinin özellikleri ne olmalıdır?

8. Ders sırasında işlenen örnek olaylar hakkındaki görüşleriniz nelerdir?

9. Örnek Olaya Dayalı Öğrenme Modelinin size akademik ve sosyal açıdan neler kazandırdığını düşünüyorsunuz?

APPENDIX G

CASE-1: EVOLUTIONARY WEAKNESSES APPEAR BY TIME

Part-1: Is it a men problem?

Scenario: Early in the morning, at home.

Mr. Mehmet Saruhan woke up early at 5:30 as he always does three times even more a week. He sometimes thinks of going back to the bed and sleeping again but as he extremely cares about his health and exercising is a life style for him since high school years he always overcomes these deterrent thoughts. His grand girl Selin has benefited from this determined attitude of Mr.Saruhan several times when she has made an engagement for the morning exercises with his father but she feels tired to wake up early. Her father's energy always impresses her and gives inspiration to move. Mr. Saruhan stretched and then let his legs hang down the bed. He dressed and went outside. With his first step he felt a pain at his right groin. He made a face due to this pain. This was not the first time he felt this. He also recognized a bulge at this region a day before. 'Can this be a sign of hernia?' he thought. Although he cares about his health a lot, he does not like visiting doctors. But this time he decided to visit a doctor as soon as possible. While walking towards the track they used to go jogging with his friends he remembered that one of his friends in the group was a doctor. 'I may talk about this situation with Rıdvan' he thought.

He turned the corner fast by ignoring the previous pain he felt and saw his friends on the track.

'Good morning everybody.'

'Good morning Mehmet ' they replied together.

'You are late today" said Haldun Abi 'I think you are getting older'.

He is the oldest member of the group this is why they call him as Haldun Abi and do not take offense due to his jokes.

'I don't think so' replied Mehmet with a smiling face, 'I feel 18 mentally'. 'But you may be right Haldunl Abi, sometimes your body may not follow your brain. This is what happened to me this morning'.

'Ooo, you are accepting that you are getting older, are you?' said Adil.

'No, off course not! But sometimes you may need to grease your machine'.

'Is there a problem?' asked Mustafa.

‘I don’t know really but I feel pain in my groin and I recognized swelling’.

‘Do you have infection? ’asked Haldun Abi.

‘No, I don’t think so’ said Mehmet.

‘Hey doc! Our speedy Mehmet has a problem,’ Adil called out to Rıdvan.

‘You should not force yourself and us that much’ answered Rıdvan by smiling, ‘We are elderly people and have to be careful about our hernia’.

Mr. Saruhan is one of the fastest runners among them. He likes to transcend his own limits. He is the person who generally motivates the group to walk more and to extend the jogging limits to the hillocks near.

‘Is it really hernia?’ asked Mehmet.

‘Possibly yes,’ said Rıdvan ‘But, I should examine’.

‘I have told you before, you are getting older." Haldun Abi whispered to Mehmet.

‘Is it always related with age?’ asked Mehmet.

‘Not necessarily there are many types. Some times babies may be born with hernia’ replied Rıdvan.

‘Why illnesses always find men?’ asked Mustafa as a feverish anti-feminist.

‘Although men are more prone to hernia it can be seen in but the type is different’ said Rıdvan. "But I am careful about not to lift heavy things and I am not over-weighted. Why did this happen to me" asked Mehmet.

‘It is not diagnosed Mehmet, don’t worry yet. Even if it is so, the treatment is easy and the outcome is usually good,’ replied Rıdvan ‘ but if it is so you should not force yourself too much and if you develop nausea, vomiting, or a fever with your hernia and/or if it becomes red, purple, dark, or discolored you should call your doctor immediately’.

The group continued to walk, making jokes about their age.

Discussion Questions:

1. Is there enough evidence to say that Mr. Saruhan's symptoms indicate a hernia? Which evidences you used? If there is not enough evidence, what other evidences you need to diagnose the hernia?

2. Consider the story and conclude about the factors that effect the development of a hernia. What other factors may be effective on hernia development?

3. Do you have enough evidence to diagnose the type of hernia Mr. Saruhan developed?

4. What is the relationship between age and hernia development? What type of information you need to explain the relationship between hernia and age?

5. Which conditions require immediate call for doctor? Why?

Part-2: Result of evolutionary weakness or life style?

Scenario-1: Waiting for children.

Two weeks later, Mr. Saruhan and his wife were in a hurry as they were expecting their children for the dinner. The bell rang, Mr. Saruhan opened the door. His girl Selin was the first to come. Mr.Saruhan hugged his girl 'You look refreshed Selin. How was the Black Sea?'. Selin was a biologist and making a research on genetics of endemic brown trout species of Turkey. Last week she traveled to the Black sea region to take samples.

'It was good dad. I will narrate. But will you help me? , I bought fish to eat but you should help me to lift, come, they are in the baggage' answered Selin while she was walking through the car. Mrs. Saruhan came to the door at that moment and prevented his husband to move towards the car. She moved to the car herself, hugged her girl and said:

'Welcome honey, I will help you. It is forbidden to your father to lift heavy things as doctor diagnosed his hernia last week'.

She quickly turned to his father looked at his face and tried to understand her fathers feelings as she knows how much her father hates being ill. She moved towards her father and hugged again and asked 'I am sorry dad, is it too bad?'.

'No, it is not. Don't worry. Go and bring my fish' he answered.

Scenario-2: Barbecue in the garden.

They made barbecue in the garden with the fish Selin brought from Black Sea. The whole family was again together.

'Do you know father, inguinal hernia-that was the diagnosis of the doctor for her father- is largely a human hazard, attributable to our two-legged stance, which places much strain on the lower abdomen. Such hernias are very infrequent in mammals that walk on four legs' said Selin then she realized that his father felt uncomfortable when he remained stand up for a long time. His little sister wondered and asked 'but what is the relationship between them? '.

'During the embryonic development, the testes form in the dorsal portion of the abdominal cavity from the same embryonic tissue that gives rise to the ovaries in females. Later, the testes descent about the time of birth from their points of origin into the scrotal sac. The cavity of this pouch is initially continues with the abdominal cavity via a passageway called the inguinal canal. Once the testes have descended through the inguinal canal into the scrotum, the canal slowly plugged by cell

division, so that the scrotal and abdominal cavities are no longer continuous' answered Selin.

'But, my doctor didn't mention any problem with the testes; instead, he said there was a rupture in the abdominal membrane and my intestine had bulged from the ruptured region' said his father.

'You are right dad. The problem is the bulging of the intestine, but I am trying to explain why intestine is bulging from this region' replied Selin. "Sometimes the inguinal canal fails to close properly; and even when it does, it remains a point of weakness and easily broken open again when subjected to excessive strain, as when a man lifts a heavy object. That's inguinal hernia is more common in men than women'' continued Selin.

'I see, that's why doctor asked me whether I have chronic cough and I am also able to understand now why he wants me to go to the bathroom as soon as I have the urge' said Mr. Saruhan and he remembered what Mustafa told about difference between males and females and laughed.

'Why did you laugh father?' asked his son Selim. He transferred what Mustafa said two weeks ago while tracking.

'This is not off course valid for all systems, but reproductive systems of the females are evolutionary more developed than male's system as there is an increased separation of the reproductive system from its ancestral dependence on excretory system' said Selin, but soon realizing that nobody understood what she had said.

'Let me explain more; for example urine and sperms are expelled from the same opening in males but there are two separate openings for the eggs and urine in females'.

'Iıııh, it is disgusting' made a face her little sister Esin.

Selin laughed at her sister and added 'don't worry there are some mechanisms that prevent mixing of sperms and urine'. 'Dad, I still hardly understand that how you developed a hernia as you are a fit person and exercising regularly' asked Selim. The answer came from her mother:

'Don't you know your father children? Your father must run fastest, must be the person who always walks the longest distance'.

'I got it. The evolution has not produced such a strong inguinal canal that can resist my father's speed' said Esin.

'Yes, you are right. I think you understood it very well' told her sister Selin. They laughed all together.

Discussion Questions:

1. Mr. Saruhan has no weight problem and he is exercising regularly. His job does not require lifting heavy objects and he is also careful about lifting techniques in his daily life. We know he is 59 years-old. What other factors might have been contributed to the development of inguinal hernia by Mr. Saruhan?

2. Evaluate why two-legged stance makes human males more prone to develop inguinal hernia than mammals that walk on four legs?

3. In some mammals inguinal canal remains partly open, and testes move back into the abdominal cavity during the non-reproductive season. Suggest an explanation about the possible reason(s) of this movement.

4. Suggest a possible treatment for a baby boy with undescended testicles. Discuss about the consequences if it remains untreated.

5. Is there any other structure(s) in male's reproductive system that use both inguinal canal and abdominal canal? What is/are the function(s) of these structure(s).

6. The urethra in the mammalian male is a common passageway used by both the excretory and reproductive systems; urine passes through it during excretion and semen passes through it during sexual activity. What are the mechanisms that prevent mixing of them? Explain whether females need a similar mechanism or not.

7. What would be the possible results of malfunctioning of prostate gland?

APPENDIX H

CASE-2: WHAT YOU ARE EATING AND WHAT YOU ARE THINKING DETERMINES WHO YOU ARE.

Scenario-1: Breakfast with Umut and Elif.

Umut is a medical doctor in one of the important state university hospitals. He married five years ago. His wife- Elif is a professional volleyball player. Last season her team finished the league as champion and Elif made the greatest contribution to this success as she is one of the important volleyball players not only in Turkey but in Europe. Elif exercised frequently and excessively last year with her team and she lost too much weight. This morning while having breakfast together, Elif informed Umut that she hasn't had her periods for four months. Umut excited, stood up and asked "Are you pregnant!".

"No, unfortunately I am not. I applied many home pregnancy tests since then and each gave negative result" said silently Elif.

She has just wanted to make a surprise but she is very sad instead, because she knows how much her husband wants a baby.

"You know these tests are really reliable nowadays" added Elif.

Umut was worried about this condition and offended by her not telling him before. They were not using any birth control methods since they decided to have a baby six months ago.

"You exercised extensively and lost too much weight last season. You also were under severe stress, you know. Stress might have also triggered your weight loss" said Umut. He was a little bit angry with his wife.

Elif looked at his face and asked "But, this is my job. I have to practice to be successful".

"You are right honey but, you should learn to deal with stress. Remember how you were excited before matches especially before important ones".

Elif thought that her husband was right. This has been her handicap since she knew herself.

"Honey, you know, you don't like eating and you are not careful about what you are eating" added Umut.

"But, I don't understand. I used to have a regular menstrual period up to last four months. May all these things cause such a problem?" asked Elif.

"I am not a gynecologist; but, I guess it is secondary amenorrhea" replied Umut.

"What is it, is it serious?" asked Elif.

"The causes of secondary amenorrhea may vary but I think it is exercise-associated amenorrhea. Among non-pregnant women, ovarian conditions are the most common cause of secondary amenorrhea; these conditions include polycystic ovary syndrome (PCOS) and ovarian failure that is early menopause. Functional hypothalamic amenorrhea is also a common cause of secondary amenorrhea. Prolactin-secreting pituitary tumors are another common cause of secondary amenorrhea" answered Umut.

"What, tumors" screamed Elif?'

Umut hugged his wife and told her: "that's what I really intended to say while I was talking about dealing with stress. Don't worry I think it is functional hypothalamic amenorrhea".

Umut called one of his gynecologist friends and made an appointment for the next day.

Discussion Questions:

1. What is your understanding of problem of Elif?

2. What was Umut's opinion about his wife's problem? Which criteria did he use to guess the possible diagnosis?

3. Make a brief search about contribution of Elif's life style to her problem?

4. What other possible reasons of secondary amenorrhea are there in the text? Try to guess why Umut did not take these possible causes into consideration?

5. If there is secondary amenorrhea, there must be a primary amenorrhea. What are the differences between primary and secondary amenorrhea? Decide whether Elif's problem is primary or secondary amenorrhea. Which criteria did you use to define Elif's problem?

Scenario-2: In the clinician office.

Elif and Umut were inside the clinician office. The clinician Ezgi is one of the friends of Umut. She asked some questions about growth and sexual development of Elif. Ezgi wanted to learn how her health was during infancy and childhood, and her sexual development during puberty. She also asked some questions about the Elif's family growth and puberty patterns.

Clinician: When did your first menstrual period start and how frequently periods have occurred since then Elif?

Elif: "I was 15 years-old and now I am 28. I used to have 30-days-menstrual periods up to last four months."

Clinician: "Is there any discharge from your breasts"'

Elif: "No, there is not."

Clinician: "Did you ever experience hot flashes."

Elif: "No, I did not."

Clinician examined masculine features to see any sign for polycystic ovary syndrome. She asked for headaches or impaired vision. The results were all negative. The clinician also asked about any medications, herbs, and vitamins used, recent stress, recent gynecologic procedures and events, changes in weight, diet, or exercise patterns, and any illnesses. Elif was not taking any medications, herbs and vitamins etc. She has reported no gynecologic procedures and events and any illnesses. She expressed her life style and explained how much weight she lost last year.

Later clinician examines the Elif's reproductive tract anatomy by pelvic ultrasound.

Clinician: "The anatomy is normal. I did not detect any embryonic sac but to be sure, I will order a hormone test for pregnancy. No need for further scanning process like MRI to determine if there are hypothalamic or pituitary gland abnormalities as there is no sign for tumor. But I want to see the blood hormone levels as a change in the normal pattern of GnRH secretion may result in disruption of ovulation and amenorrhea. All things seem normal except excess exercising and loss of weight. Your menstrual disorder is most probably due to the functional hypothalamic amenorrhea, Elif."

A few days later clinician called for results. "Blood sample results confirmed my diagnosis Elif, it is functional hypothalamic amenorrhea" said Ezgi.

Elif: "What should I do now, Ezgi?"

Clinician: "The treatment is easy. I will see you tomorrow at 2:30, do you agree?"

Elif: "I will be there."

Clinician: "See you then."

Elif: "See you, bye."

Discussion Questions:

1. Outline the approach that the clinician used while evaluating the Elif's problem.

2. What does normal reproductive anatomy mean? How does a normal female anatomy look like?

3. Is a 30-days menstrual period normal? Most women feel uncomfortable during their menstruation period. Can you consider lack of menstruation as an advantage for women? Why is it seen as a problem in this text?

4. Suppose that Elif and Umut were using calendar method-also called as natural family planning before deciding to have a baby. **Make a calendar as a guide to help them to track Elif's ovulation (suppose that today is the last day of Elif's menstrual period and use imaginary data to track the day of ovulation).**

5. Clinician ordered a blood test to determine the presence of pregnancy. **What is the basis of this procedure?**

6. The secretion of GnRH is difficult to assess in the human because it is rapidly metabolized within 2 to 4 minutes in blood circulation. Thus, it is not possible to directly assess GnRH secretion, and the majority of clinical investigations utilize measurements of LH concentrations as a marker for hypothalamic GnRH secretion. In women with regular menstrual cycles, clinical studies have demonstrated a characteristic secretion of LH during the follicular phase and the luteal phase. Small alterations in LH can result in a range of disorders including luteal phase defects, oligo-ovulation and anovulation. Thus, most studies have examined for changes in LH as the major endpoint in studies to investigate functional hypothalamic amenorrhea.

What is the relationship between GnRH and LH secretion, why LH is used as a marker to determine the GnRH secretion? What can be the possible alterations in blood LH level of Elif?

7. Which alternatives were eliminated as possible reasons for lack of menstrual period? Why did clinician eliminate these alternative causes?

Scenario-3: Second time in the clinician office.

"I don't believe that exercising cause such a problem" said Elif; she was in Ezgi's office.

"Although exercise offers wonderful health benefits, exercising frequently or excessively can lead to amenorrhea and infertility. Studies suggest that amenorrhea develops when a woman's caloric intake is less than she burns with exercise and other daily activities, or when a woman's percentage of body fat drops below a critical level. Most women with amenorrhea associated with exercise have also lost weight, as it is in your case" explained Ezgi.

"Is it possible to cure this?" asked Elif.

Ezgi tried to look quite relaxed while answering this question as she informed by Umut that Elif's stress level was quite high. "Women who have functional hypothalamic amenorrhea may resume having normal menstrual periods with certain lifestyle changes."

"What kind of changes are you talking about?"

"I have talked with a dietician and made an appointment for you. You will prepare a diet that is suitable for your life style. By this way, we will increase caloric and/or fat intake so you will gain weight. You should also reduce the intensity or frequency of exercise. Another important thing is to resolve emotional stress. This will be your home work or if you want I can recommend you a psychologist."

"I think I can deal with stress by my self as I know my problem right now. If I couldn't I will ask for help."

"Okay, it's up to you. Clinicians usually recommend a hormonal contraceptive such as a birth control pill for women with amenorrhea who do not wish to cut back on exercise or increase caloric intake. I think we agree on decreasing the intensity of exercise and increasing caloric intake, don't we?"

"Yes, I will talk with my coach again but he already knows that we want a baby"'

"So, I will not recommend you a hormonal medication to minimize bone loss and to allow you to get pregnant. Instead, you will take a1500 mg of calcium daily and a vitamin D supplement that is 400 IU daily. These measures are particularly important if a woman is trying to become pregnant. I have already informed your dietician about these supplements."

"Thank you Ezgi."

"It's my job. You don't need to thank. I will see you a month later again."

"Okay, I will call you for an appointment. See you later."

"See you later, bye."

Discussion Questions:

1. It is known that low body weight and/or nutritional deficiencies are among the causes of functional hypothalamic amenorrhea. Women with eating disorders such as anorexia nervosa or bulimia often need specialized care. This usually includes nutrition counseling and work with eating disorder specialists. **Discuss why eating disorders and intensive exercising result in functional hypothalamic amenorrhea?**

2. What are the reasons that clinician did not recommend Elif contraceptive pills? What could be the possible results of using these pills for Elif? Do you think that using such pills would be suitable for Elif, explain your reasons? Discuss the possible risks.

3. Outline the treatment that is proposed by clinician. Explain why clinician recommended Elif to use daily supplement of calcium and vitamin D?

4. Birth control pills contain estrogen and progesterone and can replace ovarian hormones. **Although pills contain ovarian hormones, why hormone replacement therapy can not restore the egg production in ovaries?**

APPENDIX I

TEACHERS' GUIDE FOR CASE BASED TEACHING

Cases are curriculum materials that engage students in higher order mental processing, requiring their reflection on the substantive issues in the curriculum. Although case method teaching varies, certain conditions in form and style must be present:

1. Cases: **Cases are used as instructional tools in this method. Cases include information and data that appear in the form of narratives. Good cases are drawn around problems or big ideas that are usually constructed from real-life problems confronting real people.**

2. Study Questions: **At the end of each case, there is a list of study questions. These questions require students to examine ideas of consequence, concepts and issues relevant to the case. Study questions call for students to apply what they know in analyzing data and proposing solutions.**

3. Small Group Work: **Students discuss their responses to the study questions in small study groups. Study group sessions may be arranged as out-of-class assignments or they may take place during class. Students have opportunities to discuss the cases and questions with each other prior to the whole-class discussions. Small group sessions give students their first chance at examining the issues.**

4. Whole-Class Discussion (Debriefing a case): **Whole class discussion enables students to bring sharper analysis of the case. They work together toward deeper insights.**

Teacher's ability to lead a class discussion is extremely important here. Debriefing requires skill in listening to and comprehending students' meanings. Teacher should orchestrating the discussion so that all students feel safe to volunteer their ideas, so that all students' ideas are respected; keeping the discussion on 'track', so that it does not go off course by students' introduction of personal anecdotes and unrelated issues.

5. Follow-up Activities: **If a case drives students' interest, they want to find more data. A list of follow-up activities may be given after the whole-class discussion session.**

Textbooks, articles from newspapers and magazines, tables and charts with primary data, research reports, and documentary films are vital sources of

information and offer opportunities to learn more. Follow-up activities may be carried out by individual students or in groups. What ever follow-up activities are used, their value is enhanced by further debriefing-like discussions, in which issues get extended examination and new perspectives are introduced.

Suggestions for Teachers while teaching with cases:

You may wish to use this framework, shown below, as a way to think about what you might ask students to do as they work with cases.

I. Problem posing: analyzing a case

A. Introduce the case:

Students see the case for the first time in class and read it together or the case may be given as home study and students become familiar with the case and discussion questions before coming to the class.

B. Recognize potential issues and major topics: Carry out a brief large-group discussion identifying the content of the case.

C. Pose specific questions via Know/Need to Know analysis:

Introduce collaborative small group (4-5 students) discussion to make students to identify prior knowledge and outstanding questions. Want them make a 'what do we know/ what should we know chart.

What do we know?	What should we know?

II. Problem-solving: investigating the questions

A. Provide additional references/resources:

These may be supplied or students can search by themselves.

B. Let them to define problems further by sharing views and concerns:

Start a whole-class discussion session. Students discuss what they've learned and refine their questions.

III. Peer persuasion: supporting methods and reasoning

A. Ask them to produce materials that support understanding of the conclusions:

Want them to produce materials like posters, videos, consulting reports, graphics, power point presentations, newspaper stories or editorials, or new case studies that show understanding of conclusions.

B. Evaluate what was learned:

It is important to evaluate both process and subject matter content. Did students reorganize their material, did they manage information appropriately, and did they work well in groups?

Don’t be afraid to give explicit directions, such as:

- “We begin by having one person read the case aloud. Who would like to do this?”
- “Are there any words don’t know?”
- “What you think this case is about?”
- “It will help you later if one you acts scribe and writes down the ideas on the chalkboard. You might want to keep track of facts, questions, issues, and proposed answers to the problem.”
- “We have 10 minutes left and you need to plan for next meeting. What do you see key issues you’d like to work on?”
- "Don't interrupt one another"
- "Don't attack people personally, focus on ideas"
- "Each person must contribute to the group. There are many ways to do this."

APPENDIX J

LESSON PLAN FOR CASE-1

Case-1: Evolutionary Weaknesses Appear By Time

Lesson 1: 45 minutes
1. Explain case based learning (15 min.)
2. Arrange class for small group discussion and make groups of size 4 to 5 students. (5 min.)
3. Let them to read guide for students. (10 min)
4. Give part-1 of the case-1; let them to read the case in their groups.(10 min)
5. Want students make 'what do we know/what should we know' chart to determine their learning goals for the next lesson.(5 min.)

Lesson 2: 45 minutes
1. Let them to share their answers to the questions they stated together in previous lesson while constructing 'what do we know/what should we know' chart and to discussion questions in their small group discussion session.
2. Provide them materials to research more about the questions that remained unclear and need further information.
3. Let a student be the speaker of the group and start a whole-class discussion session.

Lesson 3: 45 minutes.
1. Give the part 2 of the case. Want one of the students read the case loudly.(10 min)
3. Want them to make a 'what we know/ what should we know' chart to determine the group's learning goals.(10 min)
4. Ask them to research for both group's learning goals and discussion questions by providing materials.(30 min)

Lesson 4: 45 minutes.
1. Let the groups study their learning goals and discussion questions for 10 minutes.(5 min)
2. Want each group write and discuss their common idea for both discussion questions and their own questions.(10 min)
3. Let a student be the speaker of the group and start a whole-class discussion session. (20 min)
4. Give students the learning goals of the case 1.(5 min)
5. Give them peer evaluation form to be completed for all members of their groups.(5 min)

APPENDIX K

LESSON PLAN FOR CASE-2

CASE-2: What you are eating and what you are thinking determines who you are.

Lesson 1: 45 minutes
1. Give scenario-1 of the case-2; let them to read the case in their small groups.(10 min)
2. Want students make 'what do we know/what should we know' chart.(5 min.)
3. Ask them to research for both group's learning goals and discussion questions by providing materials.(20 min)
4. Let them to discuss their answers to the questions they stated together while constructing 'what do we know/what should we know' chart and to discussion questions given after case in their small groups. (10 min)

Lesson 2: 45 minutes
1. Let a student be the speaker of the group and start a whole-class discussion session.(25 min)
2. Give scenario-2 of the case-2; let them to read the case in their small groups.(10 min)
3. Want students make 'what do we know/what should we know' chart.(8 min.)
4. Ask them to make a brief search to reach their learning goals and answers to the discussion questions.(2 min)

Lesson 3: 45 minutes
1. Ask them to share their own materials with the group. (5 min)
2. If they need, let them to research more to reach group's learning goals and to answer discussion questions by providing them materials.(15 min)
3. Let them to discuss their answers to the questions in their small groups. (5 min)
4. Let a student be the speaker of the group and start a whole-class discussion session.(20 min)

Lesson 4: 45 minutes
1. Give scenario-3 of the case-2; let them to read the case in their small groups.(10 min)
2. Want students make 'what do we know/what should we know' chart.(10 min.)
3. Ask them to research for both group's learning goals and discussion questions by providing materials.(20 min)

Lesson 5: 45 minutes.

1. Let the groups study on their learning goals and discussion questions for 10 minutes.(10 min)
2. Want each group write their common idea on the questions posed by both discussion questions and their own questions.
3. Let a student be the speaker of the group and start a whole class discussion session.
4. Give students the learning goals of the case 1.
5. Give them peer evaluation form to be completed for all members of their groups.

APPENDIX L

STUDENTS' GUIDE FOR CASE BASED TEACHING

Cases are curriculum materials that engage students in higher order mental processing, requiring their reflection on the substantive issues in the curriculum. Although case method teaching varies, certain conditions in form and style must be present:

1. Cases: **Cases are used as instructional tools in this method. Cases include information and data that appear in the form of narratives. Good cases are drawn around problems or big ideas that are usually constructed from real-life problems confronting real people.**

2. Study Questions: **At the end of each case, there is a list of study questions. These questions require students to examine ideas of consequence, concepts and issues relevant to the case. Study questions call for students to apply what they know in analyzing data and proposing solutions.**

3. Small Group Work: **Students discuss their responses to the study questions in small study groups. Study group sessions may be arranged as out-of-class assignments or they may take place during class. Students have opportunities to discuss the cases and questions with each other prior to the whole-class discussions. Small group sessions give students their first chance at examining the issues.**

4. Whole-Class Discussion (Debriefing a case): **Whole class discussion enables students to bring sharper analysis of the case. They work together toward deeper insights.**

5. Follow-up Activities: **If a case drives students' interest, they want to find more data. A list of follow-up activities may be given after the whole-class discussion session. Follow-up activities may be carried out by individual students or in groups.**

STUDENT NOTES FOR USING CASES

Educational approaches are constantly revised. The case study approach is a method of providing students with an opportunity to use stories of people dealing with science-based issues (i.e., the cases) as a way to structure their own learning.

This approach to learning biology may feel awkward at first since it is different from more highly structured ways to learn. You will find yourself posing problems, trying to solve them, and presenting conclusions that represent your

own findings to others. Your instructors as well as your classmates are collaborators in this process.

You may find yourself working in a group. This is an excellent way to begin exploring biology since scientific investigations necessarily involve similar group dynamics. While discussing the case in small groups or in whole-class sessions try to be careful about the following things:

-'Don't interrupt one another'

-'Don't attack people personally, focus on ideas'

-'Each person must contribute to the group'

Even if you are not planning on becoming a scientist yourself, it is nevertheless essential for you to develop a familiarity about the way scientists work in order to better understand biological issues that affect you as a global citizen. Here are some useful tips for you:

1. Read the case.

2. Recognize potential issues :

- Go back and read the case again, this time noting words or phrases that seem to be important to you in understanding what the case is about.
- Note your ideas and questions about these phrases.
- If you are working in a group, one person may keep a list of issues (maybe on the chalkboard)
- Make a 'what we do know/ what should we know chart.

What do we know?	What should we know?

3. Brainstorm for connections

- Think about the case as a whole and see if there are underlying themes.
- List questions you have as a result of reading the case.

4. Pose specific questions

- Brainstorming can lead to a long list of questions, not all of which you or your group (or your teacher) may choose to pursue. Spend time as a group identifying key issues of interest.

5. Obtain additional references/resources

- You will seek and use other resources to help you develop a persuasive answer.

- Resources may include your textbooks; other library materials; results of computer simulations; results of lab or field research; articles, data sets, maps, emails, or other electronically based resources; pamphlets from organizations; interviews with experts; museum exhibits, etc.

6. Define the problem further by sharing your views and concerns

- Consult with others: members of your group or other classmates. Talking about your ideas and plans with others is an important step in refining problems, and can lead you to different perspectives that might be good research problems.

- Continue this practice of sharing with others as you gather evidence in answer to your problem, and as you prepare to present your conclusions.

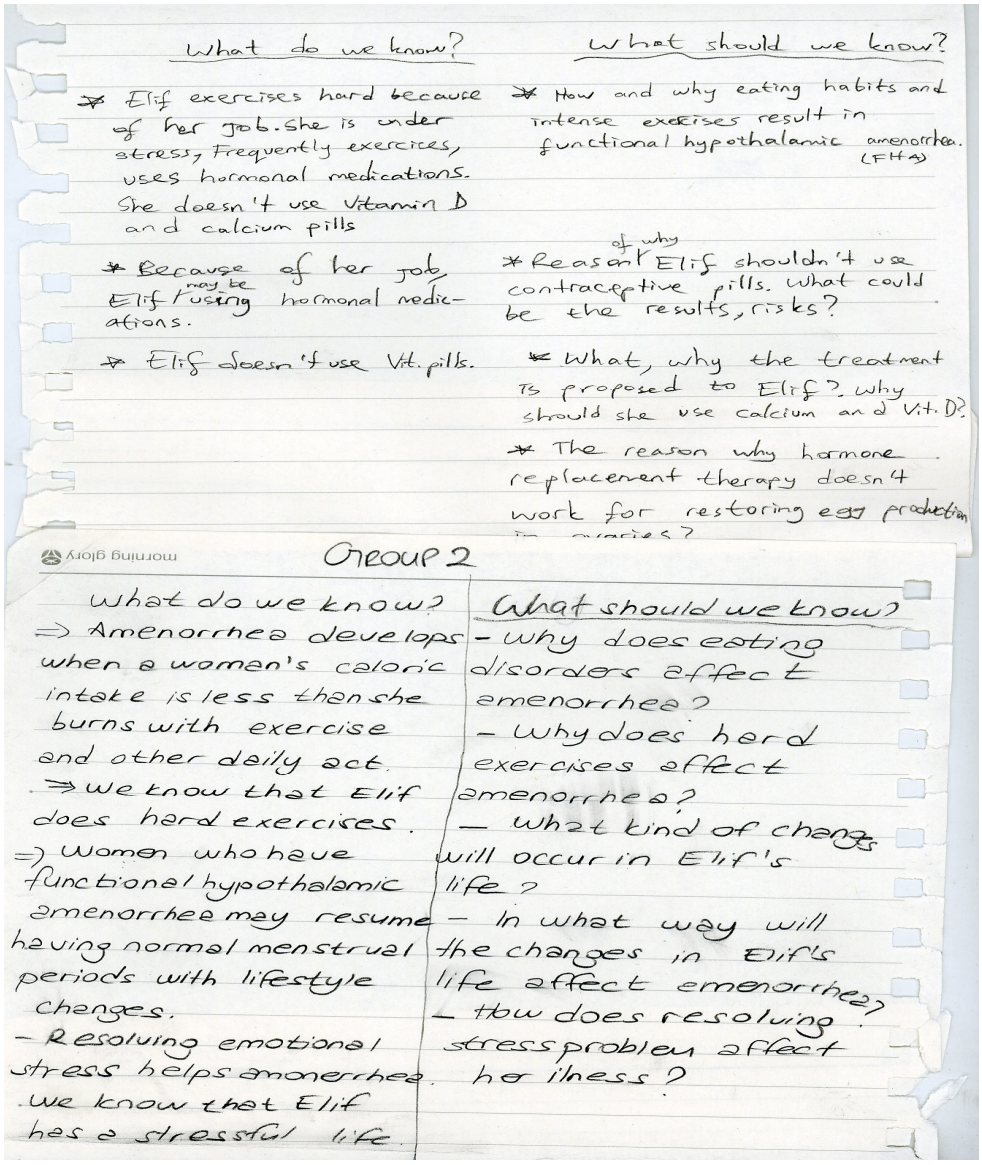
7. How to end?

- Develop analyses/reports to persuade others of your ideas.

- Produce materials that support understanding of the conclusions you are making.The possibilities are vast: posters, poetry, plays, videos, booklets, pamphlets, consulting reports (if you are role playing), artwork, designs for new technology, scientific reports, power point presentations, a new case study, etc.

APPENDIX M

A SAMPLE FOR WHAT DO WE KNOW/ WHAT DO WE NEED TO KNOW CHART



What do we know?

* Elif exercises hard because of her job. She is under stress, Frequently exercices, uses hormonal medications. She doesn't use Vitamin D and calcium pills
* Because of her job, Elif may be using hormonal medications.
* Elif doesn't use Vit. pills.

What should we know?

* How and why eating habits and intense exercises result in functional hypothalamic amenorrhea. (FHA)
* Reason of why Elif shouldn't use contraceptive pills. What could be the results, risks?
* What, why the treatment is proposed to Elif? Why should she use calcium and Vit. D?
* The reason why hormone replacement therapy doesn't work for restoring egg production in ovaries?

morning glory

GROUP 2

What do we know?

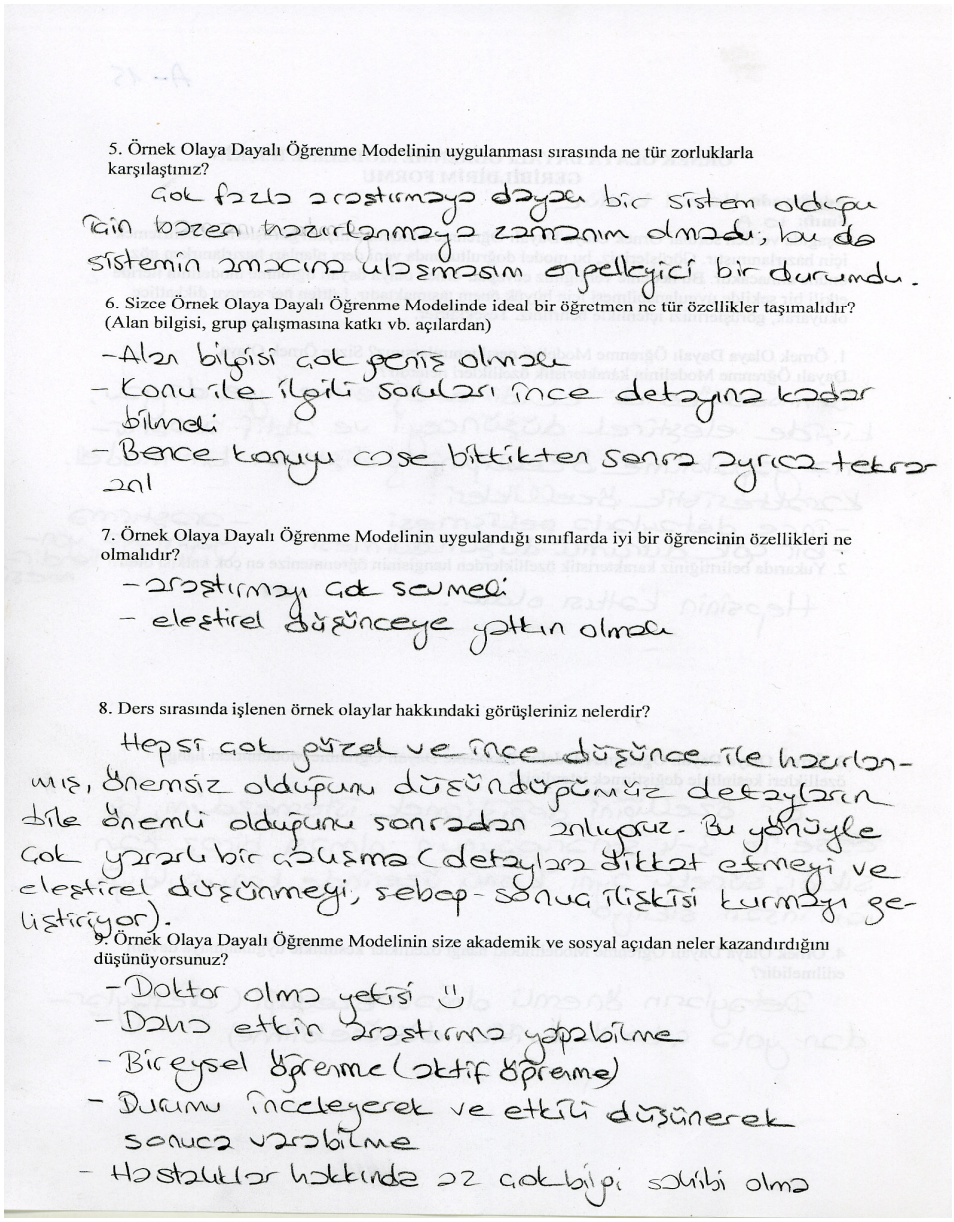
=> Amenorrhea develops when a women's caloric intake is less than she burns with exercise and other daily act.
=> We know that Elif does hard exercises.
=> Women who have functional hypothalamic amenorrhee may resume having normal menstrual periods with lifestyle changes.
- Resoluing emotional stress helps amenorrhee.
We know that Elif has a stressful life.

What should we know?

- Why does eating disorders effect amenorrhee?
- Why does hard exercises effect amenorrhea?
- What kind of changes will occur in Elif's life?
- In what way will the changes in Elif's life affect amenorrhee?
- How does resoluing stress problem affect her illness?

APPENDIX N

A SAMLE FOR STUDENTS' OPINIONS ABOUT CASE BASED LEARNING



5. Örnek Olaya Dayalı Öğrenme Modelinin uygulanması sırasında ne tür zorluklarla karşılaştınız?

Çok fazla araştırmaya dayalı bir sistem olduğu için bazen hazırlanmaya zamanım olmadı, bu da sistemin amacına ulaşmasını engelleyici bir durumdu.

6. Sizce Örnek Olaya Dayalı Öğrenme Modelinde ideal bir öğretmen ne tür özellikler taşımalıdır? (Alan bilgisi, grup çalışmasına katkı vb. açılardan)

- Alan bilgisi çok geniş olmalı
- Konu ile ilgili soruları ince detayına kadar bilmeli
- Bence konuyu case bittikten sonra ayrıca tekrar anl

7. Örnek Olaya Dayalı Öğrenme Modelinin uygulandığı sınıflarda iyi bir öğrencinin özellikleri ne olmalıdır?

- Araştırmayı çok sevmeli
- eleştirel düşünceye yatkın olmalı

8. Ders sırasında işlenen örnek olaylar hakkındaki görüşleriniz nelerdir?

Hepsi çok güzel ve ince düşünce ile hazırlanmış, önemsiz olduğunu düşündüğümüz detayların bile önemli olduğunu sonradan anlıyoruz. Bu yönüyle çok yararlı bir çalışma (detaylara dikkat etmeyi ve eleştirel düşünmeyi, sebep-sonuç ilişkisi kurmayı geliştiriyor).

9. Örnek Olaya Dayalı Öğrenme Modelinin size akademik ve sosyal açıdan neler kazandırdığını düşünüyorsunuz?

- Doktor olma yetisi ☺
- Daha etkin araştırma yapabilme
- Bireysel öğrenme (aktif öğrenme)
- Durumu inceleyerek ve etkili düşünerek sonuca varabilme
- Hastalıklar hakkında az çok bilgi sahibi olma