METHOD-APPROACH INTERACTION: THE EFFECTS OF LEARNING CYCLE VS TRADITIONAL AND CONTEXTUAL VS NON-CONTEXTUAL INSTRUCTION ON 11TH GRADE STUDENTS' ACHIEVEMENT IN AND ATTITUDES TOWARDS PHYSICS

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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

METHOD-APPROACH INTERACTION: THE EFFECTS OF LEARNING CYCLE VS TRADITIONAL AND CONTEXTUAL VS NON-CONTEXTUAL INSTRUCTION ON 11TH GRADE STUDENTS' ACHIEVEMENT IN AND ATTITUDES TOWARDS PHYSICS

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The main purpose of the study was to explore how learning cycle and traditional method as teaching methods contribute to the effect of contextual approach on 11th grade students' achievement in "impulse and momentum", and attitude towards physics. Therefore, a distinction between teaching approach (contextual vs. non-contextual) and teaching method (learning cycle vs. traditional method) was made and they were used as independent variables. Students' gender was also used as an independent variable. Thus, the study was a 2x2x2 factorial design. The sample, drawn through the purposive sampling, included 226 students. Pretests and posttests were used for assessing students' achievement in impulse and momentum, and attitude towards physics. Using Multivariate Analysis of Covariance (MANCOVA), the main effects of contextual approach, learning cycle, and student gender as well as the interaction effects among them were investigated. Consequently, (1) contextual approach was more effective in supporting students' conceptual understanding of impulse and momentum, (2) learning cycle was as effective as the traditional method, (3) gender related difference in attitude towards physics in favor of males could not be removed through the treatments, (4) contextual approach worked better with the traditional method than the learning cycle for achievement and attitude, (5) males benefitted a little more from learning cycle while females benefitted a little more from traditional method in terms of conceptual and non-conceptual scores.

Keywords: context-based approach, contextual approach, contextual learning, physics education, impulse and momentum, attitude and motivation towards physics

ÖZ

YÖNTEM-YAKLAŞIM ETKİLEŞİMİ: ÖĞRENME DÖNGÜSÜNE KARŞI GELENEKSEL VE BAĞLAM TEMELLİYE KARŞI BAĞLAMSIZ ÖĞRETİMLERİN 11. SINIF ÖĞRENCİLERİNİN FİZİKTEKİ BAŞARI VE TUTUMLARINA ETKİLERİ

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Çalışmanın esas amacı bağlam temelli yaklaşımın 11. sınıf öğrencilerinin itme ve momentum konusundaki başarıları ve fiziğe karşı tutumları üzerindeki etkisine öğretim yöntemleri olarak öğrenme döngüsü ve geleneksel yöntemin nasıl katkı sağladıklarını araştırmaktı. Bundan dolayı öğretim yaklaşımı (bağlam temelli yaklaşım bağlamsız yaklaşıma karşı) ve öğretim yöntemi (öğrenme döngüsü geleneksel yönteme karşı) arasında bir ayrım yapıldı ve bağımsız değişken olarak kullanıldılar. Öğrenci cinsiyeti de bir bağımsız değişken olarak kullanıldı. Dolayısıyla çalışma 2x2x2 faktöriyel desenliydi. Amaçlı örnekleme yoluyla elde edilen örneklem 226 öğrenci içerdi. Öğrencilerin itme ve momentum konusundaki başarıları ile fiziğe karşı tutumlarını ölçmek amacıyla ön ve son testler kullanıldı. Ortak Dağılımın Çok Değişkenli Analizi (MANCOVA) kullanılarak bağlam-temelli yaklaşımın, öğrenme döngüsünün ve öğrenci cinsiyetinin ana etkileri ve bunlar arasındaki etkileşim etkileri incelendi. Sonuç olarak, (1) öğrencilerin itme ve momentum konusundaki kavramsal anlamalarını desteklemede bağlam temelli yaklaşım daha fazla etkiliydi, (2) öğrenme döngüsü geleneksel yöntem kadar etkiliydi, (3) erkeklerin lehine olan cinsiyete bağlı fiziğe karşı tutumdaki farklılık uygulamalarla giderilemedi, (4) bağlam temelli yaklaşım başarı ve tutum açısından öğrenme döngüsünden ziyade geleneksel yöntemle daha çok işe yaradı, (5) kavramsal ve kavramsal olmayan puanlar bakımından kızlar geleneksel yöntemden daha fazla yararlanırken erkekler öğrenme döngüsünden daha fazla yararlandılar.

Anahtar Kelimeler: bağlam temelli yaklaşım, bağlama dayalı yaklaşım, yaşam temelli yaklaşım, fizik eğitim, itme ve momentum, fiziğe karşı tutum ve güdü

To my family

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LIST OF ABBREVIATIONS

ACQ: Affective Characteristics Scale

IMAT: Impulse and Momentum Achievement Test

MANCOVA: Multivariate Analysis of Covariance

ANCOVA: Analysis of Covariance

CHAPTER 1

INTRODUCTION

Providing students with deep conceptual understanding of physics concepts, developing their problem-solving skills, and supporting their motivation in physics are major goals of physics instruction. However, traditional instruction succeeds these goals partially; leaving most students confused basic physics concepts, leading them to use poor problem-solving skills, and causing poorly motivated students (Taasoobshirazi & Carr, 2008).

Realizing the inadequacies of traditional methods on students' possible gains from the instructions, researchers proposed alternative teaching methods and explored their effectiveness on students' achievement and motivation. For example, Hake (1998) investigated how effective the interactive-engagement methods are with respect to the traditional method on students' conceptual understanding of physics. Teaching methods which are designed for promoting conceptual understanding through the use of heads-on (always) and hands-on (usually) activities (Hake, 1998) are classified as interactive-engagement methods. Researcher used data obtained from 62 introductory physics courses and 6542 students in the United States. Consequently, the researcher reported the interactive-engagement methods to be significantly better in promoting students' conceptual understanding.

Besides the efforts on developing and testing the effectiveness of alternative teaching methods, researchers initiated curriculum reform movements across a number of countries. Approximately for two decades, one of the most important trends in science curriculum is to use contexts as tools for helping students understand scientific concepts, such as the Victorian Certificate of Education (VCE) in Australia, the PLON project in the Netherlands, the Large Context Problems (LCP) in Canada, the applications-led approach in Scotland, Event Centered Learning in Brazil and in the UK, and more recently in the UK, Supported Learning in Physics Project (SLIPP). (Bennett, Lubben, & Hogarth, 2007; Wilkinson, 1999). Turkey has also been following a similar trend and physics curricula for secondary schools, emphasizing the use of contextual approach, have been developed and started to be administered by the Ministry of National Education since 2008.

In general science education, particularly physics education faces some serious issues, such as, content overload, lack of transfer, inability to relate the concepts to real-life situations, inability to recognize the significance of the content to be learnt, and inadequate scientific literacy (Gilbert, 2006; Bennet et al., 2007; Whitelegg & Parry, 1999). Context-based instruction is hoped to be able to overcome most of these issues. First, students' attitude and motivation is expected to be increased through relating the content to real-life situations. Then, promoted attitude and motivation is expected to improve learning (Bennet et al., 2007). That is, if students are interested and motivated in what they are doing in the class, this engagement may improve their learning of science.

1.1 Rationale and Significance of the Study

There are different definitions and use of context based instruction in the related literature. What context based instruction means can be synthesized based on the related literature as follows: Context-based instruction is a type of instruction in which students acquire the new content in a real-life context surrounding the content in a way that the content is derived from the context (i.e. Bennett et al., 2007; Gilbert, 2006; Whitelegg & Parry, 1999).

Taasoobshirazi and Carr (2008) reviewed context-based physics related research studies in order to determine whether there is enough evidence for suggesting teachers to use context-based instruction or assessment in physics classes. They selected the studies that evaluated the effectiveness of context-based physics instruction or assessment on students' motivation, problem solving, or achievement. For the purpose of their study, the researchers defined the context-based physics as integrating physics concepts or process skills in real-life contexts as defined by Glynn and Koballa (2005, p. 75 as cited in Taasoobshirazi & Carr, 2008). After a systematic search, the researchers held ten studies and broke them into two types. The first type included the studies having evaluated the effectiveness of context-based assessment with respect to traditional assessment. However, in this type, both groups (context-based and traditional assessment) were taught with traditional instruction. The second type included studies having evaluated the effectiveness of context-based physics instruction with respect to traditional instruction.

Associated with the efficacy of context-based assessment, the review by Taasoobshirazi and Carr (2008) revealed that there was no enough evidence that context-based assessment either work or does not work to improve achievement. Therefore, the researchers suggested conducting more and better designed studies exploring the effectiveness of context-based assessment.

Associated with the efficacy of context-based physics instruction, the researchers stated that it was again difficult to draw conclusions because of little or poorly designed research studies. They said that there was evidence that context-based physics instruction improves students' conceptually based problem solving. However, it was difficult to interpret the results because group work, which is not included in traditional method, was used with context-based instruction. Major methodological flaws in the studies the researchers reviewed included a lack of pretest, control group, or random assignment.

In short, Taasoobshirazi and Carr (2008) suggested conducting better designed research studies for evaluating the efficacy of context-based instruction as accurately as possible because research evidence supporting recommendations that teachers should use context-based physics assessment or instruction was insufficient.

Similarly Bennett et al. (2007) also reviewed experimental studies about science instruction with contextual approach. The studies were categorized as medium, medium high and high quality, mainly according to methodological issues (i.e. if control and experimental groups included similarity in size, gender balance, performance on external tests, if there are pre-tests, etc.). Afterwards, 17 studies, which are medium high or high quality, were decided to be evaluated for drawing a conclusion about how effective the context-based instruction is. The researchers concluded that context-based instruction was effective in terms of attitude and motivation, and was as effective as the traditional instructions in terms of science achievement. Furthermore, a methodological problem related to assessment of learning was reported. Using contextual problems for assessing science learning was in favor of experimental groups in which contextual approach was implemented whereas using traditional problems was in favor of control groups. It was also emphasized that non-traditional teaching activities had accompanied implementation of the context-based instructions and it was difficult to decide if the results should have been attributed to the context-based approach or the teaching activities accompanying it.

Consequently, some methodological issues pertaining to the studies about the effectiveness of context based instruction are reported in the related literature. Thus, better-designed experimental studies exploring the effectiveness of the context-based instruction are suggested. Second, because non-traditional teaching activities were included in implementations of the context based instruction, drawing obvious conclusions about the effectiveness of it was difficult. In addition, teaching approach and teaching method are different educational terms (Anthony, 1963, as cited in Richards, & Rodgers, 2001) even though this distinction has not been explicitly emphasized in science or physics education research. Taken together, this distinction is made in this study and contextual approach is differentiated from teaching methods for designing a better experimental study exploring the effectiveness of the contextual approach.

1.2 Purpose of the Study

The main purpose of the study was to disentangle the effects of teaching methods from those of the context-based approach in high school physics. Thus, a 2x2 factorial design was decided to perform. One of the independent variables was "teaching approach" with two levels, non-contextual and contextual approach. The other one was "teaching method" again with two levels, traditional method and the 5E learning cycle model. Why the traditional method and the learning cycle were selected as the teaching methods of this study is basically due to that they are obviously two distinct methods. Traditional method is a behaviorist and expository teaching method whereas the learning cycle is a constructivist and inquiry teaching method (Abraham, 1998; Flick, 1995). In addition, how an instructor should behave while teaching is explicitly stated in the learning cycle (Bass, Contant, & Carin, 2009, p. 118; Lawson, 1995, pp. 132-176) and this is one of the other reasons for selecting the learning cycle. Furthermore, gender was determined as another independent variable in order to evaluate if males and females are influenced by the treatments differently or not.

In short, taking students' gender into account, there were three independent variables, teaching approach (non-contextual vs. contextual), teaching method (traditional method vs. the learning cycle), and student gender. Thus, in line with the main problem, main effects of teaching approach, method, and gender on students' achievement, attitude, and motivation in physics, and interactions among them were investigated through this study. The interaction effects were going to reveal how the teaching methods would contribute to the effectiveness of context-based approach, how males and females would benefit from the contextual or non-contextual approaches, and how males and females would benefit from the learning cycle or traditional methods.

1.3 The main Problem

The main problem to which a response will be explored is as follows:

In what way the learning cycle and the traditional method as teaching methods contribute to the effect of context-based approach on 11^{th} grade science major public high school students' achievement in "impulse and momentum" and attitude towards physics?

1.3.1 Sub-problems

The sub-problems pertaining to this study are as follows:

1. What is the main effect of teaching approach (non-contextual vs. contextual approaches) on the population means of the combined dependent variables of 11^{th} grade science major students' posttest achievement scores in "impulse and momentum" and posttest attitude scores towards physics when students' GPA scores in the previous year's physics lesson and pretest attitude scores towards physics are controlled?
2. What is the main effect of teaching method (traditional method vs. 5E learning cycle) on the population means of the combined dependent variables of 11^{th} grade science major students' posttest achievement scores in "impulse and momentum" and posttest attitude scores towards physics when students' GPA scores in the previous year's physics lesson and pretest attitude scores towards physics are controlled?
3. What is the main effect of gender on the population means of the combined dependent variables of 11^{th} grade science major students' posttest achievement scores in "impulse and momentum" and posttest attitude scores towards physics when students' GPA scores in the previous year's physics lesson and pretest attitude scores towards physics are controlled?
4. What is the interaction effect between teaching approach and teaching method on the population means of the combined dependent variables of 11^{th} grade science major students' posttest achievement scores in "impulse and momentum" and posttest attitude scores towards physics when students' GPA scores in the previous year's physics lesson and pretest attitude scores towards physics are controlled?

5. What is the interaction effect between teaching approach and gender on the population means of the combined dependent variables of 11^{th} grade science major students' posttest achievement scores in "impulse and momentum" and posttest attitude scores towards physics when students' GPA scores in the previous year's physics lesson and pretest attitude scores towards physics are controlled?
6. What is the interaction effect between teaching method and gender on the population means of the combined dependent variables of 11^{th} grade science major students' posttest achievement scores in "impulse and momentum" and posttest attitude scores towards physics when students' GPA scores in the previous year's physics lesson and pretest attitude scores towards physics are controlled?

1.4 Null Hypotheses

In line with the sub-problems given in Chapter 1, the null hypotheses tested in the analysis are as follows:

1. There is no statistically significant main effect of teaching approach (non-contextual vs. contextual approaches) on the population means of the combined dependent variables of 11^{th} grade science major students' posttest achievement scores in "impulse and momentum" and posttest attitude scores towards physics when students' GPA scores in the previous year's physics lesson and pretest attitude scores towards physics are controlled?
2. There is no statistically significant main effect of teaching method (traditional method vs. 5E learning cycle) on the population means of the combined dependent variables of 11^{th} grade science major students' posttest achievement scores in "impulse and momentum" and posttest attitude scores towards physics when students' GPA scores in the previous year's physics lesson and pretest attitude scores towards physics are controlled?
3. There is no statistically significant main effect of gender on the population means of the combined dependent variables of 11^{th} grade science major students' posttest achievement scores in "impulse and momentum" and

posttest attitude scores towards physics when students' GPA scores in the previous year's physics lesson and pretest attitude scores towards physics are controlled?

4. There is no statistically significant interaction effect between teaching approach and teaching method on the population means of the combined dependent variables of 11th grade science major students' posttest achievement scores in "impulse and momentum" and posttest attitude scores towards physics when students' GPA scores in the previous year's physics lesson and pretest attitude scores towards physics are controlled?
5. There is no statistically significant interaction effect between teaching approach and gender on the population means of the combined dependent variables of 11th grade science major students' posttest achievement scores in "impulse and momentum" and posttest attitude scores towards physics when students' GPA scores in the previous year's physics lesson and pretest attitude scores towards physics are controlled?
6. There is no statistically significant interaction effect between teaching method and gender on the population means of the combined dependent variables of 11th grade science major students' posttest achievement scores in "impulse and momentum" and posttest attitude scores towards physics when students' GPA scores in the previous year's physics lesson and pretest attitude scores towards physics are controlled?

1.5 Definition of Important Terms

Some important terms particularly associated with this study are as the following.

Teaching approach and teaching method

> …An approach is a set of correlative assumptions dealing with the nature of language teaching and learning. An approach is axiomatic. It describes the nature of the subject matter to be taught…
>
> … Method is an overall plan for the orderly presentation of language material, no part of which contradicts, and all of which is based upon, the selected approach. An approach is axiomatic, a method is procedural. Within one approach, there can be many methods… (Anthony, 1963, pp. 63-67, as cited in Richards, & Rodgers, 2001)

Traditional instruction:

Taasoobshirazi and Carr (2008) referred to traditional physics instruction as a usual business in the class, and they defined it as an instruction in which the teacher presents the material, calculates related example problems on the board, and occasionally performs lab demonstrations. What students do in such an instruction is simply listening to the lecture, taking notes, but rarely asking questions or making comments. In best case circumstances, they carry out confirmatory physics experiments.

The 5E Learning cycle:

Learning cycle is one of the inquiry-teaching methods (Abraham, 1998; Bass, Contant, & Carin, 2009, p. 118; Lawson, 1995, pp. 132-176). The 5E learning cycle has got five phases, engagement, exploration, explanation, elaboration, and evaluation. In engagement, students are helped to become engaged in a new concept through a short activity. The main purpose is to elicit their preconceptions and promote curiosity. In other words, through the use of a short activity connecting past and present learning experiences, students' thinking toward the learning outcomes of the activity is organized. In exploration, students are provided with exploration of a concept through use of some kind of teaching activity, mostly laboratory experiments. In explanation, students and/or teacher label the concept via the data collected by the students in the exploration phase. In elaboration, students are provided with the opportunity to explore the usefulness and application of the concept through some other activities. In the evaluation phase, students are encouraged to assess their learning and it enables the teacher to evaluate progress of the students with the learning outcomes (Abraham, 1998; Bass, Contant, & Carin, 2009, p. 118; Bybee et al., 2006; Lawson, 1995, pp. 132-176; Soomro, Qaisrani, Rawat, & Mughal, 2010).

Contextual approach:

Based upon the literature (Bennett et al., 2007; Gilbert, 2006; Taasoobshirazi & Carr, 2008; Whitelegg & Parry, 1999; Wilkinson, 1999), context-based instruction is defined as a type of instruction in which students acquire the new content in a real-life context surrounding the content in a way that the content is derived from the context.

CHAPTER 2

LITERATURE REVIEW

The literature review starts with the crucial aspect of this study, distinction between teaching approach and teaching method. It is followed with what the traditional instruction means in this study. Then, what the context-based approach is and the related literature is presented. Afterwards, the learning cycle and the related literature are presented. Finally, literature on attitude and motivation in physics and gender related differences in physics is reviewed.

2.1 Definition of Teaching Approach and Method

Although science or physics education literature was reviewed carefully, any study that explains the relationship between teaching approach and method could not be encountered. However, it is clearly identified and presented in language teaching literature. The relationship among approach, method and technique was first identified and depicted by Anthony (1963, as cited in Richards, & Rodgers, 2001).

> …An approach is a set of correlative assumptions dealing with the nature of language teaching and learning. An approach is axiomatic. It describes the nature of the subject matter to be taught…
>
> … Method is an overall plan for the orderly presentation of language material, no part of which contradicts, and all of which is based upon, the selected approach. An approach is axiomatic, a method is procedural. Within one approach, there can be many methods…
>
> … A technique is implementational - that which actually takes place in a classroom. It is a particular trick, strategem, or contrivance used to accomplish an immediate objective. Techniques must be consistent with a method, and therefore in harmony with an approach as well. (pp. 63-67)

Anthony's terms are still commonly used in language teaching literature (Brown, 2007). In addition, Richards and Rogers (2001) extended and reformulated Anthony's model and made principle contributions to the meaning of teaching method. These studies would be very beneficial for explicitly categorizing teaching approaches and methods in science and physics education. However, it is not in the scope of this study and, Anthony's model is completely consistent with the purposes of the study. In brief, teaching approach is a set of correlated assumptions and beliefs about the nature of teaching while teaching method and technique are related to overall plan and implementation of teaching. However, they are tightly based on the approach of teaching. In addition, as Anthony expressed, many teaching methods may take place in within a teaching approach.

Although there are no any explicit statements in science or physics education literature about the difference between teaching approach and method, some implicit statements could be encountered. For example, Kortland (2002) implied such a distinction and clearly reported that the Physics Curriculum Development Project in the Netherlands (PLON) did not imply any particular teaching methodology.

2.2 Traditional Teaching Method

The most common characteristics of traditional instruction is that students are first informed about what they are expected to know (Abraham, 1998). Informing is carried out through the use of textbooks, lecturing, or other media. Highly academic, courses had much chalk and talk, very few classroom demonstrations, and almost no activities for students (Wilkinson, 1999). Taasoobshirazi and Carr (2008) referred traditional physics instruction to business as usual in the class, and they defined it as the instruction in which the teacher presents the material, calculates related example problems on the board, and occasionally performs lab demonstrations. What students do in such an instruction is simply listening to the lecture, taking notes, but rarely asking questions or making comments. In best case circumstances, they carry out confirmatory physics experiments.

Hake (1998) defined traditional instruction as those making little or no use of interactive engagement methods. In interactive engagement methods, it is intended to improve students' conceptual understanding through heads-on (always) and hands-on (usually) activities which yield immediate feedback through discussion with peers and/or instructors. However, on the contrary, traditional instruction relies on passive-student lectures, recipe labs, and algorithmic problem exams.

2.3 Why Is Not Traditional Method Suggested?

Physics education researchers are in agreement with that traditional physics instruction, even those given by the most talented and popular physics instructors, supplies students with little conceptual understanding of physics concepts (Hake, 1998).

Taasoobshirazi and Carr (2008) presented some issues related to traditional physics instruction based on the literature. First of all, physics instructors request students to solve quantitative physics problems in class, on homework assignments, or on tests. Frequently, students simply focus on equations and calculations to solve the problems, and thus, missing the deeper conceptual relationships present in the problems. A more serious issue is that instructors assume students to catch the conceptual relationships in the problems as they solve them step-by-step on the board. So, this type of physics instruction at last results in students believing that physics is based on memorization and computations.

2.4 What is Context-Based Instruction?

Studies about the context-based education started in the 1970s. Wilkinson (1999) reported a good summary of changes in physics curriculum in different countries in favor of context-based approach. They are the Victorian Certificate of Education (VCE) in Australia, the PLON project in the Netherlands, the Large Context Problems (LCP) in Canada, the applications-led approach in Scotland, Event Centered Learning in Brazil and in the UK, and more recently in the UK, Supported Learning in Physics Project (SLIPP). Particular information related to each of them is available in the Wilkinson (1999) study. In general, the common tendency is to make physics content more interesting and relevant to students. Thus, students' motivation, achievement, and skills are expected to increase.

Although context-based instruction has been used at primary school and university levels, it is more commonly used at secondary schools (Bennett et al., 2007). About the definition of context-based instruction, there are slight variations in statements. For example, Boltz and Swartz (1997) defined it as associating classroom theory and real-world application, Bennett et al. (2007) and Taasoobshirazi and Carr (2008) used it as placing physics material in a real-life context, Robin (1997), and Whitelegg and Parry (1999) defined as setting the content in a context of everyday applications. However, all researchers emphasize the importance of starting the lesson with the selected context and derive the content from it. As a result, the definition of context-based instruction can be synthesized as follows: Context-based instruction is a type of instruction at which students acquire the new content in a real-life context surrounding the content, provided that the content is derived from the context.

Furthermore, a systematic definition of "context", based on the explanations provided by Duranti and Goodwin (1992, p.3), has been provided by Gilbert (2006). The researcher defined the context as a focal event embodied in its cultural setting. What makes his definition more systematic is presentation of the attributes a context should possess. The educational context has got four attributes as listed by Gilbert (2006) based on the Duranti and Goodwin (1992, pp. 6-8) study:

> a. a setting, a social, a spatial, and temporal framework within which mental encounters with focal events are situated;
> b. a behavioural environment of the encounters, the way that the task(s), related to the focal event, have been addressed, is used to frame the talk that then takes place;
> c. the use of specific language, as the talk associated with the focal event that takes place;
> d. a relationship to extra-situational background knowledge (Duranti & Goodwin, 1993, pp. 6/8)

Afterwards, Gilbert (2006) presented three examples of context clarifying the attributes of a context. Table 1 summarizes them with respect to the attributes. The attributes were rephrased by Gilbert (2006) in the explanation of an example and they seem to be clearer. Therefore, the rephrased attributes are given in the second raw. By the way, the first example is related to physical science as the others are related to chemistry.

Table 2. 1 Exemplary Educational Contexts Given by Gilbert (2006)

	Attributes			
Focal event	a. Where, when, how is the focal event situated?	b. What do people do in this situation; what actions do they take?	c. In what language do people speak about their actions?	d. What is the background knowledge of those who act?
Earthquakes	The setting may be devastated area requiring rebuilding. The framework may be determined by the type of society in the country involved, the density and distribution of population, and the imminence of bad weather.	The need for constructing new buildings requires methods and resources used by architects, material scientists, and city-planners.	The need for earthquake-resistant buildings, the use of concrete rather than fragile materials, the notion of flexible structures for buildings.	The action of uneven forces on buildings, the composition of concrete for specific purposes, and the redistribution of forces on flexible buildings.
The Chemistry of Global warming	Manifest throughout the world in different ways	In addition to measures to remove the gases related to global warming already in the atmosphere, various measures to reduce the production of those gases are discussed.	The molecular structures of the gases related to global warming (a particular emphasis on the way that internal vibrations lead to the effects of observed).	The need for a general education about molecular structure and conservation of energy.
Possible Pollution of Swimming Water	Potentially polluted river or lake in the close environment of students	Developing and executing research plans, chemical analysis, and experimental laboratory skills, which include chemical concepts and principles.	Turbidity, pH, colorimetric analysis, norms for Escherichia coli concentration, the representative sampling of swimming water.	General knowledge such as concentration, norms, mean, nitrite, etc.

2.5 Why Context-Based Instruction?

Gilbert (2006) listed some issues chemical education had been facing and attributed them to why researchers seem the context-based instruction to be necessary. They are briefly as follows: (1) curriculum is overloaded with learning content, (2) students do not know how to build connections between isolated facts, (3) students can solve problems similar to ones given in the class but they cannot apply the concepts in those problems to other problems (lack of transfer), (4) students do not know the importance of why they learn the content presented in the class (lack of relevance), and (5) traditional instructions are deficient in helping students develop scientific literacy.

Similar reasons for declining interest in physics in the UK were stated by Whitelegg (1999). They are associated with ,such as, the negative image of the subject because it is perceived as difficult and highly mathematical, content overload, theoretical nature of most syllabuses, increased attractiveness of other subjects, and lack of relationship to society and to people.

Many researchers in science education believe the context-based instruction to overcome such kind of issues (i.e. Bennett et al., 2007; Gilbert, 2006; Pilot & Bulte, 2006; Taasoobshirazi & Carr, 2008; Whitelegg & Parry, 1999). Bennett, Lubben, and Hogarth (2007) said there are various reasons for the context-based instruction to be supported. The most important reason they indicated was related students' affective responses to science (feelings about their experiences of science). That is, the contexts used for developing science concepts of students are hoped to improve the students' attitudes toward science by presenting why they are studying what they are studying. A second reason for the context-based instruction, Bennett, Lubben, and Hogarth (2007) indicated, is that it is believed to improve learning of science. That is, if students are interested and motivated in what they are doing in the class, this engagement may improve their learning of science.

In sum, the context-based instruction is supposed to make physics more interesting and relevant for more students (Kortland, 2002; Waltner, Wiesner, & Rachel, 2007; Wilkinson, 1999). This may result motivate students and increase their achievement

(Bennett et al., 2007; Çoker, Çatlıoğlu, & Birgin, 2010; Taasoobshirazi & Carr, 2008). In addition, context-based instruction may provide students with a more authentic picture of science and of its contribution to people's lives (Çoker, Çatlıoğlu, & Birgin, 2010; Millar, 1993; Pilot & Bulte, 2006). However, without connecting the cognitive activity to context, merely embodying learning methods in contexts is not enough (Stinner, 1995).

2.6 Implementations of Context-Based Physics Instruction

Gilbert (2006) categorized implementation of context-based instruction in to four models. The first model is not interpreted as context-based instruction while the last model is the most properly use of context-based instruction.

In the first model, following the presentation of the concept, applications related to the concept are given as illustrations to the students. However, Gilbert (2006) clearly explained that such an implementation does not meet the criteria for a context-based instruction through the attributes a context must have. That is, giving an application of content as an illustration after presenting the concept does not provide students with a setting, a social, a spatial, and temporal framework within which individuals and focal events are situated (attribute a). This model does not provide a high quality learning task because the behavioral environment is not clear (attribute b). It does not possess "attribute c" as well because it does not help students acquire a coherent use of specific language. "Attribute d" is partially possessed because very little background knowledge in mentioned.

Model 2 is named "context as reciprocity between concepts and applications". In this model, the context possesses several subgroups of it and concept is presented in these subgroups of the context. However, a concept may have a different meaning in another subgroup of a context. For example, "pure water" has different meanings in chemistry and environmental chemistry. Thus, it can cause confusion by students, even by teachers. Also, as an example for such a model, the Science-Technology-Society (STS) movement is given. This model is interpreted as a model that meets large part of the criteria for context-based instruction. In this model, focal events are selected and concepts are introduced in phases on a need-to-know basis, however any overt rationale is missing.

Model 3 is named "context as provided by personal mental activity". In this model, there are different terminologies to those used in the attributes. First one is "situations" which is the "settings" for "focal events" in attribute a. The transformation of "situations" through personal mental activity produces "contexts" which is the second one. The third one is "narratives" which refers to the links between the "contexts" and some theme in the life of learners. Gilbert (2006) finds this model as a successful context-based instruction. However, the social dimension is missing.

In the Model 4, is named "context as the social circumstances". As understood from the name, a context is a cultural entity in society this time. Thus, a context may be a technological development in genetic modification, a scientific research about it, or social implications of developing technologies. In addition, it may be global climate, healthy food, etc. According to Gilbert (2006), this model is the most successful context-based instruction in terms of the attributes.

Stinner (1995) also introduced some criteria for context-based learning. First of all, contexts should be planned very well so that students are interested in them and find them "real". Also, students should be able to make sense of the contexts. Second, teachers should keep in mind that, at the beginning of the implementation, students should be provided with basic questions and problems which are appropriate for them. Third, students should be asked interesting questions that cannot be answered easily. Finally, the students should be motivated to learn the new content through group discussions, guidance, and well sequenced concrete activities.

In general, related to the implementation of the context based instruction, the most emphasized criterion is to start the lesson with the context and to derive the content from the context (Kortland, 2002; Millar, 1993). Usually, the context first introduced through the use of some basic questions. Thus, everyday life situations in which the content is embodied are mentioned. In addition, students should be provided with a wide range of activities as possible so that they can be engaged in the instruction (Kortland, 2002; Millar, 1993).

2.7 Research on Context-Based Instruction

Researchers have been expecting the contextual approach to be helpful in improving students' conceptual understanding, problem-solving skills, and motivation. However, research-based evidence is a necessity for offering the context based approach. Therefore, number of research studies analyzing the effect of contextual approach on students' possible gains has been increasing (Değermenci, 2009; Demircioğlu, 2008; Ekinci, 2010; Kasanda et al., 2005; Sari, 2010; Tekbıyık, 2010; Tekbıyık & Akdeniz, 2010; Toroslu, 2011; Yayla, 2010).

Toroslu (2010) used 7E learning model supported with real-life context-based instruction in experimental group for exploring its effect on students' misconceptions, conceptual understanding, and science process skills. The implementation was found to be effective on students' conceptual understanding and science process skills but not effective on overcoming misconceptions. Sari (2010) developed and used context-based instructional material on the topic "The Earth and The Universe" for 5^{th} grade students. The researcher reported the context-based to be superior to the traditional one with respect to the content understanding. However, in terms of the attitudes towards science, there was no a significant difference. Demircioğlu (2008) also developed context-based instructional materials and explored the effectiveness of them. The materials were about "States of Matter" and participants were freshman prospective primary school teachers. Results were in favor of the group the contextual materials were used in terms of the academic achievement and attitudes. Similarly, Ingram (2003) designed a contextual learning instruction to explore its effect on high school students' science achievement, attitude toward science, and motivation toward participating in learning process. Student gender was also taken into account. As a result, the researcher found differences in achievement in favor of contextual learning. No difference was observed between males and females. In addition, both males and females in contextual learning group had more positive attitude towards science and higher motivation towards participating in learning process.

Taasoobshirazi and Carr (2008) reviewed and evaluated ten existing research studies that evaluate the effectiveness of context-based physics instruction or problems on student motivation, problem solving, and achievement. Four of ten studies had been comparing the effectiveness of context-based and traditional physics assessment on students' motivation, problem solving, or achievement under traditional physics instruction. The researchers concluded about the context-based assessment that, due to a dearth of this type of research, there was no enough evidence about if context-based assessment does or does not work to improve physics achievement. Furthermore, research on context-based assessment had not included context-based instruction although the goal had been to suggest the context-based instruction. This case was indicated as a major limitation of that kind of research. Six of ten studies had explored the effectiveness of context-based instruction on students' motivation, problem solving and achievement. The studies indicated that students taught with context-based instruction had seemed to be more motivated. Those students had been observed to use more effective problem solving, but the interpretation of results was not certain enough because of methodological issues. In addition, only two of six studies had explored the effectiveness of context-based instruction on achievement, however again there were serious methodological issues having made it difficult to interpret the results. Therefore, Taasoobshirazi and Carr (2008) suggested more and better designed experimental research studies on context-based physics instruction so that recommendations can be made to educators about the effectiveness of context-based instruction.

Taasoobshirazi and Carr (2008) summed up the limitations of research on context-based instruction in three categories. First limitation is associated with difficulty of designing context-based curricula. Unlike the traditional textbooks which may use real-life examples after giving the related concepts, in few context-based textbooks, physics concepts are embedded in real-life contexts. However, it is difficult for educators to find resources handling physics instruction in a contextual approach. Second, there are a limited number of studies examining the effect of context-based instruction on students' understanding and achievement in physics. In other words, there is a dearth of research on context-based instruction. Third, the existing studies have got serious methodological problems; such as, a lack of pretest, control group, or random assignment. Such flaws cause the interpretation of results to be uncertain.

In sum, studies exploring the effectiveness of context-based instruction can be said to be limited in number with serious methodological problems. Thus, experimental studies with better designs are needed. Also, if possible positive findings are due to either the use of context-based approach or to the use of non-traditional teaching activities should be investigated.

2.8 Learning Cycle

Bolt and Awartz (1997) reported that students will more likely remember the way the course was taught if they are asked to recall a course. Thus, they suggested acquiring learning through the process of inquiry. Learning cycle is one of the inquiry-teaching methods, an inductive approach (Abraham, 1998; Bass, Contant, & Carin, 2009, p. 118; Lawson, 1995, pp. 132-176). The learning cycle is consisted of three phases. First phase is exploration. In this phase, students are provided with exploration of a concept through use of some kind of teaching activity, mostly laboratory experiments. In the second phase, named the conceptual invention phase, students and/or teacher label the concept via the data collected by the students in the exploration phase. In the third phase, called as the application phase, students are provided with the opportunity to explore the usefulness and application of the concept through some other activities. Based on this three-phase model, there are other models have been developed. One of them is 5E learning cycle (Bass, Contant, & Carin, 2009, p. 119). The 5E learning cycle was developed by the Biological Sciences Curriculum Study (BSCS) in 1989. As can be understood from the name of the model, there are five phases. They are engagement, exploration, explanation, elaboration, and evaluation. Exploration, explanation, and elaboration phases of this model are the same as the basic model. In engagement, students are helped to become engaged in a new concept through a short activity. The main purpose is to elicit their preconceptions and promote curiosity (Bybee et al., 2006; Soomro, Qaisrani, Rawat, & Mughal, 2010). In other words, through the use of a short activity connecting past and present learning experiences, students' thinking toward the learning outcomes of the activity is organized. In the evaluation phase, students are encouraged to assess their learning and it enables the teacher to evaluate progress of the students with the learning outcomes (Bybee et al., 2006; Soomro et al., 2010). Examples of the learning cycle model are provided by Bass et al. (2009) and Marek and Cavallo (1997).

2.9 Research on Learning Cycle

Research on learning cycle was presented by Abraham (1998) based on the literature review. Accordingly, there were unambiguous results pointing out the learning cycle to be effective on attitude and motivation, process skills, and reasoning ability. However, results were not so unambiguous about the effect of learning cycle on content achievement. Some studies found no difference and some found mixed results when they compared the learning cycle with the traditional method.

In addition, there are more recent studies exploring effectiveness of the learning cycle model. For example, Cakiroglu (2006) investigated effectiveness of the 5E learning cycle on eight grade students' understanding photosynthesis and respiration in plants. The result was indicating the learning cycle to be more effective with respect to the traditional method. Method and gender interaction was also explored and a significant interaction was not the case. That is, males and females benefited from the learning cycle method similarly. Nuhoğlu and Yalçın (2006) investigated effect of the learning cycle on candidate teachers' attitude towards science and scientific success. There was no significant difference between candidate teachers' attitude towards science but the scientific success. Ates (2005) also conducted a research exploring the effect of learning cycle on learning of DC circuits of university students. The learning cycle was observed to help students learn better and to close the gender gap in achievement. That is, there was a significant difference between female and make students' achievement prior to the treatment and this difference was disappeared at the end. More recently, Kaynar, Tekkaya, and Çakıroğlu (2009) conducted a study to explore the effect of learning cycle on sixth grade students' understanding of cell concepts and their epistemological beliefs. Results were in favor of the experimental group in which the 5E learning cycle was implemented in terms of the achievement and the epistemological beliefs. Ceylan and Geban (2009) also used 5E learning cycle in the experimental groups to compare its effect with the traditional method's effect on tenth grade students understanding of state of matter and solubility concepts. Results indicated the learning cycle to be better in helping the students understand the concepts. In another study, Türker (2009) explored the effect of 5E learning cycle on 6^{th} grade students' meaningful learning in force concept and found statistically significant difference in favor of the experimental groups. Papuçcu (2008) studied the effect 5E learning cycle on 11^{th} grade students' achievement in acid-base concepts and attitude towards science. The researcher found significant differences for both achievement and attitude in favor of the experimental group. On the other hand, Keskin (2008) found no statistical difference between the groups instructed with 5E learning cycle and traditional method in achievement in simple harmonic motion and attitude towards physics.

Moreover, several interaction effects were reported in a meta-analysis of 39 studies on inductive and deductive teaching approaches by Lott (1983, as cited in Abraham, 1998). First, inductive approach was reported to be more effective on intermediate level students. It was also more effective when higher levels learning outcomes are involved. Second, the inductive approach was better in small classes containing 17-16 students. Third, the inductive approach was found to be better when it was implemented within a complete program rather than in an isolated unit of instruction. About the effectiveness of inquiry teaching methods particularly on more capable students was also emphasized by Flick (1995).

2.10 Literature on Attitude and Motivation in Physics

Duit, Niedderer, and Schecker (2007) pointed out that attitudinal and motivational variables play an essential role in science learning. It is believed that attitude influences motivation and motivation in turn influences learning (Koballa & Glynn, 2007). Teaching methods should not only take into account the cognitive variables but also attitudinal and motivational variables (Kroh & Thomsen, 2005). In addition, context-based approach literature has frequently emphasized possible contributions to affective domain (i.e. Bennett et al., 2007; Whitelegg, 1999; Wilkinson, 1999). Particularly, Bennett et al. (2007) reports some studies presenting evidence that context-based approach contributes to students' attitude and motivation.

Commonly, attitude is defined as predisposition to respond positively or negatively to things, people, ideas, or places (Koballa & Glynn, 2007; Nieswandt, 2005). For example, "I love science", "I hate my science teacher", or "Science experiments are wonderful" are related to attitude toward science (Koballa & Glynn, 2007). Motivation is defined as an internal state that arouses, direct, and sustains students' behavior (Koballa & Glynn, 2007). For example, "I want to develop my physics skills", "I want to take more physics than I have to", "Thinking about an upcoming physics test makes me anxious", "I feel nervous in physics class", "I am capable of obtaining good grades in physics courses", "I try hard to do well in physics", and "I am sure that I can learn physics" (Gungor, Eryılmaz, & Fakıoglu, 2007).

In the related literature, many different attitudinal and motivational constructs and assessment instruments are presented (i.e. Koballa & Glynn, 2007; Nieswandt, 2005). Among them, the attitudinal and motivational instrument, Affective Characteristics Questionnaire, developed and validated by Abak (2003) is particularly for physics education research. In that study, attitudinal and motivational constructs are categorized as importance of physics, situational interest, personal interest, physics self-efficacy, physics self-concept, student motivation in physics, achievement motivation in physics, test and course anxiety in physics. Based on the literature, the researcher reviewed, importance of physics refers to the value given to physics or perception of how useful physics is. As a general manner, the related literature treats interest as feelings of enjoyment and involvement (Abak, 2003). Although self-concept is a complex construct and has got many facets (Bong & Clark, 1999), it simply is related to how students regard their ability in physics in a general manner (Abak, 2003). Self-efficacy is defined as a person's belief about his or her capabilities to produce designated levels of performance (Bandura, 1994). Because self-concept and self-efficacy are highly related constructs of motivation, Abak (2003) emphasized the difference between them through the explanation given by Zimmerman (1995, p.218). Accordingly, self-efficacy is one's context-dependent judgment about his or her capabilities whereas self-concept is one's general assessment about his or her capability. In a general manner, student motivation is any intrinsic or extrinsic reward that influences performance Abak (2003). Achievement motivation is associated with choice of achievement tasks, persistence on these tasks, vigor in carrying out them, and performance on them (Wigfield & Eccles, 2000). Anxiety is defined as a general uneasiness, a sense of foreboding, a feeling of tension (Koballa & Glynn, 2007).

2.11 Gender Related Differences in Physics

Nieswandt (2005) emphasized that all studies exploring effectiveness of teaching methods do not take gender into account although there is evidence that there are gender related differences in attitudes toward science. For example, a research to explore the factors contributing to Turkish students' attitudes towards physics revealed that characteristics, gender, experience in teaching, and age of teachers, gender of student, and conditions of school were significant predictors (Özyürek & Eryılmaz, 2001). That is, males and females possess different levels of attitudes toward physics. In addition, consistently with the related literature, males were observed to possess significantly higher levels of attitudes towards physics with respect to females.

Why females possess less positive attitude toward science than do males is attributed to physiological or commonly to sociological functions (Koballa & Glynn, 2007). For example, that parents, teachers, or peers place different cultural expectations on females and males is a sociological reason. Also, males and females are provided with different experiences (Jones, Howe, & Rua, 2000; She, 1998, as cited in Koballa & Glynn, 2007).

Taasoobshirazi and Carr (2008) emphasized that the largest gender related differences in achievement have been found to be especially in physics and suggested that context-based physics instruction may provide females with some hands-on activities which help them improve their understanding of physics concepts. Furthermore, females, more than males, feel physics irrelevant to them and their future goals (Murphy & Whitelegg, 2006). Because context-based physics instruction may make physics relevant through some examples and experiences and may be especially beneficial for females. In other words, context-based physics seems to have the potential to reduce the gender gap in physics.

Taasoobshirazi (2007) also explored gender related differences in achievement and particularly motivation in physics, and emphasized that the context-based physics instruction may make physics more relevant and hence may close the gap in gender related difference.

CHAPTER 3

METHOD

In this chapter, information on the accessible population to which the results are generalized, the sample drawn from the accessible population, the variables used in the analysis, the instruments used for assessment, the instructional materials, the research methodology, the procedure followed, the treatments implemented, how the treatment fidelity was assured, the statistical analysis performed, the power analysis for estimating the required sample size, the unit of analysis, and the assumptions and limitations related to the study are presented.

3.1 Population and Sample

The accessible population of the study is defined as all 11th grade high school science majors in Etimesgut, a district of Ankara, Turkey. The sample was drawn from two of seven high schools that comprise the accessible population. The sampling method was defined as purposive sampling because schools where the same teacher was teaching at least four 11th grade science major classes was chosen deliberately. However, the treatments were randomly assigned to the intact classes in the purposively selected schools. The sample was consisted of 226 students. Numbers of female and male students were 105 and 121, respectively. A more detailed distribution of the students with respect to their gender and school is given in Table 3.1. In Etimesgut Anatolian High School, number of females and males were almost equal. However, in Ufuk Arslan High School, males were more than females. Thus, in general, males were more than females. In addition, numbers of students in each school are interestingly equal. Associated with the students' ages, they were ranging from 17 to 18.

Table 3. 1 Distributions of Cases in the Sample with respect to Gender and School

	Etimesgut Anatolian High School	Ufuk Arslan High School	Total
Female	56	49	105
Male	57	64	121
Total	113	113	226

3.2 Variables

Independent variables of the study were consisted of teaching approach (approach), teaching method (method), students' gender (gender), the pretest scores on the Impulse and Momentum Achievement Test (IMAT) (preachieve), the pretest scores on the Affective Characteristics Questionnaire (ACQ) (preaffect), and the students' physics grades in the previous year (pre_year_ach). The dependent variables were consisted of the posttest scores on quantitative items of the IMAT (quan_scores), the posttest scores on conceptual items of the IMAT (concept_scores), and posttest scores on the ACQ (postaffect). In Table 3.2, more information about the variables is given.

Table 3. 2 List of variables pertaining to the study

Variable	Dependent (DV) / Independent (IV)	Continuous / Categorical	Scale
Approach	IV	Categorical	Nominal
Method	IV	Categorical	Nominal
Gender	IV	Categorical	Nominal
Preachieve	IV	Continuous	Interval
Preaffect	IV	Continuous	Interval
Pre_year_ach	IV	Continuous	Interval
Quan_scores	DV	Continuous	Interval
Concept_scores	DV	Continuous	Interval
postaffect	DV	Continuous	Interval

Among the independent variables, preachieve, preaffect, and pre_year_ach were possible covariates for adjusting the dependent variables.

3.3 Instruments

The IMAT was developed and used for assessing students' achievement in impulse and momentum. An adapted version of the ACQ, which was developed by Abak (2003), was used for assessment of attitudinal and motivational constructs in physics. In addition, a classroom observation checklist was developed and used for the assessment of treatment verification. More information about the instruments is available in the following sections.

3.3.1 Impulse and Momentum Achievement Test (IMAT)

This test was developed by the researcher in order to assess students' achievement in the topic, impulse and momentum. First of all, because there had not been a well-defined physics curriculum, specific objectives were detected and written based on the textbook used in physics classes (see Appendix A). In order to assess each objective by means of at least two items, questions were written. Table of specification for the IMAT is presented in Appendix B. Most of the questions were traditional questions. However, some context-based questions were also written so that the test was tried not to be in favor of any groups. In addition, quantitative and conceptual questions were written in line with the objectives. Items 4, 5, 7, 12, 14, 15, 16, 19, 20, 23, 24, 25, 26, 27, and 28 assess conceptual understanding while Items 1, 2, 3, 6, 8, 9, 10, 11, 13, 17, 18, 21, 22, and 29 quantitative ones. That is, numbers of conceptual and quantitative items are almost equal. Afterwards, the IMAT was evaluated by four experts in physics education. They evaluated if there is any ambiguity in the items, if the answer key is correct, and what objective is assessed by the items. Based on the feedbacks, some minor revisions were made in the IMAT (see Appendix C and Appendix D for the answer key) and it was administered to two science major 12th grade classes in one of the high schools in Etimesgut. The school was a different school from the schools the study was conducted. The reason for administering the IMAT to 12th grade classes was related to that they had studied the topic, impulse and momentum, before. Afterwards, item analysis was conducted to evaluate the items in terms of item difficulty and discrimination indeces. The related output is given in Appendix E. In the end of the output, some descriptive statistics is presented. In the test, there are 29 items. Number of examinees was 47. Mean was 16.04. Possible maximum score was 29. Thus, a normal distribution is expected, and the skewness and kurtosis values support this. The Cronbach alpha reliability was .79 and it is an acceptable value (Pallant, 2007). Mean item difficulty is .55 and it indicates that items are in medium difficulty level. Such a difficulty level is expected to result in acceptable discrimination indices. Mean biserial is .50 and it means in general that most of high achievers on the test had been able to response the items correctly while most of the low achievers had not been able to respond correctly. In addition, there are discrimination indices which are around zero or negative. The items with unacceptable discrimination indices were 4, 19, 20, 24, 27, and 29. Among these items, the most serious may be with item 20 because the related discrimination index is -.26 while others are around zero or a little less than .20. When the items were checked, any serious problem could not be detected and they were decided to be held in the test. Another item analysis was conducted using posttest achievement scores. For this analysis, all of the point biserial values were positive and, except for two of them, they were all above .20. In addition, the alpha reliability coefficient was .90 for the posttest achievement scores.

3.3.2 Affective Characteristics Questionnaire (ACQ)

The ACQ used in this study is an adapted version of ACQ developed and validated by Abak (2003). In a personal communication, she suggested to use a new version of ACQ whose items are the items of ACQ with high factor loadings in the explanatory factor analysis. This version of the ACQ includes seven attitudinal and motivational constructs. They are situational interest, importance of physics, physics self-efficacy, physics self-concept, achievement motivation, student motivation, and test anxiety. The ACQ is given in Appendix F. The Cronbach alpha coefficients were estimated as .74 and .80 for pretest and posttest scores. These values mean that the ACQ scores represent students' attitude and motivation scores in physics at an acceptable level. However, confirmatory factor analysis were required if seven attitudinal and motivational constructs could be measured through the use of ACQ as expected. The results showed that both pretest and posttest ACQ scores (preaffect and postaffect) could assess seven attitudinal and motivational constructs as expected. Details related to the confirmatory factor analysis are in the following subsections.

3.3.2.1 Confirmatory Factor Analysis

In order to present evidence about whether the seven constructs are really assessed through the use of ACQ, two separate confirmatory factor analysis were conducted using pretest and posttest scores on the ACQ. First of all, it is needed to explore the descriptive statistics and how well the assumptions were assured.

3.3.2.1.1 Descriptive Statistics for Confirmatory Factor Analysis

Descriptive statistics of the study was performed by means of Statistical Package for Social Studies (SPSS), version 20. Overall descriptive statistics for all attitudinal and motivational constructs in physics are given in Table 3.3. Minimum and maximum values in the table give information about the accuracy of data because there are no any scores out of the range. When the means in the table are investigated, all can be said to be large. At least, they are above the midpoints. Cronbach alpha coefficients more than .70 are accepted to indicate reliable scores (Pallant, 2007). In this case, all the alpha coefficients are satisfactory in order to perform the confirmatory factor analysis. Standard deviations are expected to be large because of the satisfactory reliability coefficients and they seem to be large enough. All the skewness and kurtosis values give information about if distributions of the variables are normal. Because they are around zero, all variables seem to be normally distributed.

3.3.2.1.2 Assumptions of Confirmatory Factor Analysis

Barrett (2007), and Weston and Gore Jr. (2006) suggested the minimum sample size to perform structural equation modeling to be at least 200. In this study, there are 194 participants. It is below 200 but very close to it. However, Tabachnick and Fidell (2007, p. 683) reported that sample size may be fewer in case of reliable variables. For example, they (2007, p. 733) find a ratio of participants to observed variables, which is 16:1, adequate to perform confirmatory factor analysis because of the highly reliable observed variables. In this case, the ratio is almost 28 (it is 194:7). Because the observed variables are reliable enough, this sample size seems to be adequate as well.

Table 3. 3 Descriptive Statistics for Pretest Scores on the ACQ and Related Reliability Coefficients

	N	Min	Max	Mean	SD	Skew.	Kurt.	Alpha
presint	194	1.50	5.00	3.54	.80	-.63	.36	.81
preimp	194	1.40	5.00	3.63	.75	-.36	-.19	.81
preseff	194	1.40	5.00	3.71	.71	-.16	.04	.89
preachmo	194	1.75	5.00	3.99	.64	-.52	.47	.76
prestumo	194	1.00	5.00	3.49	.84	-.32	-.03	.85
prescon	194	1.00	5.00	3.57	.71	-.37	.85	.74
preanx	194	1.00	5.00	3.91	.88	-1.03	1.12	.88
postsint	194	1.00	5.00	3.62	.82	-.53	.15	.84
postimp	194	1.20	5.00	3.69	.83	-.63	.08	.84
postseff	194	1.00	5.00	3.81	.88	-.85	.96	.92
postachmo	194	1.00	5.00	3.94	.79	-.92	1.36	.83
poststumo	194	1.25	5.00	3.55	.83	-.45	-.07	.84
postscon	194	1.00	5.00	3.60	.80	-.33	.12	.78
postanx	194	1.00	5.00	3.75	.95	-.73	.01	.90

Note. sint: situational interest, imp: importance of physics, seff: self-efficacy, achmo: achievement motivation, stumo: student motivation, scon: self-concept, anx: test anxiety

As aforementioned, skewness and kurtosis values indicate normal distribution for all observed variables. In addition, all skewness values are negative and this means that all distributions are skewed in the same direction. Thus, linearity assumption could be said to be met (Tabachnick, & Fidell, 2007, p.224). Univariate outliers were checked using boxplots as described in Pallant (2007, p. 63). There were few univariate outliers for each observed variable. Multivariate outliers were checked by means of Mahalanobis distances as explained in Pallant (2007, p. 278). Only one case was exceeding the critical distance. However, those cases were not excluded from the data in order not to decrease the sample size. For checking if multicollinearity is present, it is needed to check the correlations among the observed variables. Table 3.4 presents the correlation matrix for pretests and posttest separately. All the correlations are significant. However, there are no any too high correlation, and thus multicollinearity is not the case for neither pretest nor posttest variables. As a result, the assumptions of confirmatory factor analysis were not violated.

Table 3. 4 Correlations among Attitudinal and Motivational Constructs prior to Treatments

Variables	presint	preimp	preseff	preachmo	prestumo	prescon
presint						
preimp	.375*					
preseff	.421*	.352*				
preachmo	.438*	.189*	.348*			
prestumo	.520*	.409*	.469*	.455*		
prescon	.405*	.215*	.567*	.388*	.353*	
preanx	.532*	.312*	.477*	.364*	.311*	.390*
Variables	postsint	postimp	postseff	postachmo	poststumo	postscon
postsint						
postimp	.500*					
postseff	.502*	.381*				
postachmo	.533*	.322*	.478*			
poststumo	.708*	.598*	.532*	.532*		
postscon	.377*	.273*	.621*	.449*	.435*	
postanx	.556*	.322*	.403*	.462*	.398*	.350*

Note. sint: situational interest, imp: importance of physics, seff: self-efficacy, achmo: achievement motivation, stumo: student motivation, scon: self-concept, anx: test anxiety

* Correlation is significant at the 0.01 level (2-tailed).

3.3.2.1.3 Results of the Confirmatory Factor Analysis

In the model, attitude to and motivation in physics is the latent variable and it predicts seven constructs: situational interest, importance of physics, physics self-efficacy, achievement motivation, student motivation, self-concept, and test anxiety. Figure 3.1 shows the latest model that resulted in a good fit for the pretest variables.

At first, there was no a good fit between the model and observed data (χ^2 = 47.50, p = 0.00, GFI= 0.93; AGFI= 0.87; RMSEA= 0,078; SRMR= 0.055). For further information, a detailed output is given in Appendix G. Therefore, the model was modified twice according to the modification indices suggested by the software and the covariances added in the model by Gungor, Eryılmaz, and Fakıoglu (2007). First, a covariance was added between self-efficacy and self-concept. Second, a covariance was added between student motivation and test anxiety. The model shown in the figure is the final model after the modifications. These modifications resulted in a good fit between the model and observed data ($\chi^2 = 16.09$, $p = 0.19$, GFI= 0.98; AGFI= 0.95; RMSEA= 0,042; SRMR= 0.034).

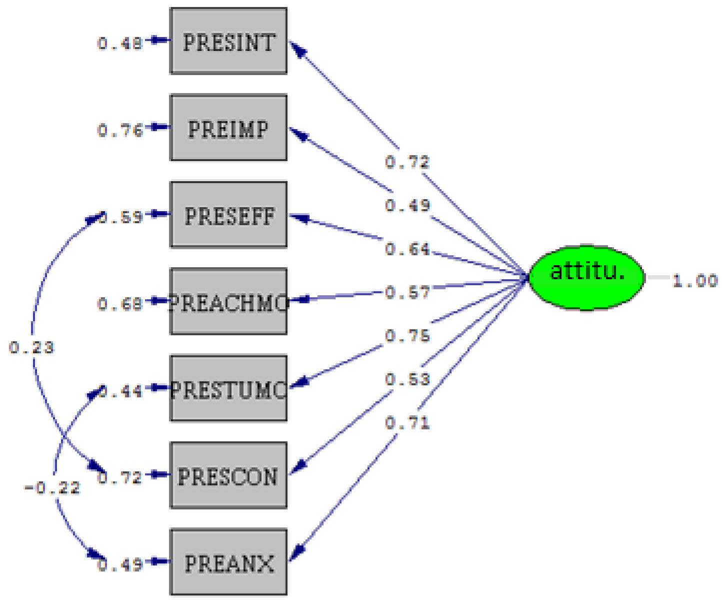


Figure 3. 1 The model showed a good fit with the pretest data with the standardized regression coefficients

Figure 3.2 shows the latest model that resulted in a good fit for the posttest variables. At first, there was no a good fit between the model and observed data ($\chi^2 = 77.76$, $p = 0.00$, GFI= 0.90; AGFI= 0.79; RMSEA= 0.15; SRMR= 0.065). For further information, a detailed output is given in Appendix H. Therefore, the model was modified twice according to the modification indices. First, a covariance was added between self-efficacy and self-concept. Second, a covariance was added between student motivation and test anxiety. The model shown in the figure is the final model after the modifications. These modifications resulted in a good fit between the model and observed data (χ^2 = 20.26, p = 0.06, GFI= 0.97; AGFI= 0.93; RMSEA= 0,060; SRMR= 0.040).

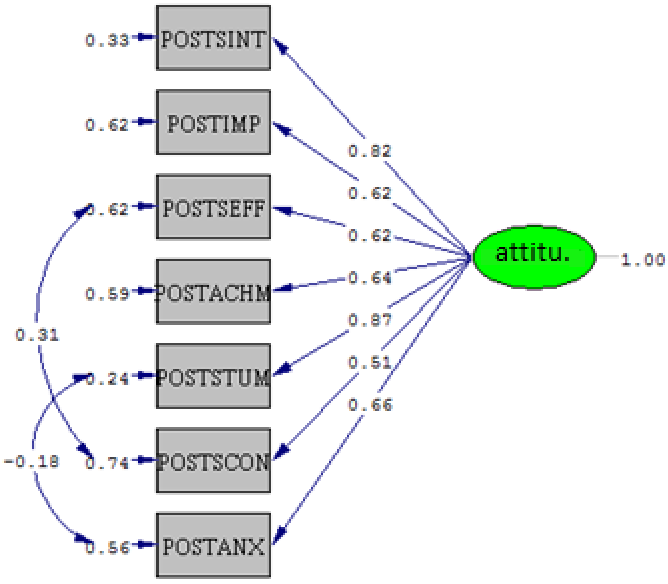


Figure 3. 2 The model showed a good fit with the posttest data with the standardized regression coefficients

To sum up, in order to confirm if the ACQ really assesses seven attitudinal and motivational constructs, the confirmatory factor analysis was performed. However, the first model we tested did not give a good fit to the data. Therefore, we took the modification indices into account to modifying the model. After modifying the model twice, we got a good fit between the modified model and the data. These modifications include adding a covariance path between physics self-efficacy and physics self-concept, and adding a covariance between student motivation and test anxiety. The modifications mean that the mentioned motivational constructs are correlated to each other. However, in spite of these correlations, the ACQ assesses the seven constructs due to the good fit between the modified model and the observed data both for pretest scores and posttest scores.

3.3.3 Classroom Observation Checklist

In order to check whether the treatments were implemented as planned, a verification checklist for each treatment type was developed by the researcher. That is, because there are four types of treatments implemented, there are four different observation checklists. The checklists were developed based on the main characteristics of the treatments (see Appendix I). Bass et al. (2009, p.120) reported a table showing what a teacher and students should do or should not do in case 5E learning cycle is implemented. While developing the learning cycle related observation checklists, especially this table was used. An expert in physics education checked the observation checklists and some minor modifications were made in line with the suggestions by the expert.

3.4 Instructional Materials and Treatments

The instructional materials used in the study are embodied in the lesson plans (see Appendices J, K, L, and M). In this section, the educational context used in the study is presented with the attributes clarified by Gilbert (2006). Afterwards, treatment for each group is tried to be depicted.

3.4.1 The Educational Context

The attributes of an educational context reported by Duranti and Goodwin (1992) and depicted by Gilbert (2006) were taken into account to operationally define the context used in this study. It is given in Table 3.5 with its attributes. As seen in the table, the focal event was casualties in traffic accidents. The setting in which the focal event was embodied was Turkey (attribute a). Thus, the context was intended to be perceived by the students as a societal issue. In order to prevent the traffic accidents, traffic rules have been set and safer cars have been designed. These are the actions taken by the responsible people, such as policy makers or car manufacturers (attribute b). Related to the traffic rules, several regulations concerning speed limits are set. For example, speed limits in local traffic area or intercity traffic area are different, or speed limits for cars or trucks are different. Related to designing safer cars, seat belts, air bags, or crumple zones have been designed. These refer to the specific language used in the context (attribute c).

Finally, the specific language used requires some background knowledge (attribute d). For example, why speed limits are different in local or intercity areas and how air bags save us require deep understanding of the relationship between impulse and momentum change.

The context of “casualties in traffic accidents” is an umbrella for the contexts of “traffic rules” and “safety in cars”. These sub-contexts are strongly associated with the main context and all the physics concepts in “impulse and momentum” were studies in these two sub-contexts. The following figure shows the relationship mentioned.

Table 3. 5 Attributes of the Context within which “Impulse and Momentum” was handled

	Attributes			
	a. Where, when, how is the focal event situated?	b. What do people do in this situation; what actions do they take?	c. In what language do people speak about their actions?	d. What is the background knowledge of those who act?
Focal Event: Casualties in traffic accidents	Casualties in traffic accidents in Turkey between 1999 and 2008 according to the overall statistics reported by Turkish Statistical Institute	Traffic rules are set, car manufacturers design safer cars.	Related to traffic rules, i.e. the speed limit in local traffic area is 50 km/h rather than 90 km/h, speed limits for cars and trucks are different. Related to safety in cars , i.e. function of seat belts, function of air bags, why padded dashboards, and why crumple zones.	Impulse, momentum, relationship between the change in momentum and impetus, conservation of momentum, elastic and inelastic collisions.

Specifically, “impulse”, “momentum”, and “relationship between impulse and the change in momentum” were studied in contexts of “traffic rules” and “safety in cars”. “Conservation of momentum”, “elastic and inelastic collisions” were studied in context of “crumple zones in cars” which is in the context of “safety in cars”.

Finally, “collisions” was studied in context of “car headrests” which is also in the context of “safety in cars”.

The educational contexts were presented in form of discussions with students. In the groups the traditional teaching method was implemented, the teachers presented the educational contexts and raised related questions to the students. Eliciting student ideas through the use of context-oriented questions provided a need-to-know basis for the new physics content. The content was presented and the context-oriented questions were again addressed. This time, they were responded by means of the new physics content.

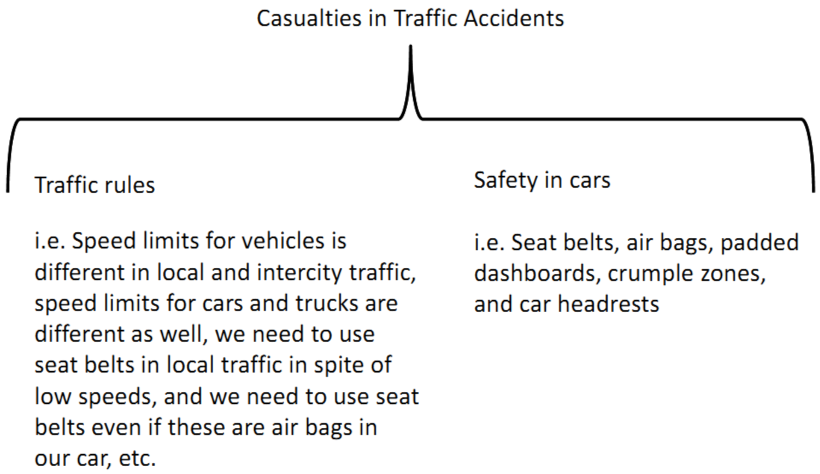


Figure 3. 3 The educational context with sub-contexts

In the groups the 5E learning cycle model was implemented, the educational context was introduced in the engagement phase and the same context-oriented questions were asked to the students. The students’ responses to the questions were used to help the students construct hypothesis to be tested in the following phase of learning cycle. The context-oriented questions were again addressed in the evaluation phase, and the students were encouraged to respond them using the new physics content.

3.4.2 Treatments

There are four types of treatments implemented in the study in line with the experimental design: (1) Traditional teaching method with non-contextual approach, (2) traditional teaching method with contextual approach, (3) learning cycle with non-contextual approach, and (4) learning cycle with contextual approach.

3.4.2.1 Traditional Method with Non-Contextual Approach

The main characteristic of the traditional method was that it was teacher-centered (see Appendix J). Teachers introduced the physics content, solved some exemplary problems, and had the students solved some additional problems. For example, at the beginning of the class, the teachers directly presented how the equation showing the relationship between impulse and change in momentum is derived from Newton's second law. Meanwhile, definitions of impulse and momentum and why they are vectors were also explained by the teachers.

However, students from different classes were in touch in break times, and thus they may have been mentioning about what they were doing in their class hours. If students of the class traditional method were being implemented would have heard that new teaching activities were being carried out in the other classes, they may have been demoralized and this may have influenced their performance positively or negatively. This situation is associated with attitude of subjects and called as John henry effect (Hake, 1998). In order to avoid influences of such confounding variables, the teachers carried out some of the activities designed for the learning cycle groups in the form of demonstrations in the groups under traditional teaching method. Teachers did the demonstrations and directed some related questions to the students so that the new physics content was going to be confirmed. Afterwards, the teachers answered the questions using the presented physics content. For examples, as seen in Appendix J, a demonstration, at which students observed the position and motion of an object rolling down a ramp, was carried out. As seen in Figure 3.4, a channeled ramp, marbles different in mass, and a half-cut paper cup were required for the demonstration. Moreover, a ruler and timekeeper were necessary.

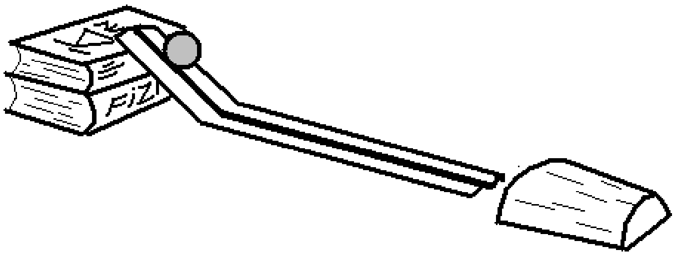


Figure 3. 4 Figure of the demonstration

The teacher first expressed the students that after having released the marble, it would move the cup until they stop due to the friction between the cup and table. Afterwards, the teacher explained this event through the relationship between impulse and momentum change. That is, the marble which is released from a determined height gains some speed while it is rolling down the ramp due to the conservation of mechanical energy. At the bottom of the ramp, the marble has got some momentum. After it enters the cup, they will move together and they will decelerate until they stop because of the friction between the cup and table. This friction will be applied for a moment and the final momentum of the marble will be zero. That is, the frictional force applied for a moment will result in a momentum change. After that, the teacher asked the students for guessing how further the cup would be moved if two marbles different in mass were released from the same height. The teacher performed the demonstration and explained the observation again through the use of relationship between impulse and momentum change. This time, he emphasized that with the same velocity due to the same height the marbles are released, the heavier marble has larger momentum. It means more change in momentum; thus more impulse. Because the frictional force is almost the same, time elapsed until the cup stops is longer. Then, the teacher asked the students for guessing how further the cup would be moved if two identical marbles were released from different altitudes. Teacher performed the demonstration, and explained the situation again through impulse and momentum. He emphasized that the marble having been released from a higher altitude had a velocity with larger magnitude, and thus its momentum was larger. Afterwards, teacher showed how to solve related problems through some examples from the textbook.

In addition, because giving some real-life examples and explanations following the presentation of the physics content does not necessarily mean context-based approach, some real life examples and explanations were presented after presentation of some physics content.

3.4.2.2 Traditional Method with Contextual Approach

This treatment was almost the same as the treatment mentioned above except for the educational context integrated with the traditional method (see Appendix K). In this treatment, the teachers started the lesson with the related context and asked context-oriented questions to the students. That is, the context was introduced in a form of discussion. Students' responses were taken and they were discussed as detailed as possible. For example, the teachers started the lesson by delivering a handout presenting a table on the overall statistics of casualties in traffic accidents in Turkey between 1999 and 2008 (see Appendix K). Related to that statistics, students were invited to guess why number of casualties had decreased in spite of the increase in the number of traffic accidents. With the help of the teachers the discussion led the students to talk about the traffic rules and safety in cars. Then, the teachers addressed context-oriented questions, such as, whether the use of seat belt is necessary in a car with air bags, whether it is still necessary to use seat belt with low velocities, which car crash in which two cars bounce off each other or a car crash in which two cars crumple together is more serious.

Afterwards, the teachers made a transition from contextual discussion to physics content. The presentation of the physics content was with traditional teaching method as in the first treatment. Following the presentation of the new physics content, the context-oriented questions raised during the discussion were addressed again, and, at this time, they were responded using the new physics content.

Even though all types of questions, including real-life related and traditional textbook questions, were tried to be solved in this group, the number of questions solved was less than the ones solved in the non-contextual traditional groups due to the time spent during the presentation of and discussions about the context.

3.4.2.3 Learning Cycle with Non-contextual Approach

In these groups, 5E learning cycle method was used (see Appendix L). There are five phases in this model: (1) engagement, (2) exploration, (3) explanation, (4) elaboration, and (5) evaluation. In this treatment, first, students were engaged through questions associated with activities in exploration as shown in the examples of Bass, Contant, Carin, (2009) and Marek and Cavallo (1997). That is, the activity planned to be performed by the students in the exploration phase is introduced to the students in the engagement phase. Thus, activity-related questions were used to arouse the students' curiosity. For example, after the activity in Figure 3.4 was introduced to the students, the teacher asked them for guessing how further the cup would be moved if two marbles different in mass were released from the same altitude. Students were requested to write down their guesses as their hypothesis. Then, the teacher asked the students for guessing how further the cup would be moved if two identical marbles were released from the different altitudes. Again, the students were requested to write down their guesses as their hypothesis. Afterwards, the exploration phase started and students performed the activity as groups with 4 to 6 students to test their hypothesis. In explanation phase, the teacher requested to answer the questions put in the first phase. In this phase, teacher guided the students to explain their observation through some additional questions, such as, if the velocities of two identical marbles released from different altitude are the same, if the velocities of marbles with different masses but released from the same altitude are the same, what kind of motion the cup experiences until it stops, etc. Then, the teachers let the students interpret their observations and bring some explanations about them. Afterwards, the teacher clarified the students' observation through the use of impulse and momentum, thus presented the related physics content. At this time, the teacher showed the derivation of the equation showing the relationship between impulse and momentum change by means of Newton's second law, definitions of impulse and momentum, if they are vectors or scalar, etc. In elaboration phase, the teacher had two students hold up a bed sheet as in Figure 3.5. Then, each student was separately invited to toss an uncooked egg at the sheet in order to break it. However, they could not break any eggs although some of them tried one more time. Finally, students were requested to explain why the eggs could not be broken through the use of impulse and momentum change.

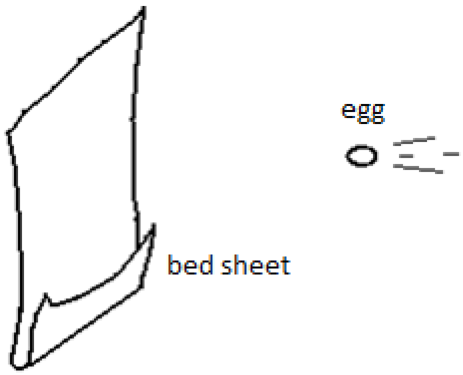


Figure 3. 5 Egg throw activity

In the evaluation, the new content related physics problems were solved by the teachers and students. In addition, some real life-related questions were also solved because solving such questions after presentation of the physics content does not necessarily mean context-based approach. For example, “if a non-flexible rope was used in bungee-jumping, what would happen?” was asked and an explanation through the use of impulse and momentum was requested.

3.4.2.4 Learning Cycle with Contextual Approach

This treatment was almost the same as the treatment of learning cycle with non-contextual approach except for the educational context integrated (see Appendix M). In the engagement phase of the learning cycle, students’ curiosity was tried to be aroused through context-oriented questions. That is, first, the context was introduced in a form of discussion. Students’ responses were taken and they were discussed as detailed as possible. For example, the teacher started the lesson by delivering a handout presenting a table on the overall statistics of casualties in traffic accidents in Turkey between 1999 and 2008. Related to that statistics, students were invited to guess why number of casualties had decreased in spite of the increase in the number of traffic accidents. The discussion leads the participants to talk about the traffic rules and safety in cars. Then, the teacher addressed context-oriented questions, such as, if use of seat belt is necessary in a car with air bags, if it is still necessary to use seat belt with low velocities, if a car crash in which two cars bounce off each other or a car crash in which two cars crumple together is more serious.

Afterwards, the teachers made a transition from contextual discussion to the activity. Then, the instruction proceeded according to phases of learning cycle as described in the previous section. Additionally, in the evaluation phase, the context-oriented questions were addressed again and, this time, they were replied using the new physics content, impulse and momentum.

In addition, even though all types of questions were tried to be solved in the class, number of questions solved was less in this treatment due to the educational context integrated. However, more contextual questions were solved and explained in learning cycle with contextual approach groups.

3.5 Experimental Design

To explore the main and interaction effects, a 2x2x2 factorial experimental design (Fraenkel & Wallen, 1996, p. 278) was conducted with eight treatment groups. Based on the independent variables, teaching approach and method, there were four groups: (1) a traditional method with non-contextual approach, (2) a traditional method with contextual approach, (3) a learning cycle with non-contextual approach, and (4) a learning cycle with contextual approach. Also, all these groups were including males and females (see Table 3.6). In addition, prior to and just after the treatments, the IMAT, assessing students' achievement in impulse and momentum, and the ACQ, assessing students' attitudinal and motivational constructs, were administered.

		Teaching approach			
		Non-contextual		Contextual	
		Female	Male	Female	Male
Teaching method	Traditional	Group 1	Group 3	Group 5	Group 7
	Learning cycle	Group 2	Group 4	Group 6	Group 8

Table 3. 6The factorial design pertaining to this experimental study

3.6 Procedure

The study started with the researcher's interest on context based approach. The researcher became aware of the context-based approach through the development and administration of the physics curriculum by the Turkish Ministry of Education, and the related literature was decided to be reviewed. Key words, used for the literature review, are presented in Appendix N. However, it should be emphasized that the literature review started prior to the identification of research problem and continued until completion of the dissertation. Also, for the literature review, the electronic sources provided by the METU Library such as e-theses, e-journals, Academic Search Complete, EBSCOhost, Education Research Complete, ERIC, Dissertations and Theses, etc, available hard copies in the METU Library, METU thesis and dissertations, and Turkish Higher Education Council National Dissertation Center and Google scholar search engine were utilized. Based on the review of the literature specific research questions were generated. After that, the population and a related physics unit were determined. Based on the literature review, treatments were started to be developed in the form of detailed lesson plans. Then, the treatments were reviewed by the supervisor and some revisions were made. Meanwhile, The IMAT was developed, validated and administered for pilot study. Following the item analysis and required permission from the Directorate of National Education in Ankara, in the fall semester of 2009-2010 academic year, the treatments were implemented (see Appendix O). In one of the schools, the researcher became the teacher of classes. Prior to the implementation of the treatments, the researcher informed the teacher in the other school about the study and the teacher requested to administer the pretests. During the implementations, every week on Fridays, the researcher and the teacher came together so that the next week's instructions were reviewed and planned based on the lesson plans, and required activities were carried out together prior to the instructions. The treatments lasted for four weeks. Following the completion of the implementations, the posttests were administered. Finally, the collected data were entered in electronic medium to be analyzed. Using IBM SPSS Statistics 20, the data were cleaned and analyzed.

3.7 Treatment Fidelity and Verification

The treatments have two facets: (1) teaching approach, and (2) teaching method. Related to teaching approach, what should and should not be done in contextual and non-contextual instructions were identified based upon the detailed explanations and some exemplary implementations provided in the related literature. However, there were differences in definitions and examples of context-based approach. At this point, two sources of information provided by Gilbert (2006) and Turkish Ministry of Education were used as primary sources. Gilbert's study reports a clear definition and good examples of educational context. In addition, the new physics curricula developed and just started to be administered by the Turkish Ministry of National Education encourages the context-based approach and presents useful information about it.

Related to teaching method, traditional method and learning cycle must have been defined. That is, what should or should not be done in traditional method and learning cycle must have been clarified. Fortunately, the related literature is much more consistent in the implication of learning cycle although there are several types of it. Especially, the book of Bass et al. (2009, p. 120) was beneficial at this point. They reported a table showing what teachers and students should or should not do while 5E learning cycle is implemented. In addition, there are good examples in the study of Marek and Cavallo (1997).

As a result, in line with the related literature, the lesson plans were started to be developed. While they were being developed, the supervisor guided the researcher and the necessary revisions were made on the lesson plans based on the suggestions by the supervisor.

Furthermore, in order to verify the treatments, the researcher observed about 30 percent of the lessons during the implementations in one of the schools. In the other school, the researcher was the teacher during the implementations. In addition, another observer who was a research assistant in the department of Secondary Science and Mathematics Education at METU observed four to five lessons in both schools. However, this observer could only partially fill in the learning cycle related checklists because only one or several phases of the learning cycle could be observed in one or two class hours. Consequently, the researcher and the other observer were in agreement that the implementations were consistent with the lesson plans according to the observations made together.

3.8 Statistical Analysis

In the study, three group membership variables (approach, method, gender) and two covariates (preaffect and pre_year_ach) were identified. In addition, there were three dependent variables which were posttest scores obtained through the conceptual and quantitative items in the IMAT (concept_scores and quan_scores) and through the ACQ (postaffect). Because science learning has started to be referred as a students' gains on affective domain as well as cognitive domain in the literature (Duit & Treagust, 2003), post-test scores on the IMAT and on the ACQ were used as the dependent variables. Multivariate Analysis of Covariance (MANCOVA) was performed for the inferential statistics following the descriptive statistics and checking whether the related assumptions were assured. Following the MANCOVA, follow-up ANCOVAs were performed in order to evaluate effects of the independent variables on each dependent variable separately.

3.9 Power Analysis

Power analysis was performed prior to the study so that the results were going to be as powerful as desired. The power analysis was performed on the basis of the explanations by Cohen, Cohen, West, and Aiken (2003, p. 177). They gave the following equation for estimating the sample size required to get results with the desired power.

$$n = \frac{L}{f^2} + k_A + k_B + k_C + 1$$

In the equation, "n" is the sample size, L is a value obtained using a table in Cohen et al. (2003, pp. 650-651) with respect to the alpha level (probability of Type I error), k_B, and the power desired, f^2 is the effect size, k_A is the number of covariates, k_B is the number of independent variables, and k_C is the number of interaction terms.

First, L was needed to be determined. As usual in educational research, alpha level was set as .05, and the desired power was .80. In this study, there were three categorical independent variables. In this case, for each independent variable, number of dummy variables needed to represent that independent variable was used as the number of independent variables. For example, the independent variable, teaching approach, has two levels (non-contextual vs. contextual). Thus, 1 dummy variable, which is obtained by subtracting 1 from the number of level of the independent variable, is required to represent it. The same procedure was followed for the other two independent variables, teaching method and gender. That is, k_B is 3. Then, to determine L, Cohen's table on page 651 was used and L determined as 10.90. With some hesitation, Cohen et al. (2003, p. 179) offers f^2 as "small" if it is .02, "medium" if it is .15, and "large" if it is .35. In this study, it was set as medium. That is, f^2=.15. Number of covariates (k_A) is 2, and the number of independent variables (k_B) is 3. Thus, the number of interaction terms (k_C) is 6. After the required calculations, the minimum sample size was resulted as 84.67. In this study, the inferential statistics were performed with the data collected from 194 participants, and thus, we could detect effect sizes, equal to or larger than medium effect size with a power of more than .80.

3.10 Unit of Analysis

In an experimental study, if the experimental unit and the unit of analysis are the same, then the independence of observation is said to be met. In this study, the unit of analysis is each participant while the experimental unit is each intact group. Because they are not the same, it is not possible to generate a claim about the independence of observation. In addition, lots of interactions among the participants are inevitable during class hours. However, it should be emphasized that the teachers tried the participants not to interact at least while data were being collected. Thus, independence of observation may be assumed at least for the measurement processes.

3.11 Assumptions and Limitations

Assumptions associated with this study are as follows:

The students responded the items on the measurement tools seriously, consciously, and truthfully.

And, related limitations are as follows:

1. The results of this study are limited to 11^{th} grade students who were mostly low or medium achievers.
2. The results are limited to “impulse and momentum” unit.
3. Time required to implement the treatments was different for each of the treatment groups because of the required additional time for the presentation and discussions of the context. Nevertheless, this issue was tried to be overcome by teachers by solving additional problems during the extra time intervals.
4. Other variables such as scientific process skill or problem solving skills were not assessed. That is, if contextual approach is effective on such variables, it is missing in this study.
5. Students’ achievement scores were evaluated as conceptual and quantitative scores because there was more or less the same number of conceptual and quantitative items in the achievement test. Thus, almost all the objectives were assessed by both the conceptual and quantitative items. However, number of contextual items with respect to the non-contextual ones was less. That is, students’ achievement could not be evaluated as contextual and non-contextual scores.

CHAPTER 4

RESULTS

This chapter starts with how the missing data were handled and how the data got ready to perform the desired analysis. Then, results of the MANCOVA performed to test the hypothesis of this study are presented.

4.1 Missing Data Analysis

Numbers of present and missing values associated with the variables used in the study are presented in Table 4.1. As seen in table, the number of missing values of pretest scores on the IMAT is large. This is because the teacher in one of the schools forgot to deliver the IMAT to one of his classes prior to the treatments. Replacing these missing values with the mean score was not found to be appropriate because the number of the missing values of preachive was large and the mean score of the present values may not represent the mean score of the class. Therefore, preachive was decided to be excluded from the study.

Nonetheless, there may have been significant differences among the mean scores of IMAT for each cell of the factorial design. If the preachive was not excluded, it could be used as a covariate and it may have significantly adjusted the posttest scores on the IMAT in the MANCOVA. That is, the exclusion of preachive may have been a serious problem for the analysis of data. However, the students' physics grades belonging to the previous year (pre_year_ach) were assumed to be significantly correlated with preachive scores. Thus, the use of the pre_year_ach variable as a covariate can minimize the problem related to the exclusion of preachive.

Table 4. 1 Missing values prior to the analysis

Variable	**Present (N)**	**Missing (N)**	**Missing (%)**
Preachive	179	47	21
Preaffect	198	28	12
Pre_year_ach	212	14	6
Postachive	198	28	12
Postaffect	195	31	14
Gender	226	0	0
Approach	226	0	0
Method	226	0	0

Associated with the missing values of pre_year_ach variable, its percentage was less than 5 percent and thus there seems to be no inconvenience for replacing the missing values with the series mean value (Tabachnick & Fidell, 2007, p. 63).

12 percent of preaffect scores were also missing and it could not be ignored. As suggested by Tabachnick and Fidell (2007, p. 63), a dummy variable with two groups was formed using the pretest scores on the ACQ (preaffect) in order to check if there was a pattern in the missing values of preaffect. Cases with missing values were coded as 1 and the remaining cases were coded as 0. This dummy variable was used as an independent variable while the posttest scores were used as dependent variables to perform MANCOVA for testing whether there was a significant difference between the missing and present cases in posttest scores. Because no evidence was found to claim a significant difference, it was not necessary to use the dummy variable as an independent variable for the analysis of data.

Afterwards, all the students who took both posttests were identified and retained for the analysis. Consequently, 194 cases were used for performing MANCOVA and their missing pretest scores were replaced with series means (see Appendix P for the last version of the data).

4.2 Multivarite Analysis of Covariance

MANCOVA was performed to test the null hypothesis of this study. However, before the MANCOVA results will be presented, related descriptive statistics and the procedures used to check the assumptions of MANCOVA will be presented first.

4.2.1 Descriptive Statistics

The descriptive statistics for dependent variables and covariates are computed for each level of the independent variables and for each level of the interactions among the independent variables. Because we will perform inferential statistics for main and interaction effects of the independent variables on the dependent variables, descriptive statistics related to the main and interaction effects are presented for the dependent variables as well as the overall descriptive statistics. For covariates, only the overall descriptive statistics is presented.

4.2.1.1 Descriptive Statistics for Quantitative Scores

Table 4.2 presents the descriptive statistics for posttest scores on the quantitative test items of the IMAT.

The highest score the students could take through the quantitative items of the IMAT was 14. The overall mean of the quantitative scores for 194 students is 8.71. The minimum and maximum scores range from 1 to 14. Thus range of the scores is 13 and it can be said to be large. The standard deviations also support this conclusion. Sample size of each cell is equal to or over 20. This is important for assuring normality assumption (Tabachnick & Fidell, 2007, p. 279). Moreover, skewness and kurtosis values give information about whether the samples are distributed normally. Because all of them are between -2 and +2, all distributions in each cell are normal (George & Mallery, 2003, pp. 98-99).

Associated with the main effects, there is no much difference between mean scores of the groups with contextual and non-contextual approaches (8.55 and 8.88, respectively). There is no much difference between traditional and learning cycle methods either (8.86 or 8.55, respectively). With respect to gender, again, there is no much difference between female and male students (8.84 and 8.60, respectively). Therefore, any significant main effects on quantitative understanding are not expected as a result of inferential statistics.

Table 4. 2 Descriptive Statistics for Post-quantitative Scores

Approach	Method	Gender	N	Mean	SD	Min.	Max.	Skew.	Kurt.
Non-contextual	Traditional method	Female	26	9,35	3,37	1,00	13,00	-1.09	.97
		Male	22	8,41	3,19	2,00	12,00	-.45	-.84
		Total	48	8,92	3,29	1,00	13,00	-.75	-.11
	Learning cycle	Female	21	9,57	3,44	4,00	13,00	-.75	-1.06
		Male	26	8,27	3,72	2,00	13,00	.01	-1.53
		Total	47	8,85	3,62	2,00	13,00	-.30	-1.48
	Total	Female	47	9,45	3,37	1,00	13,00	-.90	-.06
		Male	48	8,33	3,45	2,00	13,00	-.15	-1.28
		Total	95	8,88	3,44	1,00	13,00	-.49	-.52
Contextual	Traditional method	Female	24	9,29	2,18	4,00	12,00	-.60	-.23
		Male	29	8,41	2,68	3,00	13,00	.14	-.82
		Total	53	8,81	2,48	3,00	13,00	-.18	-.79
	Learning cycle	Female	20	6,85	3,80	2,00	13,00	.53	-1.27
		Male	26	9,31	3,13	4,00	14,00	-.28	-1.24
		Total	46	8,24	3,62	2,00	14,00	-.04	-1.43
	Total	Female	44	8,18	3,23	2,00	13,00	-.28	-1.15
		Male	55	8,84	2,91	3,00	14,00	-.03	-1.13
		Total	99	8,55	3,06	2,00	14,00	-.19	-1.03
Total	Traditional method	Female	50	9,32	2,83	1,00	13,00	-1.01	1.21
		Male	51	8,41	2,88	2,00	13,00	-.18	-.81
		Total	101	8,86	2,88	1,00	13,00	-.56	-.16
	Learning cycle	Female	41	8,24	3,83	2,00	13,00	-.12	1.65
		Male	52	8,79	3,44	2,00	14,00	-.17	-1.36
		Total	93	8,55	3,61	2,00	14,00	-.17	-1.47
	Total	Female	91	8,84	3,34	1,00	13,00	-.55	-.79
		Male	103	8,60	3,17	2,00	14,00	-.14	-1.12
		Total	194	8,71	3,24	1,00	14,00	-.34	-.98

If the interactions are investigated, groups with traditional and learning cycle methods do not seem to differ in both contextual and non-contextual groups. In non-contextual groups, mean scores are 8.92 and 8.85 for traditional and learning cycle groups, respectively. Similarly, they are respectively 8.81 and 8.24 for traditional and learning cycle groups in the contextual groups.

Female students' mean quantitative score is larger than male students' mean score in the groups with non-contextual approach (9.45 and 8.33, respectively) while male students' mean score is larger than female students' mean score in the groups with contextual approach (8.84 and 8.18, respectively).

In the groups with traditional teaching method, female's mean score is larger than male's mean score (9.32 and 8.41) while male students' mean score is larger than female's mean score in the learning cycle groups (8.79 and 8.24).

Consequently, teaching approach-gender and teaching method-gender interactions are expected to be significant while the teaching approach-teaching method interaction is expected to be non-significant in inferential statistics.

4.2.1.2 Descriptive Statistics for the Conceptual Scores on the IMAT

Table 4.3 presents the descriptive statistics for student scores on the conceptual test items of the IMAT.

The highest score the students could take through the conceptual items was 15. The overall mean of the conceptual scores for 194 students is 6.73. Minimum and maximum scores range from .00 to 12. All the standard deviations are large with respect to the mean scores. Skewness and kurtosis values are between -2 and +2, and thus all distributions in each cell are normal (George & Mallery, 2003, pp. 98-99).

There may be a significant difference between non-contextual and contextual approaches on the conceptual mean scores (6.26 and 7.17, respectively). If the difference is significant, it is in favor of the contextual approach. However, there seems to be no much difference between traditional and learning cycle methods (6.94 or 6.49, respectively). With respect to gender, much difference cannot be also observed between female and male students (6.49 and 6.93, respectively).

If the interactions are investigated, there may be a significant interaction between teaching approach and teaching method because groups with traditional methods seem to differ in non-contextual and contextual groups (6.27 and 7.55, respectively) while groups with learning cycle seem not to differ (6.26 and 6.74, respectively). In other words, contextual approach may have worked better with the traditional teaching method in increasing conceptual understanding of the physics content.

In addition, there may be a significant interaction between teaching approach and gender. Female students' mean quantitative scores do not seem to differ in non-contextual and contextual groups (6.51 and 6.48) while male students' mean score in the contextual groups is larger than male students' mean sore in the non-contextual groups (9.45 and 8.33, respectively) while male students' mean score is larger than female students' mean score in the contextual groups (6.02 and 7.73, respectively).

Table 4. 3 Descriptive Statistics for Post-conceptual Scores

Approach	Method	Gender	N	Mean	SD	Min.	Max.	Skew.	Kurt.
Non-contextual	Traditional method	Female	26	6,65	2,80	1,00	11,00	-.41	-.53
		Male	22	5,82	2,28	2,00	9,00	-.15	-1.17
		Total	48	6,27	2,58	1,00	11,00	-.21	-.76
	Learning cycle	Female	21	6,33	3,14	,00	10,00	-1.00	-.44
		Male	26	6,19	2,58	1,00	10,00	-.64	-.43
		Total	47	6,26	2,81	,00	10,00	-.81	-.47
	Total	Female	47	6,51	2,93	,00	11,00	-.71	-.44
		Male	48	6,02	2,43	1,00	10,00	-.42	-.79
		Total	95	6,26	2,68	,00	11,00	-.54	-.61
Contextual	Traditional method	Female	24	7,79	1,47	4,00	9,00	-1.12	.43
		Male	29	7,34	2,22	3,00	11,00	-.41	-.66
		Total	53	7,55	1,92	3,00	11,00	-.68	-.17
	Learning cycle	Female	20	4,90	1,89	2,00	9,00	.47	-.19
		Male	26	8,15	2,36	2,00	12,00	-.87	.68
		Total	46	6,74	2,70	2,00	12,00	-.05	-1.01
	Total	Female	44	6,48	2,20	2,00	9,00	-.38	-1.07
		Male	55	7,73	2,31	2,00	12,00	-.57	-.26
		Total	99	7,17	2,33	2,00	12,00	-.40	-.65
Total	Traditional method	Female	50	7,20	2,31	1,00	11,00	-.88	.45
		Male	51	6,69	2,35	2,00	11,00	.-27	-.87
		Total	101	6,94	2,34	1,00	11,00	-.55	-.41
	Learning cycle	Female	41	5,63	2,67	,00	10,00	-.33	-.91
		Male	52	7,17	2,64	1,00	12,00	-.66	-.09
		Total	93	6,49	2,75	,00	12,00	-46	-.58
	Total	Female	91	6,49	2,59	,00	11,00	-.62	-.44
		Male	103	6,93	2,50	1,00	12,00	-.45	-.49
		Total	194	6,73	2,55	,00	12,00	-.53	-.44

Similarly, there may be a significant interaction between teaching method and gender as well. Female's mean score in traditional groups is larger than female's mean score in the learning cycle groups (7.20 and 5.63) while male students' mean score in traditional groups is smaller than male's mean score in the learning cycle groups (6.69 and 7.17).

4.2.1.3 Descriptive Statistics for the Posttest Scores on the ACQ

The highest score the students could take on the ACQ was 5. The overall mean of the posttest scores on the ACQ for 194 students is 3.71.The minimum and maximum scores range from 1.26 to 5.00. All the standard deviations are large with respect to the mean scores. All skewness and kurtosis values except for two values are in the range of -2 and +2, and the sampling distributions with desired skewness and kurtosis values are normal (George & Mallery, 2003, pp. 98-99). Meanwhile, the values which are not in the range do not exceed the range much. Thus, the normality assumption is not expected to be seriously violated.

The mean score of the contextual group is little larger than the mean score of the non-contextual group but it seems to be non-significant (3.74 and 3.68, respectively). The mean score of learning cycle group is little smaller than the mean score of the traditional method, but again, it does not seem to be significant (3.74 and 3.67, respectively). On the other hand, there may be a significant difference between female and male students and male students seem to have more positive attitude and motivation than female students (3.55 and 3.85, respectively).

Mean score of the traditional group with contextual approach is larger than the mean score of the traditional group with non-contextual approach (3.84 and 3.62, respectively). Meanwhile, the mean score of the learning cycle group with contextual approach is smaller than the mean score of the learning cycle group with non-contextual approach (3.62 and 3.73, respectively).

Mean score of females in the contextual approach group is smaller than the mean score of females in non-contextual approach group while the mean score of males in contextual approach group is larger than the mean score of the males in non-contextual approach group.

Table 4. 4 Descriptive Statistics for Post-affective scores

Approach	Method	Gender	N	Mean	SD	Min.	Max.	Skew.	Kurt.
Non-contextual	Traditional method	Female	26	3,42	,75	1,89	5,00	-.26	-.21
		Male	22	3,86	,56	2,29	4,61	-1.04	1.50
		Total	48	3,62	,70	1,89	5,00	-.63	.06
	Learning cycle	Female	21	3,82	,46	3,14	4,84	.75	-.21
		Male	26	3,65	,53	2,37	4,86	.01	.75
		Total	47	3,73	,50	2,37	4,86	.16	.55
	Total	Female	47	3,60	,66	1,89	5,00	-.47	.56
		Male	48	3,75	,55	2,29	4,86	-.43	.41
		Total	95	3,68	,61	1,89	5,00	-.51	.59
Contextual	Traditional method	Female	24	3,64	,56	2,25	4,57	-.67	.32
		Male	29	4,00	,49	2,62	5,00	-.54	1.56
		Total	53	3,84	,55	2,25	5,00	-.62	.77
	Learning cycle	Female	20	3,31	,76	1,26	4,38	-.1.11	1.38
		Male	26	3,86	,53	2,49	4,64	-.91	.84
		Total	46	3,62	,69	1,26	4,64	-.1.20	1.19
	Total	Female	44	3,49	,67	1,26	4,57	-.1.09	1.65
		Male	55	3,94	,51	2,49	5,00	-.73	1.09
		Total	99	3,74	,62	1,26	5,00	-1.06	1.95
Total	Traditional method	Female	50	3,53	,67	1,89	5,00	-.50	.04
		Male	51	3,94	,52	2,29	5,00	-.81	1.49
		Total	101	3,74	,63	1,89	5,00	-.73	.52
	Learning cycle	Female	41	3,57	,67	1,26	4,84	-1.12	2.78
		Male	52	3,76	,54	2,37	4,86	-.41	.21
		Total	93	3,67	,60	1,26	4,86	-.90	2.19
	Total	Female	91	3,55	,67	1,26	5,00	-.76	1.06
		Male	103	3,85	,54	2,29	5,00	-.58	.55
		Total	194	3,71	,62	1,26	5,00	-.79	1.18

4.2.1.4 Overall Descriptive Statistics for the Pretest Scores on the ACQ

The highest score the students could take on the ACQ was 5. Minimum and maximum scores range from 2.28 to 5.00 (see Table 4.5). The midpoint is 3.64. Skewness and kurtosis values are between -2 and +2, and thus all distributions in each cell are normal (George & Mallery, 2003, pp. 98-99). The overall mean of the pretest scores on the ACQ for 194 students is 3.69. Because of the normal distribution, the mean, median, and mod must be very close to each other. They are very close to the midpoint of the range as well. Therefore, we observe a skewness value very close to zero. All the standard deviations are large with respect to the mean scores. It provides some evidence for the reliability of the scores for each cell.

Table 4. 5 Descriptive Statistics for Pre-affective Scores

Approach	Method	Gender	N	Mean	SD	Min.	Max.	Skew.	Kurt.
Non-contextual	Traditional method	Female	26	3,49	,64	2,28	4,93	.19	.07
		Male	22	3,72	,49	2,73	4,54	-.25	-.22
		Total	48	3,60	,58	2,28	4,93	-.09	-.08
	Learning cycle	Female	21	3,64	,41	3,11	4,64	.79	.26
		Male	26	3,64	,60	2,28	5,00	.01	.37
		Total	47	3,64	,52	2,28	5,00	.17	.64
	Total	Female	47	3,56	,55	2,28	4,93	.14	.45
		Male	48	3,68	,55	2,28	5,00	-.11	.20
		Total	95	3,62	,55	2,28	5,00	.01	.18
Contextual	Traditional method	Female	24	3,60	,48	2,61	4,78	.61	.86
		Male	29	3,96	,43	2,81	5,00	.18	1.54
		Total	53	3,80	,48	2,61	5,00	.21	.39
	Learning cycle	Female	20	3,58	,59	2,50	4,53	-.33	-.44
		Male	26	3,83	,46	2,83	4,94	.28	1.39
		Total	46	3,72	,53	2,50	4,94	-.28	.52
	Total	Female	44	3,59	,53	2,50	4,78	.02	.04
		Male	55	3,90	,44	2,81	5,00	.19	1.14
		Total	99	3,76	,50	2,50	5,00	-.07	.48
Total	Traditional method	Female	50	3,54	,56	2,28	4,93	.22	.37
		Male	51	3,86	,47	2,73	5,00	-.12	.63
		Total	101	3,70	,54	2,28	5,00	-.07	.21
	Learning cycle	Female	41	3,61	,50	2,50	4,64	-.11	.05
		Male	52	3,74	,54	2,28	5,00	-.06	.73
		Total	93	3,68	,52	2,28	5,00	-.05	.40
	Total	Female	91	3,57	,53	2,28	4,93	.08	.18
		Male	103	3,80	,51	2,28	5,00	-.13	.65
		Total	194	3,69	,53	2,28	5,00	-.06	.26

4.2.1.5 Overall Descriptive Statistics for Physics Grades in the Previous Year

The highest score the students could take in the previous year was 100. Minimum and maximum scores range from 22.50 to 97.50 (see Table 4.6). The midpoint is 60.00. Skewness and kurtosis values are between -2 and +2, and thus all distributions in each cell are normal (George & Mallery, 2003, pp. 98-99). The overall mean of the previous year's grades for 194 students is 62.49. Because of the normal distribution, the mean, median, and mod are very close to each other. They are a little larger than the midpoint of the range. They are very close to the midpoint as well. Thus, we observe a skewness which is very close to zero. All the standard deviations are large with respect to the mean scores. It provides some evidence for the reliability of the scores for each cell.

Table 4. 6 Descriptive Statistics for Physics Grades in the Previous Year

Approach	Method	Gender	N	Mean	SD	Min.	Max.	Skew.	Kurt.
Non-contextual	Traditional method	Female	26	63,92	19,13	22,50	93,50	-.60	-.24
		Male	22	65,59	14,66	37,00	92,50	.09	-.20
		Total	48	64,69	17,07	22,50	93,50	-.45	-.05
	Learning cycle	Female	21	67,07	15,73	42,50	93,00	.17	-1.27
		Male	26	53,86	15,54	26,50	94,00	.33	.59
		Total	47	59,77	16,82	26,50	94,00	.22	-.36
	Total	Female	47	65,33	17,58	22,50	93,50	-.41	-.31
		Male	48	59,24	16,10	26,50	94,00	.13	-.08
		Total	95	62,25	17,04	22,50	94,00	-.12	-.43
Contextual	Traditional method	Female	24	63,65	15,35	39,00	85,50	-.11	-1.42
		Male	29	61,81	18,25	31,50	95,00	.43	-.86
		Total	53	62,64	16,86	31,50	95,00	-.05	-.98
	Learning cycle	Female	20	60,15	18,85	33,50	94,00	.68	-.53
		Male	26	64,85	17,48	26,00	97,50	-.32	.30
		Total	46	62,80	18,04	26,00	97,50	.12	-.48
	Total	Female	44	62,06	16,91	33,50	94,00	.28	-.99
		Male	55	63,24	17,79	26,00	97,50	-.14	-.49
		Total	99	62,72	17,33	26,00	97,50	.04	-.73
Total	Traditional method	Female	50	63,79	17,24	22,50	93,50	-.43	-.52
		Male	51	63,44	16,74	31,50	95,00	-.04	-.63
		Total	101	63,61	16,91	22,50	95,00	-.24	-.61
	Learning cycle	Female	41	63,69	17,45	33,50	94,00	.33	-.98
		Male	52	59,35	17,29	26,00	97,50	.06	-.13
		Total	93	61,27	17,40	26,00	97,50	.18	-.46
	Total	Female	91	63,75	17,24	22,50	94,00	-.08	-.76
		Male	103	61,38	17,06	26,00	97,50	.00	-.41
		Total	194	62,49	17,14	22,50	97,50	-.04	-.60

4.3 Determination of Covariates

Correlations among possible covariates and the dependent variables are given in the following table in order to determine if the independent variables desired to be used as covariates satisfy the requirements to be used as covariates. In order to use an independent variable as a covariate, the independent variables which are desired to be used as covariates should be significantly correlated at least one of the dependent variables and correlations between the possible covariates should be less than .80 (Stevens, 2009, p. 292; Tabachnick & Fidell, 2007, p. 211). When we look at the values, preaffect and pre_year_ach variables are observed to satisfy the requirements to be used as covariates (Table 4.7). Thus, they are used as covariates in the analysis of this study.

Table 4. 7 Correlations among possible covariates and the dependent variables

Variables	preaffect	pre_year_ach	quan_scores	concept_scores
pre_year_ach	.225*			
quan_scores	.137	.510*		
concept_scores	.079	.403*	.598*	
postaffect	.639*	.344*	.200*	.240*

*Correlation is significant at .05 alpha level

4.4 Evaluation of the Assumptions in MANCOVA

Assumption associated to the Multivatiate Analysis of Covariance (MANCOVA) is as follows:

4.4.1 Univariate and Multivariate Normality

Univariate normality can be checked through skewness and kurthosis values for each cell (Tabachnick & Fidell, 2007, p.p. 79-83). If they are around zero, the sampling distributions are expected to be normal. In this study, all values indicate normal sampling distributions for each dependent variable and covarite in each cell.

Even though sample sizes are unequal among each cell of the factorial design, multivariate normality is suggested to be met if there are more than 20 cases in each cell (Tabachnick & Fidell, 2007, p. 279). Because each cell of this factorial experiment includes more than 20 cases, multivariate normality assumption seems to be assured. Moreover, a procedure called Mahalanobis distances is used to check the multivariate normality as well as checking if there are outliers (Pallant, 2007).

4.4.2 Linearity

If the dependent variables and the covariates are skewed in the same direction when they are skewed, the relationships among them are linear (Tabachnick & Fidell, 2007, p. 224). In this study, linearity assumption is assured because of the similar skewness directions.

4.3.3 Outliers

Univariate outliers were checked using boxplots as described in Pallant (2007, p. 63). There were few univariate outliers for each observed variable. Multivariate outliers were checked by means of Mahalanobis distances as explained in Pallant

(2007, p. 278). Only one case was exceeding the critical distance. However, those cases were not excluded from the data in order not to decrease the sample size.

4.4.4 Absence of Collinearity and Singularity

When the correlation matrix in Table 4.7 is examined for correlations among the dependent variables, there seems to be no multicollinearity and singularity. There is no a problem for covariates as well.

4.4.5 Homogeneity of Variance/Covariance

If largest group size/smallest group size proportion is smaller than 1.5, then the F-test is robust against this assumption (Stewens, 2009, p. 227). When the sample sizes for each cell are compared (i.e. Table 4.6) they are very close to each other.

4.4.6 Homogeneity of Regression

In order to test the homogeneity of regression assumption for performing MANCOVA and follow-up ANCOVAs, the following syntax, based on the explanations in Stevens (2009, pp. 300-308) and in Tabachnick and Fidell (2007, pp. 281-284), were written to be run on SPSS. The syntax is shown in the following figure.

```
MANOVA preaffect,pre_year_ach,Con_scores,Quant_scores,postaffect BY approach(0,1),method (0,1),gender(0,1)
/PRINT=SIGNIF(BRIEF)

/ANALYSIS=Con_scores,Quant_scores,postaffect
/DESIGN=preaffect,pre_year_ach,approach,method,gender,approach BY method, approach BY gender, method BY gender,
approach BY method BY gender,
pool(preaffect,pre_year_ach) BY approach+pool(preaffect,pre_year_ach) BY method+pool(preaffect,pre_year_ach) BY
gender+pool(preaffect,pre_year_ach) BY approach BY method+pool(preaffect,pre_year_ach) BY approach BY gender+
pool(preaffect,pre_year_ach) BY method BY gender+pool(preaffect,pre_year_ach) BY approach BY method BY gender

/ANALYSIS=Con_scores
/DESIGN=preaffect,pre_year_ach,approach,method,gender,approach BY method, approach BY gender, method BY gender,
approach BY method BY gender,
pool(preaffect,pre_year_ach) BY approach+pool(preaffect,pre_year_ach) BY method+pool(preaffect,pre_year_ach) BY
gender+pool(preaffect,pre_year_ach) BY approach BY method+pool(preaffect,pre_year_ach) BY approach BY gender+
pool(preaffect,pre_year_ach) BY method BY gender+pool(preaffect,pre_year_ach) BY approach BY method BY gender
```

Figure 4. 1 SPSS syntax for checking homogeneity of regression assumption for MANCOVA

In the syntax, the first part starting with /ANALYSIS is written for checking the homogeneity of regression assumption to perform the MANCOVA desired. The other part is written for checking the assumption to perform the follow-up ANCOVA in which post-conceptual scores is used as the dependent variable. To keep the figure short, the rest of the syntax for the other follow-up ANCOVAs is not presented. However, the syntaxes for the other ANCOVAs are the same with the syntax presented except for the name of the dependent variable.

As stated in Tabachnick and Fidell (2007, p. 281), alpha is set at .01 level for significance testing. After running the syntax on SPSS, we explore the values for the source starting with "POOL." Because all the effects by the term starting with "POOL" are non-significant, homogeneity of regression assumption is said to be met to perform the desired MANCOVA and the follow-up ANCOVAs. To perform the MANCOVA, F (42,499.13) = 1.257, p = .135, Wilks' Lambda = .742, and to perform the follow-up ANCOVAs F (14,170) = 1.81, p = .041, F (14,170) = 1.22, p = .262, and F (14,170) = 1.01, p = .444, respectively for conceptual scores, quantitative scores, and affective scores.

4.4.7 Reliability of Covariates

Students' physics grades in the previous year were obtained from school administration and it is the average of physics grades in the fall and spring terms (first and second terms). Because we do not have the students' performance on each item in their teacher-made examinations, it is not possible to estimate a reliability coefficient. However, we have their two exam results in the spring term in addition to their physics grades at the end of the terms. Therefore, we may look at the correlations among exam results and the term grades, and it may give some clues about how reliable the physics grades are. Table 4.8 presents the correlations. It could be concluded from the table that there seems to be a consistency among the exam results and the term grades. This consistency may be an indicator of that the variable, pre_year_ach, is a reliable measure of student achievement in physics in the previous year.

Table 4. 8 Correlations among exam results and term grades

Variables	Exam 1	Exam 2	Fall	Spring
Exam 1				
Exam 2	.594*			
Fall	.865*	.840*		
Spring	.633*	.691*	.787*	
Pre_year_ach	.784*	.804*	.937*	.953*

*Correlation is significant at .05 alpha level

4.5 MANCOVA Results

Because the MANCOVA related assumptions were met, the researcher could perform the analysis for testing the null hypothesis aforementioned. The dependent variables were the posttest scores on the quantitative items of the IMAT (quant_scores), the posttest scores on the conceptual items of the IMAT (concept_scores), and the posttest scores on the ACQ (postaffect). The independent variables were teaching approach (contextual approach versus the non-contextual approach), teaching method (learning cycle method versus the traditional method), and gender (males versus females). The covariates were pretest scores on the ACQ (preaffect) and physics grades in the previous year (pre_year_ach).

As seen from Table 4.9, the covariates contribute significantly to adjustment of the combined dependent variables of quantitative achievement, conceptual achievement, and attitude ($F(3, 182) = 34.785$, $p = .000$; Wilks' Lambda = .636; partial eta squared = .36 for Preaffect, and $F(3, 182) = 26.358$, $p = .000$; Wilks' Lambda = .697; partial eta squared = .303 for Preyear).

Table 4. 9 MANCOVA Results

	Wilks' Lambda	F	Hypothesis df	Error df	Sig.	Partial Eta-squared	Observed Power
Intercept	.898	6.921	3	182	.000	.102	.977
Preaffect	.636	34.785	3	182	.000	.36	1.000
Pre_year_ach	.697	26.358	3	182	.000	.303	1.000
Approach	.914	5.672	3	182	.001	.086	.943
Method	.991	.553	3	182	.646	.009	.163
Gender	.943	3.648	3	182	.014	.057	.792
Approach by Method	.954	2.949	3	182	.034	.046	.693
Approach by Gender	.965	2.171	3	182	.093	.035	.546
Method by Gender	.921	5.212	3	182	.002	.079	.923

When the main effects are checked, there is evidence that differences in the combined dependent variables of quantitative achievement, conceptual achievement, and attitude for teaching approach and gender are statistically significant (F(3, 182) = 5.672, p = .001; Wilks' Lambda = .914; partial eta squared = .086 for Approach, and F(3, 182) = 3.648, p = .014; Wilks' Lambda = .943; partial eta squared = .57 for Gender). In other words, there is significant difference between mean combined scores of the students in contextual and non-contextual groups. Furthermore, there is significant difference between mean combined scores of male and female students.

When the interaction effects are checked, we have evidence that approach by method and method by gender interactions are statistically significant (F(3, 182) = 2.949, p = .034; Wilks' Lambda = .954; partial eta squared = .046 for approach by method, and F(3, 182) = 5.212, p = .002; Wilks' Lambda = .921; partial eta squared = .079). Furthermore, the approach by gender interaction for the combined dependent variables of quantitative achievement, conceptual achievement, and attitude was not statistically significant (F(3, 182) = 2.171, p = .093; Wilks' Lambda = .965; partial eta squared = .035).

4.6 Follow-up ANCOVA Results

In order to see which groups the main effects are in favor of and how the interactions are, univariate ANCOVAs for each dependent variable and interaction plots are necessary. Table 4.10 presents the univariate ANCOVA results.

First of all, as described in Tabachnick and Fidell (2007, p. 270), a Bonferroni type adjustment is required for the inflated Type I error in case of separate univariate tests instead of a multivariate test. It is simply suggested to divide the alpha, which is usually set at .05 level, by the number of separate univariate tests, which is the number of dependent variables in this case. As a result, for the univariate tests, alpha is set at .017 level, which is obtained by dividing .05 alpha level by 3.

When we check which dependent variable's adjustment the covariates significantly contribute to, Preaffect is observed to significantly contribute to adjustment of postaffect, which is the students' post scores on the ACQ (F(1, 184) = 96.452, p = .000; partial eta squared = .344). Meanwhile, Pre_year_ach significantly contributes to adjustment of all the dependent variables (F(1, 184) = 58.473, p = .000; partial eta squared = .241 for quant_scores, F(1, 184) = 40.743, p = .000; partial eta squared = .181 for concept_scores, and F(1, 184) = 14.871, p = .000; partial eta squared = .075 for postaffect).

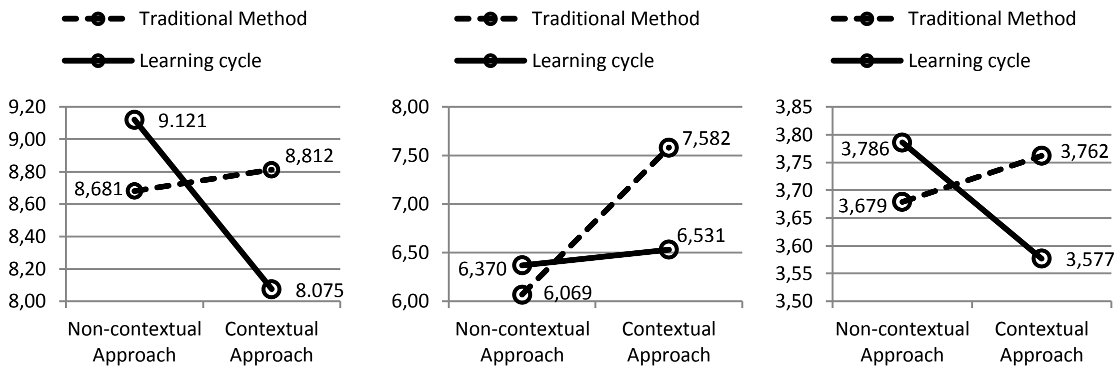
Related to the main effect of teaching approach on each dependent variable, we have evidence that contextual and non-contextual groups significantly differ in conceptual scores (F(1, 184) = 6.98, p = .009; partial eta squared = .037). Meanwhile, the effect size is small to medium. Estimated marginal means of the conceptual scores for contextual and non-contextual groups are 7.06 and 6.22, respectively. In brief, the significant difference between contextual and non-contextual groups in conceptual scores seems to be in favor of the contextual groups.

Table 4. 10 Univariate ANCOVA Results

Source	Dependent Variable	df	F	Sig.	Partial Eta Squared	Observed Power
Intercept	Quant_scores	1	1.807	.181	.010	.267
	Concept_scores	1	11.155	.001	.057	.913
	postaffect	1	12.429	.001	.063	.939
Preaffect	Quant_scores	1	.251	.617	.001	.079
	Concept_scores	1	1.031	.311	.006	.173
	postaffect	1	96.452	.000	.344	1.000
Pre_year_ach	Quant_scores	1	58.473	.000	.241	1.000
	Concept_scores	1	40.743	.000	.181	1.000
	postaffect	1	14.871	.000	.075	.970
Approach	Quant_scores	1	1.282	.259	.007	.203
	Concept_scores	1	6.980	.009	.037	.748
	postaffect	1	.934	.335	.005	.161
Method	Quant_scores	1	.136	.713	.001	.066
	Concept_scores	1	1.420	.235	.008	.220
	postaffect	1	.367	.545	.002	.093
Gender	Quant_scores	1	.000	.993	.000	.050
	Concept_scores	1	4.161	.043	.022	.528
	postaffect	1	7.170	.008	.038	.759
Approach by Method	Quant_scores	1	2.133	.146	.011	.306
	Concept_scores	1	4.588	.034	.024	.568
	postaffect	1	5.018	.026	.027	.606
Method by Gender	Quant_scores	1	5.625	.019	.030	.655
	Concept_scores	1	14.466	.000	.073	.966
	postaffect	1	.327	.568	.002	.088

Associated with gender related differences, the only significant difference between males and females based on the adjusted alpha level is in posttest scores on the ACQ, attitude and motivation scores ($F(1, 184) = 7.170$, $p = .008$; partial eta squared = .038). Its effect is small to medium. Although it is not statistically significant, there is difference with small effect size between males and females in conceptual scores as well ($F(1, 184) = 4.161$, $p = .043$; partial eta squared = .022). Both differences are in favor of male students. As a result, male students have a little higher level of attitude and motivation in physics, and little more conceptual understanding of impulse and momentum.

If the interaction effects are investigated, approach by method interactions for all of the dependent variables are observed to be not statistically significant ($F (1, 184) = 2.133$, $p = .146$; partial eta squared = .011 for quant_scores, $F (1, 184) = 4.588$, $p = .034$; partial eta squared = .024 for concept_scores, and $F (1, 184) = 5.018$, $p = .026$; partial eta squared = .027 for postaffect). However, all the related effect sizes are small. Figure 4.2 shows the teaching approach-teaching method interactions for each dependent variable.

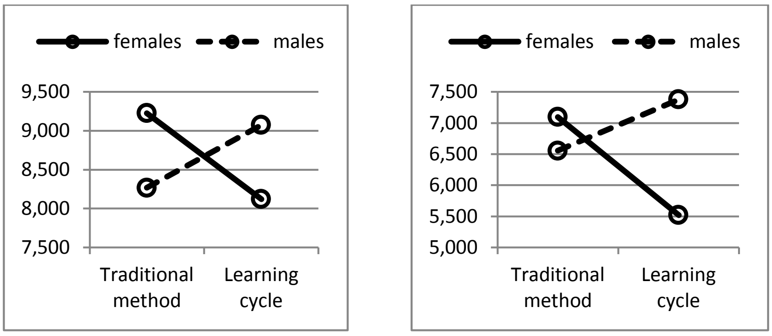


Estimated Marginal Means of Quantitative Scores | **Estimated Marginal Means of Conceptual Scores** | **Estimated Marginal Means of Attitude and Motivation Scores**

Figure 4. 2 Interaction plots for teaching approach and method

According to plot of each dependent variable, traditional teaching method seems to be little more effective in contextual groups while learning cycle seem to be little more effective in the non-contextual groups. In general, contextual approach seems to work a little better with traditional teaching method rather than learning cycle.

While the method by gender interactions are investigated, a significant interaction is observed for conceptual scores (F (1, 184) = 14.466, p = .000; partial eta squared = .073). Although it is not statistically significant, the method by gender interaction has got almost a small to medium effect size for quantitative scores (F (1, 184) = 5.625, p = .019; partial eta squared = .030). As the plots are investigated in Figure 4.3, males are observed to benefit a little more from the learning cycle while females are observed to benefit a little more in the traditional teaching method.



Estimated Marginal Means for Quantitative Scores **Estimated Marginal Means for Conceptual Scores**

Figure 4. 3 Teaching method-gender interaction plots

4.7 Summing up the Results

1. There is significant difference with a medium effect size between mean combined scores of quantitative achievement, conceptual achievement, and attitude of the students in contextual and non-contextual groups. According to follow-up ANCOVAs for each dependent variable, contextual and non-contextual groups significantly differ only in the conceptual scores with a

small to medium effect size. Finally, this significant difference seems to be in favor of the contextual groups.

2. There is significant difference with a medium effect size between mean combined scores of quantitative achievement, conceptual achievement, and attitude of male and female students. According to follow-up ANCOVAs for each dependent variable, male and female students significantly differ in attitudinal and motivational constructs in physics with a small to medium effect size. Although it is not statistically significant, male and female students differ in conceptual understanding of physics concepts with a small effect size. As a result, male students seem to have a little higher level of attitude and motivation in physics, and little more conceptual understanding of impulse and momentum.
3. There is significant interaction with almost medium effect size between teaching approach and teaching method on the combined dependent variables of quantitative achievement, conceptual achievement, and attitude. According to follow-up ANCOVAs for each dependent variable, none of the interaction effects between teaching approach and teaching method on the dependent variables are statistically significant. However, for all of them, small effect sizes are the case, and in general, contextual approach seems to work a little better with traditional teaching method rather than learning cycle.
4. There is significant interaction with medium effect size between teaching method and students' gender on the combined dependent variables of quantitative achievement, conceptual achievement, and attitude. According to follow-up ANCOVAs for each dependent variable, a significant interaction effect between teaching method and gender is observed for conceptual understanding of impulse and momentum. In addition, in spite of statistically non-significance, almost a small to medium effect size is the case for quantitative understanding. As a result, for both dependent variables, males are observed to benefit a little more from the learning cycle while females are observed to benefit a little more in the traditional teaching method.

CHAPTER 5

DISCUSSION, CONCLUSIONS, AND IMPLICATIONS

This chapter starts with the presentation of discussion section. After presenting the internal and external validity issues, conclusions and implications are given. Finally, recommendations for further research are presented.

5.1 Discussion

The purpose of this study was to disentangle the effect of context-based approach from the effect of teaching methods accompanying it. Taking student gender into account, this intention leaded the researcher to perform a 2x2x2 factorial design with three independent variables, teaching approach, teaching method, and gender. Thus, main effects of the independent variables and the interactions among them were investigated.

The main characteristics of this study can be stated as its intention to differentiate the teaching approach from the teaching method. Except for some implicit statements, the differentiation seems not to be taken account in science education literature. However, in language teaching literature, Anthony (1963, as cited in Richards, & Rodgers, 2001) defined teaching approach and teaching method, and emphasized the relationship between them. Accordingly, teaching approach is consisted of correlated assumptions while teaching method is an overall plan of the course. In this study, context-based instruction is treated as a teaching approach because it includes correlated assumptions. For example, studying content within a context has been assumed to make the content more interesting or to make it more relevant (i.e. Bennett et al., 2007; Gilbert, 2006; Pilot & Bulte, 2006; Taasoobshirazi & Carr, 2008; Whitelegg, 1999). Meanwhile, the learning cycle is treated as a teaching method because it provides the instructors with step by step what to do during the class session through its phases. Although, the differentiation between teaching approach and teaching method has not been explicitly emphasized in science and physics education literature, the existing research studies on the effect of context-based instruction are criticized for integrating some non-traditional teaching activities, such as group work or hands-on activities, into the implementation of context-based instruction (Bennett et al., 2007; Taasoobshirazi & Carr, 2008). It makes drawing a conclusion about the unique effect of context-based approach difficult. Therefore, this study was conducted mainly for systematically revealing the unique effect of context-based approach.

In addition, the effect of context-based instruction rather than the effect of context based assessment was explored in this study. Taasoobshirazi and Carr (2008) have emphasized this distinction. In their review study, they categorized the studies into two groups, studies performing context-based approach and studies used context-based assessment under traditional approach. Because real-life examples and problems were used not only in the groups with contextual approach but also in the groups with non-contextual approach, context-based assessment was embodied in all the treatments of this study.

Related to the results of the study, first of all, this study has referred to the content achievement through conceptual and quantitative scores, and a significant difference in favor of the contextual groups was observed in terms of the conceptual scores. Although there is little evidence that the context-based approach increases students' achievement (Bennett et al., 2007; Taasoobshirazi & Carr, 2008), the literature has provided evidence that it promotes conceptually problem solving (Taasoobshirazi & Carr, 2008). Thus, encountering a significant difference particularly in conceptual scores may be directly related to this acquisition. In addition, recent studies in the literature have presented evidence about the contribution of context-based approach on students' achievement (i.e. Demircioğlu, H., 2008; Ingram, 2003; Sari, 2010; Toroslu, 2011).

With respect to the main effects of teaching methods, in the literature, commonly positive results are reported, particularly in terms of attitudinal and motivational constructs (Ates, 2005; Cakiroglu, 2006; Ceylan & Geban, 2009). However, Nuhoğlu and Yalçın (2006) investigated the effect of learning cycle on candidate teachers' attitude towards science, and found no difference. In addition, especially for content achievement, literature on learning cycle point out no difference or mixed results (Abraham, 1998). In this study, any significant differences were not observed between the groups with learning cycle and traditional method. Nonetheless, it is known that the inductive approach is better when it is implemented within a complete program rather than in an isolated unit of instruction (Lott, 1983, as cited in Abraham, 1998). Thus, the reason for observing no difference related to the effect of learning cycle may be the duration the treatments were implemented. Implementations of the treatments in this study lasted four weeks and covered only one unit.

Frequently, gender related differences in science are reported and why females possess less positive attitude toward science than do males is attributed to physiological or commonly to sociological functions (Koballa & Glynn, 2007). For example, that parents, teachers, or peers place different cultural expectations on females and males is a sociological reason. Also, males and females are provided with different experiences (Jones, Howe, & Rua, 2000; She, 1998, as cited in Koballa & Glynn, 2007). For example, Sencar and Eryılmaz (2004) revealed that male and female students' differing experiences and their ages could explain in ninth grade Turkish students' gender related differences in interpreting electric circuits. In this study, male students were similarly observed to have a little more positive attitude and motivation in physics, and little more conceptual understanding of impulse and momentum. Moreover, this gender related difference in attitude and motivation in physics in favor of males had been apparent prior to the treatments because any significant interactions between teaching approach and gender or teaching method and gender could not be observed. In other words, there had been a gender related difference in attitude and motivation in physics prior to the instruction, and females benefitted more neither from the contextual approach nor the learning cycle. Thus the difference could not be closed through either contextual approach or the learning cycle.

However, the gender related differences in conceptual scores may have been caused by the teaching method and gender interaction. A medium size interaction between the teaching method and gender were detected for conceptual scores. That is, because males benefitted more from the learning cycle in terms of conceptual understanding, the gap between males' and females' conceptual scores may be increased by the learning cycle.

Some research studies revealed that males and females are differently influenced by a treatment. For example, Nieswandt (2005) reported that females seem to work better if they are engaged in social interaction with peers through small group works, while males work better individually or less often with peers. In this study, students were engaged in group works through learning cycle, and worked without group works in traditional method. Contrary to the expectations, males seemed to be influenced positively by group work while females were influenced negatively. This may be again related to cultural differences as emphasized by Nieswandt (2005).

Finally, contextual approach seems to work significantly better with traditional teaching method rather than learning cycle for the combined dependent variables of quantitative achievement, conceptual achievement, and attitude. It is very difficult to interpret this finding. However, it is known that inductive learning methods, including learning cycle, are more effective on medium or more capable students. Otherwise, deductive approaches were observed to be better (Lott, 1983, as cited in Abraham, 1998; Flick, 1995). That is, this result may be related to capabilities of the students. Moreover, Özdemir (2003) investigated the factors contributing 8th grade Turkish students' science achievement using the Third International Mathematics and Science Study – Repeat (TIMSS-R) data. Interestingly, teacher-centered activities rather than students-centered activities were observed to positively contribute to the science achievement. That is, the finding that the contextual approach seems to be more effective with the traditional teaching method may be dependent on the cultural differences.

5.2 Internal Validity

Internal validity of a study is associated with whether observation of the dependent variable(s) is dependent upon only the intended independent variables (Fraenkel & Wallen, 1996, p. 241). In other words, there may be some other independent variables influencing the dependent variable(s) in a study and they must be controlled so that the internal validity is established. Common threats to internal validity are listed as subject characteristics, mortality, location, instrumentation, testing, history, maturation, subject attitude, regression, and implementer related threats (Fraenkel & Wallen, 1996, p. 242).

Subject characteristics:

In spite of the purposive sampling, the treatments were randomly assigned to the intact classes. In addition, covariates were used in the analysis of data to adjust the posttest scores. Because use of covariates means statistical matching, subject characteristics threat is assumed to have been controlled.

Mortality:

Loss of subjects was the case while posttests were being administered. Those students were removed from the data. However, because percentages of them were equal or less than 12 percent, it was not expected at least a series issue. For the remaining students, some of them had not taken the pretests. Those cases were coded as 1 and the others were coded as 0 to create a dummy variable. Using this dummy variable, if there was a significant difference in their posttest scores was investigated. Results showed no significant differences. Thus, mortality threat is assumed not to be a serious issue.

Location:

In each school, there were four treatment groups. That is, each treatment was implemented in two classes in each school. Not only the classes in the same school but all the classes in both schools had similar conditions. Thus, the location threat is assumed to be controlled.

Instrumentation:

There researcher informed the teachers about data collection. Students were informed about that the tests were for a research study and their responses were going to be used only by the researcher and were not going to be shared with anybody else. Pretests were administered by the teachers of the classes. That is, for each school, the same teacher administered the pretests. When posttests were administered, the researcher administered the posttests in one of the schools. In the other school, again the teacher administered the posttests. That is, in order to control "data collector characteristics" one person collected data in each school. However, it would be better if one person had collected all the data. Because objective test items were used in the instruments, "instrument decay" is assumed to have been controlled. In addition, in order to control the "data collector bias", the teachers were warned about administering the tests in a standard way and obeying the directions.

Testing:

Use of pretests would have influenced the performance on the posttests. This threat seems to be inevitable. However, this effect is at similar degrees for each group. Thus, this threat is assumed to have been controlled.

History:

Any events which may have influenced the groups while the treatments were being implemented were not reported.

Maturation:

Because all the students were about the same ages and the treatments lasted for only four weeks, “maturation” threat was not a problem for this study.

Attitudinal effect:

Because students from different classes are in contact in break times and they may have mentioned about what they were doing in their classrooms. If students in the traditional groups would have heard that new and interesting activities were being carried out in the other classes, they may have demoralized and this may have affected their performance negatively or positively. In order to avoid such a John henry effect (Hake, 1998), some activities designed to carry out with learning cycle were presented in form of demonstrations in groups with traditional method.

Regression:

Because the study was conducted with intact classes and there were no significant differences among them with respect to the pretests, regression effect is assumed to be controlled.

Implementation:

Prior to the treatments, the teachers were informed about the significance of why they should have implemented the treatments and the teachers accepted to implement the treatments. However, just after the pretests were administered, one of the teachers rejected implementation and asked the researcher for implementing the treatments. In order not to decrease the sample size and loss one of the schools, the researcher accepted to implement the treatments. However, the researcher did his best to implement the treatments as described in the lesson plans in order to control the “implementer bias”. In addition, using the classroom observation checklist, a research assistant observed several class hours in a way that each treatment group was observed.

5.3 External Validity

The study was conducted in two of seven schools in the district. Those schools were more crowded than the other schools except for one school in the district. That is, the sample was expected to be more than 10 percent of the population. In addition, most of the students in all the schools in this district are low or medium achievers. That is, in terms of achievement level, the two schools the study was carried out are similar to other five schools. Thus, the results of this study may be generalized to the accessible population.

In the district, students are expected to be at low or medium socio-economic status. As aforementioned, the students were mostly low or medium achievers. That is, the results can be generalized to similar other settings as well.

5.4 Conclusions

Related to the study conducted, first of all, the contextual approach seems to help develop conceptual understanding of physics concepts. For quantitative problem solving, the contextual approach is as effective as the non-contextual approach.

With respect to the effect of learning cycle, it was not different from the traditional teaching method neither in increasing students' achievement nor in improving their attitudinal and motivational constructs.

There was a gender related difference in attitude and motivation in physics both prior to and just after the treatments. That is, neither contextual approach nor learning cycle contributed to the gender gap to be closed. For the gender related difference in conceptual scores, it may have been caused by the contextual approach and the learning cycle because males benefitted more from the contextual approach and particularly from the learning cycle.

Surprisingly, the contextual approach seems to work better with the traditional teaching method rather than the learning cycle. This may be related to that the students who were expected to be low or medium achievers.

In terms of quantitative and conceptual achievement, males benefit little more from the contextual approach while females benefit little more from non-contextual approach.

In terms of quantitative and conceptual achievement, males benefit little more from the learning cycle while females benefit little more from the traditional teaching method.

5.5 Implications

- The current physics curricula are based on context-based approach in Turkey. As the curriculum developers offers, teachers should deliver their instruction through the use of contextual approach for helping their students acquire more conceptual understanding and as much as quantitative problem solving the non-contextual approach provide.
- The learning cycle seems to be at least as effective as the traditional method on students most of whom are expected as low or medium achievers. Based on the related literature, it may be more effective with high achievers (Abraham, 1998; Flick, 1995). Thus, instead of the traditional method, the learning cycle is suggested to be used in physics instruction. In addition to physics achievement, and the attitudinal and motivational constructs, some other skills may be provided by the learning cycle model as well.
- However, teachers may be required to be careful if they want to use the learning cycle with contextual approach because it may not be as beneficial as the traditional method with contextual approach. Based on the literature, this may be associated with the differing effect of learning cycle with respect to the achievement level of the students. The related literature explicitly states that the learning cycle is effective particularly on high achievers (Flick, 1995). Its superiority to the traditional decreases as the achievement level decreases (Abraham, 1998).

5.6 Recommendations for Further Study

- In addition there are some other variables such as problem solving skills or scientific process skills which were not assessed in this study. Contextual approach may be positively contributing to some other variables as well.
- Researchers studying context-based approach emphasize the importance of context selection. They suggest selecting interesting contexts for students (i.e. Waltner, Wiesner, & Rachel, 2007; Whitelegg & Parry, 1999). Thus, researchers who have intention of studying the effect of context-based approach may carry out a study on what type of contexts students are interested in.
- Females and males were observed to benefit differently from contextual approach or learning cycle. This is very interesting and what reasons may be beyond such a finding is suggested being investigated.
- This study revealed that making the distinction between teaching approach and teaching method is crucial. It can be clearly stated that such a distinction is able to depict how a teaching method integrated with a teaching approach influences its effectiveness or how a teaching approach influences the effect of a teaching method. This study had an attempt to investigate how the use of the traditional and learning cycle methods contributes to the effectiveness of contextual approach, which plays an important role in most science curricula all over the world. As a result, researchers are invited to investigate effects of some other teaching methods on the effect of contextual approach or another teaching approach.
- In this study, it was recognized that it would be better if achievement of the students had been assessed through the use two separate achievement tests. One of them should have included only contextual items and the other should have included traditional physics problems. Obviously, students probably achieved different progress in traditional or contextual problem solving.

- The contextual approach may provide students with some other skills such as problem solving skills, scientific process skills, or scientific literacy. Researchers may explore effects on these or some other variables as well.

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APPENDIX A

IMPULSE AND MOMENTUM RELATED OBJECTIVES

IMPULSE

1) Use the relationship between impulse and momentum change in problems.
2) Calculate impulse.
3) Explain that impulse is a vector.
4) Explain that impulse is in the same direction with the applied force.
5) Calculate impulse using force vs. time graph

LINEAR MOMENTUM

6) Calculate momentum.
7) Explain that momentum is a vector.
8) Explain that momentum is in the same direction with the velocity.
9) Calculate average force using momentum vs. time graph.

CONSERVATION OF MOMENTUM AND COLLISIONS

10) Use the conservation of momentum.
11) Explain inelastic collisions.
12) Explain elastic collisions.
13) Solve problems related to head-on collisions, one is in motion and the other is at rest.
14) Solve problems related to collisions after which the objects stick together.

ROCKETS

16) Solve problems related to rocket propulsion based on the conservation of momentum.

APPENDIX B

TABLE OF SPECIFICATIONS FOR IMPULSE AND MOMENTUM ACHIEVEMENT TEST

	Objectives	Comprehension	Application	N
1)	Use the relationship between impulse and momentum change in problems.	9, 11, **15**, 19, **27**	1, 2, 3, **4**, **5**, 6, 10, 17	**4** 9
2)	Calculate impulse.		2, 6, 17	3
3)	Explain that impulse is a vector.	**4**, 11, **12**, **27**		**3** 1
4)	Explain that impulse is in the same direction with the applied force.	15		1
5)	Calculate impulse using force vs. time graph		8	1
6)	Calculate momentum.	11, **27**	1, 2, 6, 17, 18, 29	**1** 7
7)	Explain that momentum is a vector.	**4**, **14**, 18, **20**, 29	11	**3** 2
8)	Explain that momentum is in the same direction with the velocity.	**14**, **16**, **20**, **27**		**4**
9)	Calculate average force using momentum vs. time graph.		13	1
10)	Use the conservation of momentum.	**14**, **19**, **23**, **24**, **25**, **26**	18, 21, 22, 29	**6** 4
11)	Explain inelastic collisions.	**5**, **7**		**2**
12)	Explain elastic collisions.	**5**, **7**		**2**
13)	Solve problems related to head-on collisions, one is in motion and the other is at rest.	**23**, **24**, **25**	22	**3** 1
14)	Solve problems related to collisions after which the objects stick together.	**26**	18, 21	**1** 2
16)	Solve problems related to rocket propulsion based on the conservation of momentum.	**28**		**1**
	N	**28** 8	**2** 24	**30** 32

APPENDIX C

IMPULSE AND MOMENTUM ACHIEVEMENT TEST (IMAT)

İTME VE MOMENTUM TESTİ

Okulu : ....
Adı Soyadı : ....
Sınıfı : ....
Cinsiyeti : □ Kız □ Erkek

YÖNERGE

Bu sınav sadece araştırma amaçlı geliştirilmiş olup, sınav sonucunuz hiçbir şekilde okuldaki başarı durumunuza yansıtılmayacaktır ve verdiğiniz bilgiler araştırmacı dışında kimseyle paylaşılmayacaktır.

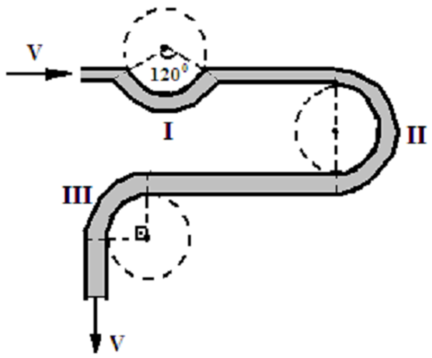
Sınav 29 sorudan oluşmaktadır ve bir ders saati süresine göre hazırlanmıştır. Bundan dolayı bütün soruları önemle cevaplayacağınızı umuyorum. Samimi katkılarınızdan dolayı:

TEŞEKKÜR EDERİM.

1. Aşağıdaki <u>eşit ebat ve esneklikteki toplardan</u> hangisinin bir pencereyi kırma olasılığı daha fazladır?
A. 2 m/s hızındaki 500 gr kütleli bir top
B. 3 m/s hızındaki 500 gr kütleli bir top
C. 4 m/s hızındaki 300 gr kütleli bir top
D. 5 m/s hızındaki 200 gr kütleli bir top
E. 9 m/s hızındaki 100 gr kütleli bir top

2. Ayşe İstanbul'daki sel felaketiyle ilgili bir haber programında sele kapılan bir insanın yaşam mücadelesini izlemektedir. Haber bülteni akıntı hızını 5 m/s olarak rapor etmiştir. Akıntı kuvvetine daha fazla dayanamayan adam ellerini bırakıyor ve akıntıya kapılıyor. Ayşe görüntülere göre adamın saniyenin yarısı kadar bir zamanda (0,5 saniye) akıntı hızına ulaştığını, adamın kütlesini de 80kg olarak tahmin ediyor. Bu verilere göre bu süreçte adama ortalama ne kadar kuvvet etkimiştir?
A. 100N B. 200N C. 400N
D. 800N E. 1600N

3. Bir sel olayında 2000 kg/s debiyle 8 m/s hızla akan su bir duvara çarpıp, sıçramadan alta inerek akıp gitmektedir. Duvara su tarafından ortalama ne kadar kuvvet uygulanmaktadır?
A. 1600N B. 3200N C. 8000N
D. 16000N E. 32000N



4. Yukarıdaki şekil içinden V sabit süratiyle su akan yatay bir borunun üstten görünüşüdür. I, II ve III ile gösterilen bükümlerde boruya etkiyen ortalama akış kuvvetlerinin büyüklük sırası nasıldır?
A. $F_I = F_{II} = F_{III}$
B. $F_{III} > F_I > F_{II}$
C. $F_I > F_{II} > F_{III}$
D. $F_I < F_{II} < F_{III}$
E. $F_I < F_{II} = F_{III}$

5. Aşağıdakilerden hangisi esnek çarpışmaya bir örnek olabilir?
A. İki çelik bilyenin çarpışması
B. Bir otomobilin ağaca çarpması
C. Elmanın yere düşmesi
D. Suyun yere dökülmesi
E. Tavana atılan çiğ köftenin tavana yapışması

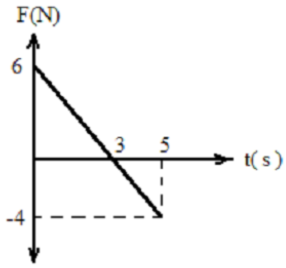
6. 40 gramlık bir çelik bilye, sert ve yatay bir zemine 5 m/s'lik hızla dik olarak çarpıyor ve 3 m/s'lik bir hızla geri sıçrıyor. Bilye zeminle 0,02s etkileştiğine göre zeminin bilyeye uyguladığı kuvvet kaç newton'dur?

A. 4 B. 16 C. 160
D. 400 E. 4000

7. Bir önceki sorudaki bilyenin zeminle çarpışması esnek bir çarpışma mıdır?

A. Evet, çünkü enerji ve momentum korunmuştur.
B. Evet, çünkü enerji korunmamış, momentum korunmuştur.
C. Evet, çünkü enerji korunmuş, momentum korunmamıştır.
D. Hayır, çünkü enerji korunmamış, momentum korunmuştur.
E. Hayır, çünkü enerji ve momentum korunmuştur.

8, 9 ve 10. soruları aşağıdaki şekle göre cevaplayınız!



8. Şekilde zamanla değişimi verilen kuvvet, 2kg kütleli bir cisme 5s boyunca uygulandığına göre kuvvetin oluşturduğu itmenin büyüklüğü kaç N.s olur?

A. 5 B. 10 C. 13
D. 26 E. 30

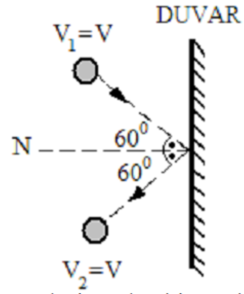
9. 5s sonundaki momentum değişimi kaç kg.m/s olur?

A. 5 B. 10 C. 13
D. 26 E. 30

10. İlk başta durgun olan cismin 5s sonunda hızı kaç m/s'dir?

A. 0,5 B. 1 C. 1,5
D. 2 E. 2,5

11 ve 12. soruları aşağıdaki şekle göre cevaplayınız!

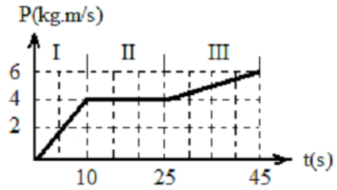


11. Kütlesi m olan bir top bir engele şekilde gösterilen hızlarda çarpıp sekiyor. Bu olayda topa uygulanan itmenin büyüklüğü aşağıdakilerden hangisi olur?

A. 0 B. $\frac{mv}{2}$ C. $\frac{mv}{\sqrt{3}}$
D. mv E. $\sqrt{3}mv$

12. Duvarın topa uyguladığı itme hangi yöndedir?

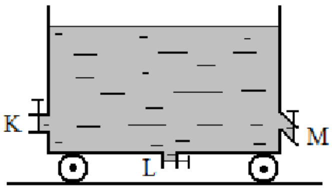
A. V_1
B. V_2
C. N doğrultusunda sola doğru
D. N doğrultusunda sağa doğru
E. $-V_2$



13. Doğrusal bir yolda ilerleyen cismin momentum-zaman grafiği şekildeki gibidir. I, II ve III zaman aralıklarında cisme etkiyen kuvvetler F_1, F_2 ve F_3'tür. Bu kuvvetlerin büyüklüklerine göre sıralanışı nasıl olur?

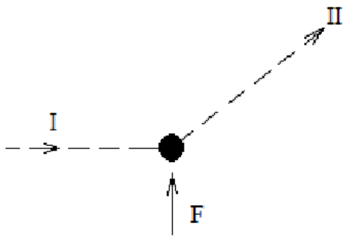
A. $F_1 > F_2 > F_3$
B. $F_1 < F_2 < F_3$
C. $F_1 > F_3 > F_2$
D. $F_1 = F_3 > F_2$
E. $F_1 = F_3 < F_2$

2



14. Şekilde K, L ve M musluklarının çapları eşittir ve K ile M muslukları yatayda aynı hizadadır. Bunlardan hangisi ya da hangilerinin tek başına açılması <u>duran arabaya</u> daha çok hız kazandırır?
A. Yalnız K
B. Yalnız L
C. Yalnız M
D. K ve M

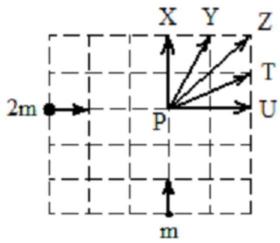
15 ve 16. soruları aşağıdaki şekle göre cevaplayınız!



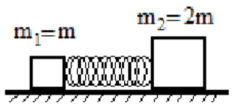
15. Şekilde bir bilardo masasında I yönünde ilerleyen topa anlık etkiyen F kuvveti ve topun sonradan izlediği II numaralı yol gösterilmektedir. Topun momentum değişimi hangi yöndedir?
A. I yönünde
B. II. yönünde
C. II yönünün tersi
D. F yönünde
E. F yönünün tersi

16. F kuvveti uygulandıktan sonra momentum hangi yöndedir?
A. I yönünde
B. II. yönünde
C. II yönünün tersi
D. F yönünde
E. F yönünün tersi

17. Kütlesi 10 g olan bir mermi namluyu 200 m/s hızla 0,1s'de terk ediyor. Silaha etkiyen geri tepme kuvveti kaç newtondur?
A. 2 B. 4 C. 10
D. 20 E. 24

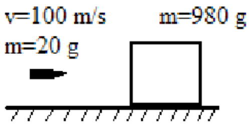


18. Aynı hızla hareket eden m ve 2m kütleli iki cisim P noktasında çarpışarak birbirlerine yapışmışlardır. Yapışan cisimlerin sonraki hareket yönü aşağıdakilerden hangisidir?
A. X B. Y C. Z
D. T E. U

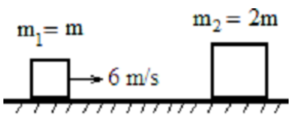


19. Şekildeki sıkıştırılmış yay serbest kaldığında m_1 kütleli cisim p_1 momentumu ve v_1 hızıyla, m_2 kütleli cisim de p_2 momentumu ve v_2 hızıyla yayı terk ediyorlar. Aşağıdakilerden hangisi doğrudur?
A. $p_1 = p_2$, $v_1 = v_2$
B. $p_1 = p_2$, $v_1 = 2v_2$
C. $p_1 = p_2$, $2v_1 = v_2$
D. $p_1 = 2p_2$, $v_1 = v_2$
E. $2p_1 = p_2$, $v_1 = v_2$

20. Bir buz patencisi sabit sürat ile pistte daire çizerek hareket etmektedir. Patencinin momentumu hakkında ne söylenebilir?
A. Sürat sabit olduğundan momentum değişmez.
B. Sürat sabit olmasına rağmen momentumun büyüklüğü değişir.
C. Hız değişmediğinden momentum da değişmez.
D. Hız değişmemesine rağmen momentum değişir.
E. Hız değiştiğinden momentum da değişir.

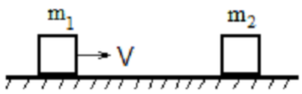


21. 20g kütleli ve 100 m/s hızındaki bir mermi 980g kütleli bir bloğa şekildeki gibi isabet ediyor ve saplanıyor. Çarpışmadan sonra bloğun hızı kaç m/s olur? (Cisimle yer arasındaki sürtünme kuvveti ve hava direncini ihmal ediniz.)
A. 1 B. 2 C. 4
D. 20 E. 25



22. Şekildeki m kütleli cisim 6m/s sabit hızla giderken durgun haldeki 2m kütleli cisimle esnek ve merkezi çarpışıyor. Çarpışma sonunda m_1 kütleli cismin hızı V_1, m_2 kütleli cisminki de V_2 oluyor. Buna göre V_1 ve V_2 kaç m/s olurlar?
A. V_1= -2, V_2=3
B. V_1=-2, V_2=4
C. V_1=0, V_2=6
D. V_1=0, V_2=3
E. V_1=0, V_2=0

23, 24 ve 25. soruları aşağıdaki şekle göre cevaplayınız!



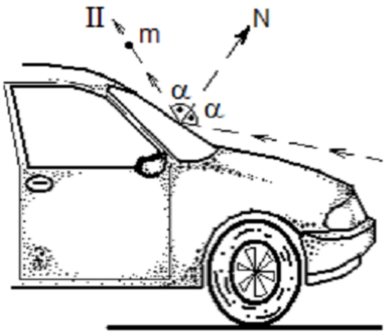
23. m_1 kütleli bir cisim sabit V hızıyla merkezi bir şekilde m_2 kütlesine tam esnek olarak çarpıyor. **m_1 ve m_2'nin eşit olması durumunda** aşağıdakilerden hangisi doğru olur?
A. m_1 durur, m_2 ise V hızıyla geliş yönünde hareket eder.
B. m_1 durur, m_2 ise V'den küçük bir hızla geliş yönünde hareket eder.
C. m_1 ve m_2 V'den küçük bir hızla geliş yönünde hareket eder.
D. m_1 V'den küçük, m_2 ise V'den büyük bir hızla geliş yönünde hareket eder.
E. m_1 geliş yönüne ters, m_2 ise geliş yönünde hareket eder.

24. **m_1'in m_2'den büyük olması durumunda** aşağıdakilerden hangisi doğru olur?
A. m_1 durur, m_2 ise V hızıyla geliş yönünde hareket eder.
B. m_1 durur, m_2 ise V'den küçük bir hızla geliş yönünde hareket eder.
C. m_1 ve m_2 V'den küçük bir hızla geliş yönünde hareket eder.
D. m_1 V'den küçük, m_2 ise V'den büyük bir hızla geliş yönünde hareket eder.
E. m_1 geliş yönüne ters, m_2 ise geliş yönünde hareket eder.

25. **m_1'in m_2'den küçük olması durumunda** aşağıdakilerden hangisi doğru olur?
A. m_1 durur, m_2 ise V hızıyla geliş yönünde hareket eder.
B. m_1 durur, m_2 ise V'den küçük bir hızla geliş yönünde hareket eder.
C. m_1 ve m_2 V'den küçük bir hızla geliş yönünde hareket eder.
D. m_1 V'den küçük, m_2 ise V'den büyük bir hızla geliş yönünde hareket eder.
E. m_1 geliş yönüne ters, m_2 ise geliş yönünde hareket eder.

26. m_1 kütleli bir cisim sabit V hızıyla giderken m_2 kütlesiyle merkezi çarpışıyor. Çarpışmadan sonra **m_1 ve m_2 kenetlenerek** hareket ediyor. Buna göre aşağıdakilerden hangisi doğrudur? (Hava direnci ve cisimlerle yer arasındaki sürtünmeleri ihmal ediniz.)

A. Momentum korunmaktadır ve cisimlerin momentum değişimlerinin büyüklükleri eşittir.
B. Momentum korunmaktadır ve m_1'in momentum değişimi daha büyüktür.
C. Momentum korunmaktadır ve m_1'in momentum değişimi daha küçüktür.
D. Cisimlerin momentum değişimleri eşittir, fakat momentum korunmamaktadır.
E. Cisimlerin momentum değişimleri eşit değildir ve momentum korunmamaktadır.



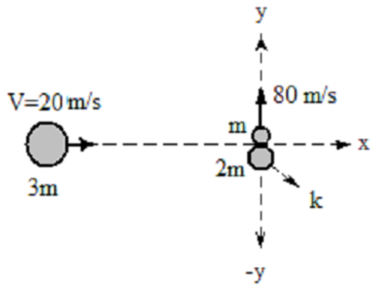
27. Bir otomobil +x yönünde hareket ederken önünde hareket halindeki kamyonun tekerlerinden fırlayan m kütleli bir mucur şekildeki gibi otomobilin ön camına esnek olarak çarpıyor. Bununla ilgili olarak verilen ifadelerden hangisi ya da hangileri doğrudur?

1. Mucurun momentum değişimi N yönündedir.
2. Camın itmesi N yönündedir.
3. Ön cam daha eğimli olsaydı itme daha az olurdu.

A. Yalnız 1 B. Yalnız 2 C. 1 ve 3
D. 2 ve 3 E. 1, 2 ve 3

28. Fırlatılan bir roketin hareketiyle ilgili aşağıdakilerden hangi doğrudur?

A. Rokete uygulanan itme sabit olduğundan sabit hızla ilerler.
B. Rokete uygulanan itme sabit olduğundan sabit ivmeyle hızlanır.
C. Rokete uygulanan itme sabittir fakat yakıtın kullanılmasından dolayı kütle azalmaktadır; böylece sabit ivmeyle hızlanmaktadır.
D. Rokete uygulanan itme sabittir fakat yakıtın kullanılmasından dolayı kütle azalmaktadır; böylece artan ivmeyle hızlanmaktadır.
E. Yakıt kullanıldıkça azalırken rokete uygulanan itme de zamanla azaldığından yavaşlayarak ilerler.



29. 3m kütleli bir cisim 20 m/s hızla ilerlemekteyken bir iç patlama sonucu m ve 2m kütleli iki parçaya ayrılıyor. m kütleli cisim +y yönünde 80 m/s hız kazandığına göre 2m kütleli cismin hızı nedir?

A. -y yönünde 40 m/s
B. -y yönünde 50 m/s
C. k yönünde 50 m/s
D. k yönünde 100 m/s
E. x yönünde 60 m/s

APPENDIX D

ANSWER KEY OF IMAT

1-B	2-D	3-D	4-B	5-A
6-B	7-D	8-A	9-A	10-E
11-D	12-C	13-C	14-A	15-D
16-B	17-D	18-D	19-B	20-E
21-B	22-B	23-A	24-D	25-E
26-A	27-E	28-D	29-D	

APPENDIX E

OUTPUT PERTAINING TO ITEM ANALYSIS

```
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       Item and Test Analysis Program -- ITEMAN (tm) Version 3.00

Item analysis for data from file whole.dat                        Page  1


                Item Statistics             Alternative Statistics
             -----------------------   -----------------------------------
Seq.  Scale  Prop.           Point            Prop.            Point
No.   -Item  Correct  Biser.  Biser.   Alt.  Endorsing  Biser.  Biser. Key
----  -----  -------  ------  ------   ----- ---------  ------  ------ ---

  1   0-1     0.915    0.887   0.495     A     0.000    -9.000  -9.000
                                         B     0.915     0.887   0.495  *
                                         C     0.043    -0.836  -0.375
                                         D     0.000    -9.000  -9.000
                                         E     0.043    -0.689  -0.309
                                       Other   0.000    -9.000  -9.000

  2   0-2     0.809    0.901   0.624     A     0.021    -0.699  -0.247
                                         B     0.021    -0.004  -0.001
                                         C     0.085    -0.774  -0.432
                                         D     0.809     0.901   0.624  *
                                         E     0.064    -0.714  -0.365
                                       Other   0.000    -9.000  -9.000

  3   0-3     0.723    0.577   0.432     A     0.213    -0.587  -0.416
                                         B     0.000    -9.000  -9.000
                                         C     0.000    -9.000  -9.000
                                         D     0.723     0.577   0.432  *
                                         E     0.021     0.083   0.029
                                       Other   0.043    -0.298  -0.134

  4   0-4     0.170    0.204   0.138     A     0.255     0.200   0.147  ?
                                         B     0.170     0.204   0.138  *
            CHECK THE KEY                C     0.043    -0.689  -0.309
   B was specified, A works better       D     0.277     0.046   0.034
                                         E     0.106    -0.005  -0.003
                                       Other   0.149    -0.292  -0.191

  5   0-5     0.915    0.403   0.225     A     0.915     0.403   0.225  *
                                         B     0.000    -9.000  -9.000
                                         C     0.021    -0.091  -0.032
                                         D     0.021    -0.004  -0.001
                                         E     0.043    -0.640  -0.287
                                       Other   0.000    -9.000  -9.000
```

6	0-6	0.383	0.874	0.686	A	0.298	-0.315	-0.239	
					B	0.383	0.874	0.686	*
					C	0.064	-0.288	-0.147	
					D	0.064	-0.430	-0.220	
					E	0.149	-0.445	-0.290	
					Other	0.043	-0.347	-0.156	

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Item analysis for data from file whole.dat Page 2

		Item Statistics			Alternative Statistics				
Seq. No.	Scale -Item	Prop. Correct	Biser.	Point Biser.	Alt.	Prop. Endorsing	Biser.	Point Biser.	Key
7	0-7	0.277	0.629	0.470	A	0.362	-0.151	-0.117	
					B	0.170	-0.129	-0.087	
					C	0.085	0.052	0.029	
					D	0.277	0.629	0.470	*
					E	0.106	-0.706	-0.420	
					Other	0.000	-9.000	-9.000	
8	0-8	0.617	0.729	0.573	A	0.617	0.729	0.573	*
					B	0.255	-0.545	-0.402	
					C	0.043	-0.102	-0.046	
					D	0.000	-9.000	-9.000	
					E	0.021	-0.699	-0.247	
					Other	0.064	-0.466	-0.238	
9	0-9	0.617	0.718	0.563	A	0.617	0.718	0.563	*
					B	0.128	-0.345	-0.216	
					C	0.128	-0.409	-0.256	
					D	0.000	-9.000	-9.000	
					E	0.021	-0.351	-0.124	
					Other	0.106	-0.537	-0.319	
10	0-10	0.638	0.600	0.468	A	0.000	-9.000	-9.000	
					B	0.043	-0.151	-0.068	
					C	0.021	0.083	0.029	
					D	0.191	-0.510	-0.354	
					E	0.638	0.600	0.468	*
					Other	0.106	-0.416	-0.248	
11	0-11	0.468	0.714	0.569	A	0.043	-0.347	-0.156	
					B	0.043	-0.102	-0.046	
					C	0.128	-0.579	-0.362	
					D	0.468	0.714	0.569	*
					E	0.234	-0.166	-0.120	
					Other	0.085	-0.460	-0.257	
12	0-12	0.660	0.686	0.530	A	0.128	-0.557	-0.349	
					B	0.085	-0.176	-0.098	
					C	0.660	0.686	0.530	*
					D	0.043	-0.200	-0.090	
					E	0.043	-0.445	-0.200	
					Other	0.043	-0.543	-0.244	

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Item analysis for data from file whole.dat Page 3

		Item Statistics			Alternative Statistics				
Seq. No.	Scale -Item	Prop. Correct	Biser.	Point Biser.	Alt.	Prop. Endorsing	Biser.	Point Biser.	Key
13	0-13	0.511	0.478	0.381	A	0.106	-0.223	-0.133	
					B	0.213	-0.174	-0.124	
					C	0.511	0.478	0.381	*
					D	0.043	-0.347	-0.156	
					E	0.043	-0.249	-0.112	
					Other	0.085	-0.290	-0.162	
14	0-14	0.298	0.555	0.421	A	0.298	0.555	0.421	*
					B	0.064	-0.182	-0.093	
					C	0.255	-0.214	-0.158	
					D	0.383	-0.265	-0.208	
					Other	0.000	-9.000	-9.000	
15	0-15	0.681	0.778	0.596	A	0.021	-0.091	-0.032	
					B	0.106	-0.682	-0.406	
					C	0.085	-0.233	-0.130	
					D	0.681	0.778	0.596	*
					E	0.043	-0.640	-0.287	
					Other	0.064	-0.430	-0.220	
16	0-16	0.809	0.787	0.545	A	0.085	-0.859	-0.479	
					B	0.809	0.787	0.545	*
					C	0.043	-0.543	-0.244	
					D	0.021	-0.351	-0.124	
					E	0.021	-0.004	-0.001	
					Other	0.021	-0.264	-0.094	
17	0-17	0.809	0.494	0.342	A	0.085	-0.318	-0.178	
					B	0.021	-0.612	-0.216	
					C	0.043	-0.053	-0.024	
					D	0.809	0.494	0.342	*
					E	0.021	-0.873	-0.309	
					Other	0.021	-0.091	-0.032	
18	0-18	0.851	0.732	0.477	A	0.000	-9.000	-9.000	
					B	0.064	-0.678	-0.347	
					C	0.043	-0.347	-0.156	
					D	0.851	0.732	0.477	*
					E	0.021	-0.699	-0.247	
					Other	0.021	-0.351	-0.124	

MicroCAT (tm) Testing System

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Item analysis for data from file whole.dat Page 4

		Item Statistics			Alternative Statistics				
Seq. No.	Scale -Item	Prop. Correct	Biser.	Point Biser.	Alt.	Prop. Endorsing	Biser.	Point Biser.	Key
19	0-19	0.617	0.044	0.034	A	0.064	-0.005	-0.002	
					B	0.617	0.044	0.034	*
CHECK THE KEY					C	0.128	0.377	0.236	?
B was specified, C works better					D	0.064	-0.359	-0.184	
					E	0.085	-0.090	-0.050	
					Other	0.043	-0.396	-0.178	
20	0-20	0.106	-0.440	-0.262	A	0.298	0.184	0.140	
					B	0.128	-0.069	-0.043	
CHECK THE KEY					C	0.298	-0.084	-0.064	
E was specified, D works better					D	0.170	0.239	0.161	?
					E	0.106	-0.440	-0.262	*
					Other	0.000	-9.000	-9.000	
21	0-21	0.766	0.759	0.550	A	0.064	-0.643	-0.329	
					B	0.766	0.759	0.550	*
					C	0.106	-0.561	-0.334	
					D	0.000	-9.000	-9.000	
					E	0.021	-0.004	-0.001	
					Other	0.043	-0.543	-0.244	
22	0-22	0.532	0.613	0.488	A	0.064	-0.430	-0.220	
					B	0.532	0.613	0.488	*
					C	0.191	-0.706	-0.489	
					D	0.128	-0.005	-0.003	
					E	0.000	-9.000	-9.000	
					Other	0.085	0.024	0.013	
23	0-23	0.745	0.531	0.392	A	0.745	0.531	0.392	*
					B	0.021	-0.178	-0.063	
					C	0.085	-0.432	-0.241	
					D	0.064	-0.075	-0.039	
					E	0.064	-0.678	-0.347	
					Other	0.021	-0.004	-0.001	
24	0-24	0.170	-0.076	-0.051	A	0.085	-0.774	-0.432	
					B	0.106	-0.319	-0.190	
CHECK THE KEY					C	0.426	0.601	0.477	?
D was specified, C works better					D	0.170	-0.076	-0.051	*
					E	0.106	-0.053	-0.032	
					Other	0.106	-0.150	-0.089	

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Item analysis for data from file whole.dat Page 5

Seq. No.	Scale -Item	Item Statistics: Prop. Correct	Item Statistics: Biser.	Item Statistics: Point Biser.	Alt.	Alternative Statistics: Prop. Endorsing	Alternative Statistics: Biser.	Alternative Statistics: Point Biser.	Key
25	0-25	0.298	0.479	0.363	A	0.085	-0.176	-0.098	
					B	0.213	-0.052	-0.037	
					C	0.128	-0.090	-0.057	
					D	0.106	-0.392	-0.233	
					E	0.298	0.479	0.363	*
					Other	0.170	-0.129	-0.087	
26	0-26	0.574	0.428	0.339	A	0.574	0.428	0.339	*
					B	0.064	-0.146	-0.075	
					C	0.085	-0.574	-0.321	
					D	0.021	-0.612	-0.216	
					E	0.128	-0.090	-0.057	
					Other	0.128	-0.048	-0.030	
27	0-27	0.340	0.064	0.050	A	0.149	-0.331	-0.215	
					B	0.043	-0.591	-0.266	
CHECK THE KEY					C	0.213	0.665	0.472	?
E was specified, C works better					D	0.106	0.019	0.011	
					E	0.340	0.064	0.050	*
					Other	0.149	-0.388	-0.253	
28	0-28	0.617	0.485	0.381	A	0.043	-0.102	-0.046	
					B	0.085	-0.062	-0.034	
					C	0.064	-0.501	-0.256	
					D	0.617	0.485	0.381	*
					E	0.128	-0.494	-0.309	
					Other	0.064	-0.005	-0.002	
29	0-29	0.128	-0.175	-0.110	A	0.085	-0.033	-0.019	
					B	0.043	-0.543	-0.244	
CHECK THE KEY					C	0.702	0.200	0.151	?
D was specified, C works better					D	0.128	-0.175	-0.110	*
					E	0.000	-9.000	-9.000	
					Other	0.043	0.241	0.108	

MicroCAT (tm) Testing System

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Item analysis for data from file whole.dat Page 6

There were 47 examinees in the data file.

Scale Statistics

Scale:	0
N of Items	29
N of Examinees	47
Mean	16.043
Variance	23.019
Std. Dev.	4.798
Skew	-0.172
Kurtosis	-0.871
Minimum	6.000
Maximum	24.000
Median	16.000
Alpha	0.788
SEM	2.207
Mean P	0.553
Mean Item-Tot.	0.369
Mean Biserial	0.499

APPENDIX F

AFFECTIVE CHARACTERISTICS QUESTIONNAIRE (ACQ)

TUTUM VE MOTİVASYON ANKETİ

Bu anket fizik ve fizik dersleri hakkındaki görüşlerinizi öğrenmek için geliştirilmiştir. Her bir yargıyı dikkatlice okuduktan sonra yargıya ne derece katılıp katılmadığınızı en iyi yansıtan cevaba ait kutucuğu (X) ile işaretleyiniz. Verdiğiniz bilgiler sadece araştırmacı tarafından kullanılacak ve ders notlarınızı asla etkilemeyecektir. Samimi ve gerçek düşüncelerinizi yansıtan cevaplarınızdan dolayı çok: **TEŞEKKÜR EDERİM**.

No	Yargılar	Kesinlikle Katılıyorum	Katılıyorum	Kararsızım	Katılmıyorum	Kesinlikle Katılmıyorum
1	Fizik derslerimiz eğlencelidir.					
2	Fizik dersini ilgi çekici buluyorum.					
3	Fizik derslerine gitmek için can atıyorum.					
4	Fizik derslerimiz sıkıcıdır.					
5	Fizik dersinin, ilerideki çalışmalarımda bana yararlı olacağını düşünüyorum.					
6	Fizik derslerinde öğrendiklerimin, gündelik hayatta işime yarayacağını düşünüyorum.					
7	Fizik dersinde öğrendiğimiz şeylerin gerçek hayatta kullanılmayacağını düşünüyorum.					
8	Fizik derslerinde öğrendiklerimin, hayatımı kolaylaştıracağını düşünüyorum.					
9	Bu dönemki fizik dersinde öğrendiklerimi bir daha kullanmayacağım için bu derse ihtiyacım olmadığını düşünüyorum.					

Table (continued)

10	Fizik öğrenebileceğimden eminim.					
11	Daha zor fizik problemleriyle başa çıkabileceğimden eminim.					
12	Fizik derslerinde başarılı olabileceğimden eminim.					
13	Fizik derslerinde zor işleri yapabileceğimden eminim.					
14	Yeterince vaktim olursa en zor fizik sorularını bile yapabileceğimden eminim.					
15	Fizik dersinde başarılı olmak için elimden geleni yaparım.					
16	Fizik dersinde yapılacak iş ne kadar zor olursa olsun, elimden geleni yaparım.					
17	Fizik derslerinde <u>başarısız</u> olduğumda daha çok çabalarım.					
18	Fizik derslerinde elimden gelenin en iyisini yapmaya çalışırım.					
19	Zorunlu olmasam da fizik dersi almak isterim.					
20	Fizikle ilgili daha çok şey öğrenmek istiyorum.					
21	Fizik becerilerimi geliştirmek istiyorum.					
22	Eğitim hayatım boyunca alabildiğim kadar fazla fizik dersi almak istiyorum.					
23	Fizik derslerindeki yeteneğimle gurur duyarım.					
24	Fizik dersiyle başa çıkabilecek kadar zekiyim.					
25	Fizik derslerindeki başarılarımla gurur duyarım.					
26	Fizik dersinde iyi notlar alma yeteneğine sahibim.					
27	Fizik dersinde kendimi gergin hissederim.					
28	Fizik dersine gitmek beni kaygılandırır.					
29	Fizik dersi, kendimi <u>rahatsız</u> ve sinirli hissetmeme neden olur.					
30	Fizik dersi, kendimi tedirgin ve şaşkın hissetmeme neden olur.					

APPENDIX G

COMFIRMATORY FACTOR ANALYSIS FOR PRETEST DATA ON THE ACQ

```
                              DATE:  2/ 8/2012
                                TIME: 16:17

                     LISREL 8.80 (STUDENT EDITION)
                                     BY
                      Karl G. Jöreskog and Dag Sörbom


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The following lines were read from file  C:\Users\Haki\Dropbox\Doktora
tezim\Analiz\cfa for acq\pretest.SPJ:
 Raw Data from file 'C:tezimfor acq.psf'
 Sample Size = 194
 Latent Variables  motivati
 Relationships
 PRESINT = motivati
 PREIMP = motivati
 PRESEFF = motivati
 PREACHMO = motivati
 PRESTUMO = motivati
 PRESCON = motivati
 PREANX = motivati
 Set the Variance of motivati to 1.00
 Path Diagram
 End of Problem

 Sample Size =   194

 cfa for pretest acq
         Covariance Matrix

            PRESINT     PREIMP    PRESEFF   PREACHMO   PRESTUMO    PRESCON
           --------   --------   --------   --------   --------   --------
  PRESINT      0.63
   PREIMP      0.22       0.56
  PRESEFF      0.24       0.19       0.50
 PREACHMO      0.22       0.09       0.16       0.41
 PRESTUMO      0.35       0.26       0.28       0.25       0.71
  PRESCON      0.23       0.11       0.29       0.18       0.21       0.51
   PREANX      0.37       0.21       0.30       0.21       0.23       0.24

         Covariance Matrix

             PREANX
           --------
   PREANX      0.77
```

```
cfa for pretest acq

Number of Iterations =  7

LISREL Estimates (Maximum Likelihood)

        Measurement Equations


 PRESINT = 0.57*motivati, Errorvar.= 0.30  , R² = 0.52
          (0.054)                   (0.040)
           10.64                     7.65

  PREIMP = 0.36*motivati, Errorvar.= 0.43  , R² = 0.23
          (0.055)                   (0.047)
           6.54                      9.22

 PRESEFF = 0.50*motivati, Errorvar.= 0.25  , R² = 0.49
          (0.048)                   (0.032)
           10.26                     7.88

PREACHMO = 0.37*motivati, Errorvar.= 0.28  , R² = 0.33
          (0.046)                   (0.031)
           8.07                      8.82

PRESTUMO = 0.56*motivati, Errorvar.= 0.40  , R² = 0.44
          (0.058)                   (0.048)
           9.56                      8.24

 PRESCON = 0.44*motivati, Errorvar.= 0.31  , R² = 0.39
          (0.050)                   (0.036)
           8.84                      8.55

  PREANX = 0.56*motivati, Errorvar.= 0.45  , R² = 0.41
          (0.061)                   (0.054)
           9.13                      8.43


        Correlation Matrix of Independent Variables

           motivati
           --------
               1.00

                          Goodness of Fit Statistics

                            Degrees of Freedom = 14
               Minimum Fit Function Chi-Square = 50.69 (P = 0.00)
       Normal Theory Weighted Least Squares Chi-Square = 47.50 (P = 0.00)
                Estimated Non-centrality Parameter (NCP) = 33.50
            90 Percent Confidence Interval for NCP = (16.24 ; 58.35)

                        Minimum Fit Function Value = 0.26
               Population Discrepancy Function Value (F0) = 0.17
             90 Percent Confidence Interval for F0 = (0.084 ; 0.30)
             Root Mean Square Error of Approximation (RMSEA) = 0.11
           90 Percent Confidence Interval for RMSEA = (0.078 ; 0.15)
             P-Value for Test of Close Fit (RMSEA < 0.05) = 0.0023

                  Expected Cross-Validation Index (ECVI) = 0.39
            90 Percent Confidence Interval for ECVI = (0.30 ; 0.52)
                         ECVI for Saturated Model = 0.29
                        ECVI for Independence Model = 3.52

     Chi-Square for Independence Model with 21 Degrees of Freedom = 665.98
                           Independence AIC = 679.98
                               Model AIC = 75.50
                             Saturated AIC = 56.00
```

Independence CAIC = 709.86
Model CAIC = 135.25
Saturated CAIC = 175.50

Normed Fit Index (NFI) = 0.92
Non-Normed Fit Index (NNFI) = 0.91
Parsimony Normed Fit Index (PNFI) = 0.62
Comparative Fit Index (CFI) = 0.94
Incremental Fit Index (IFI) = 0.94
Relative Fit Index (RFI) = 0.89

Critical N (CN) = 111.97

Root Mean Square Residual (RMR) = 0.032
Standardized RMR = 0.055
Goodness of Fit Index (GFI) = 0.93
Adjusted Goodness of Fit Index (AGFI) = 0.87
Parsimony Goodness of Fit Index (PGFI) = 0.47

The Modification Indices Suggest to Add an Error Covariance

Between	and	Decrease in Chi-Square	New Estimate
PRESEFF	PRESINT	11.3	-0.10
PRESCON	PRESEFF	16.9	0.11
PREANX	PRESTUMO	11.6	-0.13

Time used: 0.016 Seconds

TIME: 16:31

LISREL 8.80 (STUDENT EDITION)

BY

Karl G. Jöreskog & Dag Sörbom

cfa for pretest acq

Covariance Matrix

	PRESINT	PREIMP	PRESEFF	PREACHMO	PRESTUMO	PRESCON
PRESINT	0.63					
PREIMP	0.22	0.56				
PRESEFF	0.24	0.19	0.50			
PREACHMO	0.22	0.09	0.16	0.41		
PRESTUMO	0.35	0.26	0.28	0.25	0.71	
PRESCON	0.23	0.11	0.29	0.18	0.21	0.51
PREANX	0.37	0.21	0.30	0.21	0.23	0.24

Covariance Matrix (continued)

	PREANX
PREANX	0.77

cfa for pretest acq

```
Number of Iterations =  7
```

LISREL Estimates (Maximum Likelihood)

```
Measurement Equations

PRESINT = 0.60*motivati, Errorvar.= 0.27  , R² = 0.57
(0.054)                  (0.040)
11.13                    6.93


PREIMP = 0.37*motivati, Errorvar.= 0.43  , R² = 0.25
(0.056)                  (0.047)
6.67                     9.12

PRESEFF = 0.46*motivati, Errorvar.= 0.29  , R² = 0.41
(0.050)                  (0.036)
9.06                     8.21

PREACHMO = 0.38*motivati, Errorvar.= 0.27  , R² = 0.34
(0.046)                  (0.031)
8.10                     8.69

PRESTUMO = 0.57*motivati, Errorvar.= 0.38  , R² = 0.46
(0.059)                  (0.048)
9.73                     7.95

PRESCON = 0.40*motivati, Errorvar.= 0.35  , R² = 0.31
(0.052)                  (0.040)
7.54                     8.75

PREANX = 0.56*motivati, Errorvar.= 0.45  , R² = 0.41
(0.062)                  (0.055)
9.04                     8.30


Error Covariance for PRESCON and PRESEFF = 0.11
(0.029)
3.64
```

Correlation Matrix of Independent Variables

motivati

1.00

Goodness of Fit Statistics

```
Degrees of Freedom = 13
Minimum Fit Function Chi-Square = 34.47 (P = 0.0010)
Normal Theory Weighted Least Squares Chi-Square = 32.05 (P = 0.0024)
Chi-Square Difference with 1 Degree of Freedom = 15.45 (P = 0.00)
Estimated Non-centrality Parameter (NCP) = 19.05
90 Percent Confidence Interval for NCP = (6.12 ; 39.66)

Minimum Fit Function Value = 0.18
Population Discrepancy Function Value (F0) = 0.099
90 Percent Confidence Interval for F0 = (0.032 ; 0.21)
Root Mean Square Error of Approximation (RMSEA) = 0.087
90 Percent Confidence Interval for RMSEA = (0.049 ; 0.13)
P-Value for Test of Close Fit (RMSEA < 0.05) = 0.052

Expected Cross-Validation Index (ECVI) = 0.32
90 Percent Confidence Interval for ECVI = (0.25 ; 0.43)
ECVI for Saturated Model = 0.29
ECVI for Independence Model = 3.52

Chi-Square for Independence Model with 21 Degrees of Freedom = 665.98
Independence AIC = 679.98
Model AIC = 62.05
```

Saturated AIC = 56.00
Independence CAIC = 709.86
Model CAIC = 126.07
Saturated CAIC = 175.50

Normed Fit Index (NFI) = 0.95
Non-Normed Fit Index (NNFI) = 0.95
Parsimony Normed Fit Index (PNFI) = 0.59
Comparative Fit Index (CFI) = 0.97
Incremental Fit Index (IFI) = 0.97
Relative Fit Index (RFI) = 0.92

Critical N (CN) = 156.05

Root Mean Square Residual (RMR) = 0.028
Standardized RMR = 0.045
Goodness of Fit Index (GFI) = 0.95
Adjusted Goodness of Fit Index (AGFI) = 0.90
Parsimony Goodness of Fit Index (PGFI) = 0.44

The Modification Indices Suggest to Add an Error Covariance

Between	and	Decrease in Chi-Square	New Estimate	
PREANX	**PRESTUMO**	15.5	-0.15	in tb l

Time used: 0.031 Seconds

DATE: 2/ 8/2012
TIME: 16:32

LISREL 8.80 (STUDENT EDITION)

BY

Karl G. Jöreskog and Dag Sörbom

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Website: www.ssicentral.com

cfa for pretest acq

Covariance Matrix

	PRESINT	PREIMP	PRESEFF	PREACHMO	PRESTUMO	PRESCON
PRESINT	0.63					
PREIMP	0.22	0.56				
PRESEFF	0.24	0.19	0.50			
PREACHMO	0.22	0.09	0.16	0.41		
PRESTUMO	0.35	0.26	0.28	0.25	0.71	
PRESCON	0.23	0.11	0.29	0.18	0.21	0.51
PREANX	0.37	0.21	0.30	0.21	0.23	0.24

Covariance Matrix (continued)

	PREANX
PREANX	0.77

cfa for pretest acq

Number of Iterations = 6

LISREL Estimates (Maximum Likelihood)

Measurement Equations

PRESINT = 0.58*motivati, Errorvar.= 0.30 , R^2 = 0.52
(0.053) (0.038)
10.85 7.90

PREIMP = 0.37*motivati, Errorvar.= 0.43 , R^2 = 0.24
(0.054) (0.046)
6.80 9.35

PRESEFF = 0.45*motivati, Errorvar.= 0.30 , R^2 = 0.41
(0.049) (0.034)
9.25 8.69

PREACHMO = 0.36*motivati, Errorvar.= 0.28 , R^2 = 0.32
(0.045) (0.031)
8.04 9.09

PRESTUMO = 0.63*motivati, Errorvar.= 0.31 , R^2 = 0.56
(0.059) (0.048)
10.68 6.55

PRESCON = 0.37*motivati, Errorvar.= 0.36 , R^2 = 0.28
(0.051) (0.040)
7.35 9.19

PREANX = 0.62*motivati, Errorvar.= 0.38 , R^2 = 0.51
(0.063) (0.054)
9.97 7.01

Error Covariance for PRESCON and PRESEFF = 0.12
(0.028)
4.11

Error Covariance for PREANX and PRESTUMO = -0.16
(0.037)
-4.40

Correlation Matrix of Independent Variables

motivati
1.00

Goodness of Fit Statistics

Degrees of Freedom = 12
Minimum Fit Function Chi-Square = 16.28 (P = 0.18)
Normal Theory Weighted Least Squares Chi-Square = 16.09 (P = 0.19)
Chi-Square Difference with 1 Degree of Freedom = 15.96 (P = 0.00)
Estimated Non-centrality Parameter (NCP) = 4.09
90 Percent Confidence Interval for NCP = (0.0 ; 18.74)

Minimum Fit Function Value = 0.084
Population Discrepancy Function Value (F0) = 0.021
90 Percent Confidence Interval for F0 = (0.0 ; 0.097)
Root Mean Square Error of Approximation (RMSEA) = 0.042
90 Percent Confidence Interval for RMSEA = (0.0 ; 0.090)
P-Value for Test of Close Fit (RMSEA < 0.05) = 0.55

```
Expected Cross-Validation Index (ECVI) = 0.25
90 Percent Confidence Interval for ECVI = (0.23 ; 0.33)
ECVI for Saturated Model = 0.29
ECVI for Independence Model = 3.52

Chi-Square for Independence Model with 21 Degrees of Freedom = 665.98
Independence AIC = 679.98
Model AIC = 48.09
Saturated AIC = 56.00
Independence CAIC = 709.86
Model CAIC = 116.38
Saturated CAIC = 175.50

Normed Fit Index (NFI) = 0.98
Non-Normed Fit Index (NNFI) = 0.99
Parsimony Normed Fit Index (PNFI) = 0.56
Comparative Fit Index (CFI) = 0.99
Incremental Fit Index (IFI) = 0.99
Relative Fit Index (RFI) = 0.96

Critical N (CN) = 311.87

Root Mean Square Residual (RMR) = 0.018
Standardized RMR = 0.034
Goodness of Fit Index (GFI) = 0.98
Adjusted Goodness of Fit Index (AGFI) = 0.95
Parsimony Goodness of Fit Index (PGFI) = 0.42

                           Time used:    0.031 Seconds
```

APPENDIX H

COMFIRMATORY FACTOR ANALYSIS FOR POSTTEST DATA ON THE ACQ

```
                              DATE:  2/ 8/2012
                               TIME: 16:51


                        LISREL 8.80 (STUDENT EDITION)

                                     BY

                        Karl G. Jöreskog and Dag Sörbom



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```

The following lines were read from file **C:\Users\Haki\Dropbox\Doktora tezim\Analiz\cfa for acq\posttest\posttest.SPJ:**

```
 Raw Data from file 'C:tezimfor acq.psf'
 Latent Variables  motivation
 Relationships
 POSTSINT = motivation
 POSTIMP = motivation
 POSTSEFF = motivation
 POSTACHM = motivation
 POSTSTUM = motivation
 POSTSCON = motivation
 POSTANX = motivation
 Path Diagram
 End of Problem

 Sample Size =   194

 cfa for posttest
```

Covariance Matrix

	POSTSINT	POSTIMP	POSTSEFF	POSTACHM	POSTSTUM	POSTSCON
POSTSINT	0.67					
POSTIMP	0.34	0.68				
POSTSEFF	0.36	0.28	0.77			
POSTACHM	0.34	0.21	0.33	0.62		
POSTSTUM	0.48	0.41	0.38	0.34	0.68	
POSTSCON	0.25	0.18	0.43	0.28	0.29	0.63
POSTANX	0.43	0.25	0.34	0.35	0.31	0.26

Covariance Matrix

	POSTANX
POSTANX	0.90

cfa for posttest

Number of Iterations = 7

LISREL Estimates (Maximum Likelihood)

Measurement Equations

```
POSTSINT = 0.67*motivati, Errorvar.= 0.22  , R² = 0.67
          (0.051)                   (0.032)
           13.15                     7.08

 POSTIMP = 0.51*motivati, Errorvar.= 0.43  , R² = 0.37
          (0.057)                   (0.047)
           8.90                      9.02

POSTSEFF = 0.59*motivati, Errorvar.= 0.41  , R² = 0.46
          (0.058)                   (0.048)
           10.16                     8.68

POSTACHM = 0.52*motivati, Errorvar.= 0.34  , R² = 0.44
          (0.053)                   (0.039)
           9.91                      8.75

POSTSTUM = 0.68*motivati, Errorvar.= 0.22  , R² = 0.68
          (0.051)                   (0.031)
           13.40                     6.86

POSTSCON = 0.45*motivati, Errorvar.= 0.43  , R² = 0.33
          (0.056)                   (0.047)
           8.18                      9.18

 POSTANX = 0.56*motivati, Errorvar.= 0.59  , R² = 0.35
          (0.066)                   (0.064)
           8.54                      9.10
```

Correlation Matrix of Independent Variables

motivati
1.00

Goodness of Fit Statistics

Degrees of Freedom = 14
Minimum Fit Function Chi-Square = 75.97 (P = 0.00)
Normal Theory Weighted Least Squares Chi-Square = 77.76 (P = 0.00)
Estimated Non-centrality Parameter (NCP) = 63.76
90 Percent Confidence Interval for NCP = (39.75 ; 95.28)

Minimum Fit Function Value = 0.39
Population Discrepancy Function Value (F0) = 0.33
90 Percent Confidence Interval for F0 = (0.21 ; 0.49)
Root Mean Square Error of Approximation (RMSEA) = 0.15
90 Percent Confidence Interval for RMSEA = (0.12 ; 0.19)
P-Value for Test of Close Fit (RMSEA < 0.05) = 0.00

Expected Cross-Validation Index (ECVI) = 0.55
90 Percent Confidence Interval for ECVI = (0.42 ; 0.71)
ECVI for Saturated Model = 0.29
ECVI for Independence Model = 4.83

Chi-Square for Independence Model with 21 Degrees of Freedom = 917.25
Independence AIC = 931.25
Model AIC = 105.76
Saturated AIC = 56.00
Independence CAIC = 961.12
Model CAIC = 165.51
Saturated CAIC = 175.50

Normed Fit Index (NFI) = 0.92
Non-Normed Fit Index (NNFI) = 0.90
Parsimony Normed Fit Index (PNFI) = 0.61
Comparative Fit Index (CFI) = 0.93
Incremental Fit Index (IFI) = 0.93
Relative Fit Index (RFI) = 0.88

Critical N (CN) = 75.04

Root Mean Square Residual (RMR) = 0.045
Standardized RMR = 0.065
Goodness of Fit Index (GFI) = 0.90
Adjusted Goodness of Fit Index (AGFI) = 0.79
Parsimony Goodness of Fit Index (PGFI) = 0.45

The Modification Indices Suggest to Add an Error Covariance

Between	and	Decrease in Chi-Square	New Estimate
POSTSTUM	POSTIMP	14.7	0.11
POSTSCON	POSTSINT	11.1	-0.09
POSTSCON	POSTSEFF	36.4	0.20
POSTANX	POSTSINT	8.0	0.10
POSTANX	POSTSTUM	13.3	-0.12

Time used: 0.031 Seconds

TIME: 16:54

LISREL 8.80 (STUDENT EDITION)

BY

Karl G. Jöreskog & Dag Sörbom

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cfa for posttest

Covariance Matrix

	POSTSINT	POSTIMP	POSTSEFF	POSTACHM	POSTSTUM	POSTSCON
POSTSINT	0.67					
POSTIMP	0.34	0.68				
POSTSEFF	0.36	0.28	0.77			
POSTACHM	0.34	0.21	0.33	0.62		
POSTSTUM	0.48	0.41	0.38	0.34	0.68	
POSTSCON	0.25	0.18	0.43	0.28	0.29	0.63
POSTANX	0.43	0.25	0.34	0.35	0.31	0.26

Covariance Matrix (continued)

	POSTANX
POSTANX	0.90

cfa for posttest

Number of Iterations = 7

LISREL Estimates (Maximum Likelihood)

Measurement Equations

POSTSINT = 0.69*motivati, Errorvar.= 0.20 , R^2 = 0.70
(0.051) (0.031)
13.57 6.52

POSTIMP = 0.51*motivati, Errorvar.= 0.42 , R^2 = 0.39
(0.057) (0.047)
9.07 8.96

POSTSEFF = 0.56*motivati, Errorvar.= 0.46 , R^2 = 0.40
(0.060) (0.051)
9.34 8.88

POSTACHM = 0.51*motivati, Errorvar.= 0.35 , R^2 = 0.43
(0.053) (0.040)
9.67 8.80

POSTSTUM = 0.69*motivati, Errorvar.= 0.20 , R^2 = 0.70
(0.051) (0.031)
13.59 6.50

POSTSCON = 0.41*motivati, Errorvar.= 0.47 , R^2 = 0.26
(0.057) (0.050)
7.18 9.31

POSTANX = 0.56*motivati, Errorvar.= 0.59 , R^2 = 0.35
(0.066) (0.065)
8.49 9.10

Error Covariance for POSTSCON and POSTSEFF = 0.21
(0.040)

5.16

Correlation Matrix of Independent Variables

motivati
1.00

Goodness of Fit Statistics

Degrees of Freedom = 13
Minimum Fit Function Chi-Square = 38.59 (P = 0.00023)
Normal Theory Weighted Least Squares Chi-Square = 38.69 (P = 0.00022)
Chi-Square Difference with 1 Degree of Freedom = 39.07 (P = 0.0)
Estimated Non-centrality Parameter (NCP) = 25.69
90 Percent Confidence Interval for NCP = (10.71 ; 48.30)

Minimum Fit Function Value = 0.20
Population Discrepancy Function Value (F0) = 0.13
90 Percent Confidence Interval for F0 = (0.055 ; 0.25)
Root Mean Square Error of Approximation (RMSEA) = 0.10
90 Percent Confidence Interval for RMSEA = (0.065 ; 0.14)
P-Value for Test of Close Fit (RMSEA < 0.05) = 0.012

Expected Cross-Validation Index (ECVI) = 0.36
90 Percent Confidence Interval for ECVI = (0.28 ; 0.47)
ECVI for Saturated Model = 0.29
ECVI for Independence Model = 4.83

Chi-Square for Independence Model with 21 Degrees of Freedom = 917.25
Independence AIC = 931.25
Model AIC = 68.69
Saturated AIC = 56.00
Independence CAIC = 961.12
Model CAIC = 132.71
Saturated CAIC = 175.50

Normed Fit Index (NFI) = 0.96
Non-Normed Fit Index (NNFI) = 0.95
Parsimony Normed Fit Index (PNFI) = 0.59
Comparative Fit Index (CFI) = 0.97
Incremental Fit Index (IFI) = 0.97
Relative Fit Index (RFI) = 0.93

Critical N (CN) = 139.48

Root Mean Square Residual (RMR) = 0.033
Standardized RMR = 0.047
Goodness of Fit Index (GFI) = 0.95
Adjusted Goodness of Fit Index (AGFI) = 0.88
Parsimony Goodness of Fit Index (PGFI) = 0.44

The Modification Indices Suggest to Add an Error Covariance

Between	and	Decrease in Chi-Square	New Estimate	
POSTSTUM	POSTIMP	12.5	0.10	in tb l
POSTANX	POSTSTUM	16.5	-0.14	in tb l

```
Time used:    0.000 Seconds

 DATE:  2/ 8/2012
   TIME: 16:54


LISREL 8.80 (STUDENT EDITION)

              BY

 Karl G. Jöreskog and Dag Sörbom
```


cfa for posttest

Covariance Matrix

	POSTSINT	POSTIMP	POSTSEFF	POSTACHM	POSTSTUM	POSTSCON
POSTSINT	0.67					
POSTIMP	0.34	0.68				
POSTSEFF	0.36	0.28	0.77			
POSTACHM	0.34	0.21	0.33	0.62		
POSTSTUM	0.48	0.41	0.38	0.34	0.68	
POSTSCON	0.25	0.18	0.43	0.28	0.29	0.63
POSTANX	0.43	0.25	0.34	0.35	0.31	0.26

Covariance Matrix (continued)

	POSTANX
POSTANX	0.90

cfa for posttest

```
 Number of Iterations =  6
```

LISREL Estimates (Maximum Likelihood)

```
Measurement Equations


POSTSINT = 0.67*motivati, Errorvar.= 0.22  , R² = 0.67
(0.050)                   (0.030)
13.30                     7.42

POSTIMP = 0.51*motivati, Errorvar.= 0.42  , R² = 0.38
(0.056)                   (0.046)
9.13                      9.24
```

```
POSTSEFF = 0.54*motivati, Errorvar.= 0.47  , R² = 0.38
(0.059)                   (0.051)
9.21                      9.22

POSTACHM = 0.50*motivati, Errorvar.= 0.36  , R² = 0.41
(0.052)                   (0.040)
9.62                      9.14

POSTSTUM = 0.72*motivati, Errorvar.= 0.16  , R² = 0.76
(0.050)                   (0.031)
14.38                     5.15

POSTSCON = 0.40*motivati, Errorvar.= 0.47  , R² = 0.26
(0.056)                   (0.050)
7.24                      9.49

POSTANX = 0.63*motivati, Errorvar.= 0.51  , R² = 0.44
(0.066)                   (0.062)
9.44                      8.18


Error Covariance for POSTSCON and POSTSEFF = 0.21
(0.040)
5.42

Error Covariance for POSTANX and POSTSTUM = -0.14
(0.031)
-4.46
```

Correlation Matrix of Independent Variables

motivati
1.00

Goodness of Fit Statistics

```
Degrees of Freedom = 12
Minimum Fit Function Chi-Square = 19.66 (P = 0.074)
Normal Theory Weighted Least Squares Chi-Square = 20.26 (P = 0.062)
Chi-Square Difference with 1 Degree of Freedom = 18.43 (P = 0.00)
Estimated Non-centrality Parameter (NCP) = 8.26
90 Percent Confidence Interval for NCP = (0.0 ; 24.78)

Minimum Fit Function Value = 0.10
Population Discrepancy Function Value (F0) = 0.043
90 Percent Confidence Interval for F0 = (0.0 ; 0.13)
Root Mean Square Error of Approximation (RMSEA) = 0.060
90 Percent Confidence Interval for RMSEA = (0.0 ; 0.10)
P-Value for Test of Close Fit (RMSEA < 0.05) = 0.32

Expected Cross-Validation Index (ECVI) = 0.27
90 Percent Confidence Interval for ECVI = (0.23 ; 0.36)
ECVI for Saturated Model = 0.29
ECVI for Independence Model = 4.83

Chi-Square for Independence Model with 21 Degrees of Freedom = 917.25
Independence AIC = 931.25
Model AIC = 52.26
Saturated AIC = 56.00
Independence CAIC = 961.12
Model CAIC = 120.55
Saturated CAIC = 175.50

Normed Fit Index (NFI) = 0.98
```

```
Non-Normed Fit Index (NNFI) = 0.99
Parsimony Normed Fit Index (PNFI) = 0.56
Comparative Fit Index (CFI) = 0.99
Incremental Fit Index (IFI) = 0.99
Relative Fit Index (RFI) = 0.96

Critical N (CN) = 258.34


Root Mean Square Residual (RMR) = 0.027
Standardized RMR = 0.040
Goodness of Fit Index (GFI) = 0.97
Adjusted Goodness of Fit Index (AGFI) = 0.93
Parsimony Goodness of Fit Index (PGFI) = 0.42

                           Time used:    0.031 Seconds
```

APPENDIX I

CLASSROOM OBSERVATION CHECKLISTS

SINIF GÖZLEM FORMU (Geleneksel Yöntem)

Okul ve Sınıf :………………………………………
Süre :………………………….…………...
Değerlendiren :………………….…….….………..

Yargılar	EVET	KISMEN	HAYIR
Öğretmen konuyu anlattı mı?			
Konuyla ilgili örnek sorular çözdü mü?			
Örnek soru çözümlerinde öğrencilere de fırsat verildi mi?			
Ders öğretmen merkezli miydi?			
Sizce dersin işlenişi geleneksel yöntemle mi yapıldı?			

SINIF GÖZLEM FORMU (Bağlama Dayalı Geleneksel Yöntem)

Okul ve Sınıf :………………………………………
Süre :………………………….…………...
Değerlendiren :………………….…….….………..

Yargılar	EVET	KISMEN	HAYIR
Öğretmen ilgi çekici bir bağlamla mı derse başladı?			
Bağlam ele alınacak konuya uygun mu?			
Bağlamdan konuya geçiş uygun bir şekilde yapıldı mı?			
Öğretmen konuyu anlattı mı?			
Konuyla ilgili örnek sorular çözdü mü?			
Örnek soru çözümlerinde öğrencilere de fırsat verildi mi?			
Konu dersin girişinde verilen bağlamda ele alındı mı?			
Ders öğretmen merkezli miydi?			
Sizce dersin işlenişi geleneksel yöntemle mi yapıldı?			

SINIF GÖZLEM FORMU (Öğrenme Döngüsü)

Okul ve Sınıf :……………………………………
Süre :………………………….…………...
Değerlendiren :………………….…….….…………..

		Yargılar	EVET	KISMEN	HAYIR
	Isındırma	Öğretmen yapılacak etkinlikle ilgili sorular sordu mu?			
		Öğretmen öğrencilerin ilgilerini çekebildi mi?			
		Öğretmen öğrencilerin konuyla ilgili sahip oldukları fikir ve düşünceleri ortaya çıkarabildi mi?			
		Öğretmen öğrencilerin konuyla ilgili hipotezler kurmalarını sağladı mı?			
		Öğretmen sorduğu soruların cevaplarını verdi mi?			
	Araştırma	Öğretmen dersi doğrudan anlatmak yerine öğrencilerin beraberce araştırma yapmalarını sağladı mı?			
		Gerektiğinde öğrencilerin araştırmalarına yeniden yön vermek amacıyla öğretmen öğrencilere irdeleyici sorular sordu mu?			
		Öğretmen öğrencilerin araştırmaları için onlara yeterince zaman tanıdı mı?			
		Öğretmen öğrenciler için bir rehber ve danışman gibi davrandı mı?			
		Öğretmen araştırma sorularını cevapladı mı?			
	Açıklama	Öğrenciler gözlem ve bulgularını kendi ifadeleriyle açıkladılar mı?			
		Öğretmen öğrencilerden açıklamaları için kanıt talep etti mi?			
		Öğretmen bilimsel açıklamaları öğrencilerin gözlem ve bulgularını kullanarak mı yaptı?			
		Öğretmen kanıt sunulmayan açıklamaları kabul etti mi?			
		Öğretmen cevapları öğrencilerden almayı ihmal etti mi?			
	Genişletme	Öğretmen öğrencilere yeni bilgilerini kullanmalarına olanak sağlayan başka bir uygulama sağladı mı?			
		Öğretmen öğrencileri bilimsel açıklamaları yeni durumlarda kullanmaları için teşvik etti mi?			
		Yeni uygulama sırasındaki soruları cevaplayan bilgileri öğretmen mi verdi?			
	Değerlendirme	Açık uçlu sorular sordu mu?			
		Öğretmen öğrencilerin yeni bilgileri doğru anlayıp anlamadıklarını ölçtü mü?			
		Öğrencilerin fikir ve düşüncelerini değiştirdiklerine dair kanıtlar aradı mı?			

Ders öğrenci merkezli miydi?			
Sizce dersin işlenişi öğrenme döngüsü yöntemini yansıttı mı?			

*Eğik yazılmış olan ifadeler öğretmenden yapmaması beklenen davranışları göstermektedir.

SINIF GÖZLEM FORMU (Bağlama Dayalı Öğrenme Döngüsü)

Okul ve Sınıf :………………………………………

Süre :…………………………..…………...

Değerlendiren :……………………..…….….………..

		Yargılar	EVET	KISMEN	HAYIR
ÖĞRENME DÖNGÜSÜNÜN AŞAMALARI	**Isındırma**	Öğretmen ilgi çekici bir bağlamla mı derse başladı?			
		Bağlam ele alınacak konuya uygun mu?			
		Öğretmen öğrencilerin ilgilerini çekebildi mi?			
		Öğretmen öğrencilere bağlamla ilgili sorular sordu mu?			
		Öğretmen öğrencilerin konuyla ilgili sahip oldukları fikir ve düşünceleri ortaya çıkarabildi mi?			
		Öğretmen öğrencilerin konuyla ilgili hipotezler kurmalarını sağladı mı?			
		Öğretmen sorduğu soruların cevaplarını verdi mi?			
	Araştırma	Öğretmen dersi doğrudan anlatmak yerine öğrencilerin beraberce araştırma yapmalarını sağladı mı?			
		Gerektiğinde öğrencilerin araştırmalarına yeniden yön vermek amacıyla öğretmen öğrencilere irdeleyici sorular sordu mu?			
		Öğretmen öğrencilerin araştırmaları için onlara yeterince zaman tanıdı mı?			
		Öğretmen öğrenciler için bir rehber ve danışman gibi davrandı mı?			
		Öğretmen araştırma sorularını cevapladı mı?			
	Açıklama	Öğrenciler gözlem ve bulgularını kendi ifadeleriyle açıkladılar mı?			
		Öğretmen öğrencilerden açıklamaları için kanıt talep etti mi?			
		Öğretmen bilimsel açıklamaları öğrencilerin gözlem ve bulgularını kullanarak mı yaptı?			
		Öğretmen kanıt sunulmayan açıklamaları kabul etti mi?			
		Öğretmen cevapları öğrencilerden almayı ihmal etti mi?			
	Genişletme	Öğretmen öğrencilere yeni bilgilerini kullanmalarına olanak sağlayan başka bir uygulama sağladı mı?			
		Öğretmen öğrencileri bilimsel açıklamaları yeni durumlarda kullanmaları için teşvik etti mi?			
		Yeni uygulama sırasındaki soruları cevaplayan bilgileri öğretmen mi verdi?			
	Değerlendirme	Öğrenciler yeni bilgilerini dersin başında sunulan bağlamda ele aldılar mı?			
		Öğretmen öğrencilerin yeni bilgileri doğru anlayıp anlamadıklarını ölçtü mü?			
		Öğrencilerin fikir ve düşüncelerini değiştirdiklerine dair kanıtlar aradı mı?			
		Açık uçlu sorular sordu mu?			

Ders öğrenci merkezli miydi?			
Sizce dersin işlenişi öğrenme döngüsü yöntemini yansıttı mı?			

*Eğik yazılmış olan ifadeler öğretmenden yapmaması beklenen davranışları göstermektedir.

APPENDIX J

LESSON PLANS FOR TRADITIONAL METHOD GROUP

Konu: **İTME VE MOMENTUM**

Malzemeler
Oluklu eğik düzlem, kâğıt bardak, bilye, süreölçer, cetvel

İlgili Kazanımlar

1. İtme ve momentum değişimi arasındaki ilişkiyi problem çözümlerinde kullanır.
2. İtmeyi hesaplar.
3. İtmenin vektörel bir büyüklük olduğunu açıklar.
4. İtmenin uygulanan kuvvetle aynı yönlü olduğunu açıklar.
5. Kuvvet-zaman grafiğini kullanarak itmeyi bulur.
6. Momentumu hesaplar.
7. Momentumun vektörel bir büyüklük olduğunu belirtir.
8. Momentumun hızla aynı yönde olduğunu belirtir.
9. Momentum-zaman grafiğini kullanarak ortalama kuvveti bulur.

Öngörülen zaman: 5 ders saati

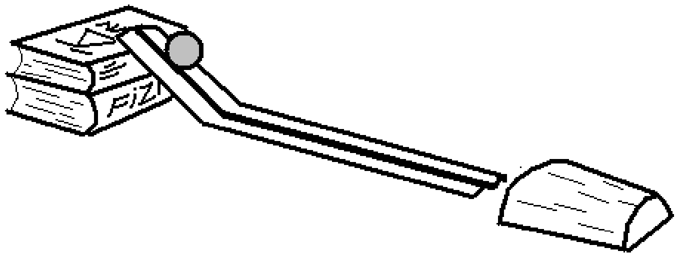
Dersin İşlenişi

1. Öğretmen derse girer. Elindeki araç gereçleri masanın üzerine koyar ve Newton'un ikinci yasasını kullanarak itme-momentum denklemini çıkarır ve aşağıdaki açıklamaları yapar.

$$\mathbf{F} = m.\mathbf{a}$$
$$\mathbf{F} = m.\ \Delta\mathbf{V}/\Delta t$$
$$\mathbf{F}.\ \Delta t = m.\ \Delta\mathbf{V}$$
$$\mathbf{F}.\ \Delta t = m(\mathbf{V_2} - \mathbf{V_1})$$
$$\mathbf{F}.\ \Delta t = m\mathbf{V_2} - m\mathbf{V_1}$$

- F. ∆t itme olarak adlandırılır.
- Birimi N.s'dir.
- İtme de kuvvet gibi vektörel bir büyüklüktür ve kuvvetle aynı yönlüdür.
- Aynı şekilde momentum değişimi de vektöreldir ve uygulanan kuvvetle aynı

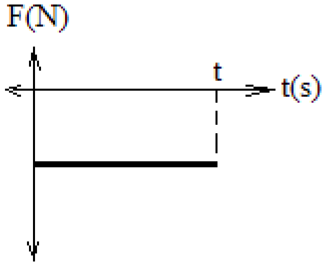
- m. ∆V momentum değişimidir ve itmeye eşittir.
- m.V'nin momentum olarak adlandırılır.
- Birimi kg.m/s'dir.
- Vektörel bir büyüklüktür ve hızla aynı yönlüdür.

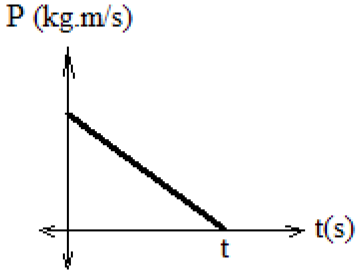


2. Yukarıdaki deney düzeneğini öğretmen masanın üzerine kurar. Farklı kütleli iki bilyeden hafif olanını göstererek “Bu bilyeyi eğik düzlemden serbest bırakırsam ne olur?” sorusunu sorar. Aşağı inerken hız kazanan bilyenin kâğıt bardağı iterek harekete geçireceğini ve sürüklenerek ilerleyen bardağın bir müddet sonra duracağı söylenir. Bilye serbest bırakır ve hareket gözlemlenir. Hareket itme ve momentum değişimi arasındaki ilişki kullanılarak açıklanır (**Eğik düzlemden yatay düzleme geçen bilye belli bir hız kazanmıştır ve neredeyse bu hızla bardağı harekete geçirir. Bu anda bilye ve bardak belli bir momentuma sahiptir. Bardak ve yer arasındaki sürtünme kuvvetinden dolayı bardak yavaşlamaya başlar ve durur. Yani momentumlarını kaybederler ve momentumları sıfır olur. Dolayısıyla bir momentum değişimi söz konusudur ve bu momentum değişimine neden olan hareket süresi boyunca etki eden sürtünme kuvvetinin neden olduğu itmedir**).
3. Sonra öğretmen bu deneyi daha ağır bir bilyeyle tekrarlarsa bardağın durma süresinin değişip değişmeyeceğini sorar. Öğrenci cevaplarından sonra daha ağır bir bilye ile etkinliği tekrarlar. Öğrencilere ağır bilye ile bardağın daha fazla yol gittiğini görüp görmediklerini sorar. Sonra olayı açıklar (**Daha büyük kütleli bilye aynı hızlı küçük bilyeye göre daha fazla momentuma sahiptir. Bardak durana kadar daha fazla momentum değişimi demektir bu. Bu da daha fazla itme anlamına gelir. Sürtünme kuvveti aynı olacağından artan hareketin süresi olacaktır ve daha fazla yol alınacaktır**).
4. Öğretmen “Aynı bilyeyi farklı yüksekliklerden bırakırsak bardağın durma süresi değişir mi?” sorusunu yöneltir. Cevaplardan sonra aynı büyüklükte bilyeleri farklı yüksekliklerden bırakır ve daha yüksekten bıraktığı bilyenin bardağı daha fazla ilerlettiğini söyler ve açıklama yapar (**Aynı kütleli fakat daha hızlı bilyenin momentumu daha fazla olacaktır. Bu da daha fazla momentum değişimi, dolayısıyla daha fazla itme anlamına gelir. Sürtünme kuvveti neredeyse aynı olacağından hareket süresi artacaktır ve daha fazla yol alınacaktır**).
5. İtme ve momentum değişimiyle ilgili ders kitabındaki örnekler sınıfta açıklanarak çözülür.

--1 ders bitti ------------------------------------

1. Öğretmen öğrencilere önceki derste yaptıkları gösteriyi hatırlatır ve bardak durana kadar geçen süreçteki kuvvet-zaman grafiğini ve momentum-zaman grafiğini çizer. Kuvvet-zaman grafiğinin altında kalan alanın itmeyi yani momentum değişiminin büyüklüğünü verdiği belirtilir ve açıklanır. Momentum-zaman grafiğindeyse eğimin ortalama kuvveti verdiği açıklanır.





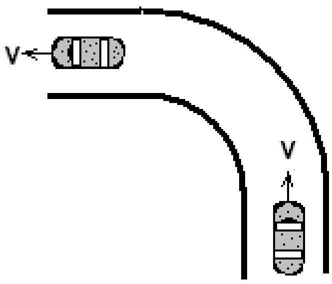
2. Öğretmen daha önce sorduğu şu soruları tekrar sorar ve farklı öğrencilerin cevaplarını alır. Onların cevaplarını itme ve momentum değişimi arasındaki ilişkiye dayalı vermeleri için teşvik eder. Öğretmen öğrencilerden sonra kendisi cevap verir.
    a. Hava yastığı olan araçlarda emniyet kemeri kullanmaya gerek var mıdır?
    b. Düşük hızla seyir halindeyken emniyet kemeri kullanmaya gerek var mıdır?
    c. Kaza durumunda direksiyona ya da kapı kollarına tutunarak kaza etkisini azaltabilir miyiz?
    d. Kamyon gibi büyük motorlu taşıtların otomobillerle aynı hızlarda seyretmeleri doğru mudur?
    e. Sacı çok kalın olan ve çarpma anında kolayca ezilmeyen taş gibi sağlam bir araba mı yoksa ince saclı ve çarpma anında bir miktar ezilebilen arabalar mı daha güvenlidir?

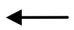
---------------------------- 1 ders bitti --------------------------------

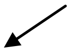
Aşağıdaki sorular öğrencilere sorulur ve cevaplandırılır.

1. Bungee jumpingde esneyen ip yerine esnek olmayan ve kopmayan bir ip kullanılsa ne olur? Esnek ip ne yapmaktadır?
2. İtme ve momentumun skaler büyüklük mü yoksa vektörel büyüklük mü olduklarını açıklayınız.
3. İtme ve momentum değişimi vektörel büyüklük olduklarına ve eşit olduklarına göre uygulanan kuvvetin ve momentum değişiminin yönleri arasında nasıl bir ilişki vardır?
4. Düzgün dairesel hareket yapan bir cismin momentumu sabit midir? Neden?
5. Yukarıdaki soruda momentum değişimi hangi yöndedir?
6. Bir trafik kazasında 90 km/h hızla giden bir otomobil bir ağaca çarparak aniden duruyor. Emniyet kemeri de 85 kg kütleli sürücüyü 400 ms’de durduruyor ve sürücünün camdan fırlamasını ya da konsola çarpmasını engelliyor.
    a. Emniyet kemeri tarafından sürücüye uygulanan ortalama kuvveti hesaplayınız.
    b. Bu kuvveti sürücünün ağırlığıyla karşılaştırınız ve böylece g-kuvvetini hesaplayınız.
    c. Ciddi bir yaralanma olasılığı hakkında ne düşünüyorsunuz? (İnsan bedeni 8g kuvvetine kadar dayanıklıdır.)

7. Yandaki şekil bir dönemeci alan arabayı göstermektedir. Aşağıdakilerden hangisi yolun arabaya uyguladığı ortalama kuvvetin yönünü en iyi gösterir?



   a. 

   b. 

   c. 

   d. 

   e. 

8. Bir penaltı atışında çok hızlı şut atmanın fiziksel bir açıklaması var mıdır? Açıklayınız.
9. 100 kg kütleli bir basketçi 80 cm zıpladıktan sonra yere bastığında basket ayakkabıları sayesinde 400ms'de tam olarak duruyor.
   a. Yer basketçinin ayaklarına ortalama ne kadar kuvvet uygulamıştır?
   b. Eğer sıradan bir ayakkabı olsaydı ve 10ms'de dursaydı ortalama ne kadar kuvvet uygulanırdı?

------------------------------ 1 ders bitti -----------------------------

2 ders saatini kapsayacak şekilde kuvvet-zaman grafiği ve momentum-zaman grafikleri ile ilgili ders kitabındaki sorular ile itme ve momentum değişimi arasındaki ilişkiyle ilgili farklı problemler çözülür.

------------------------------ 2 ders bitti -----------------------------

Konu: MOMENTUMUN KORUNUMU-ELASTİK VE İNELASTİK ÇARPIŞMALAR

İlgili Kazanımlar

1. Momentum korunumunu kullanır.
2. Esnek olmayan çarpışmayı açıklar.
3. Esnek çarpışmayı açıklar.

Öngörülen zaman: 3 ders saati

Dersin İşlenişi

Öğretmen tarafından momentumun korunumu, esnek ve esnek olmayan çarpışmaları ders kitabındaki gibi anlatır ve açıklar.

(a)

(b)

Öğretmen öğrencilerin görebileceği bir yerde (a) şeklindeki düzeneği kurar. Onlara yukarıdan bir bilye bırakması durumunda ne olacağını tahmin etmelerini ister. Sonra bir bilyeyi bırakır ve ne olduğunu gözlemlerler. Sonra öğretmen öğrencilere aynı anda yan yana iki ya da üç bilye bıraksaydı ne olacağını sorar. Öğrencilerin göreceği şekilde önce iki sonra üç bilyeyle gösteri tekrarlanır. Öğretmen öğrencilerden bu olayı momentumun korunumu, esnek ve esnek olmayan çarpışmayla ilgili öğrendiklerini kullanarak açıklamalarını ister. Mümkün olduğunca çok öğrenciden cevap istenir ve sonunda öğretmen açıklama yapar.

--------------------- 1 ders bitti ---------------------

Önceki derste işlenenleri öğrencilerden anlatmaları istenir. Sonra aşağıdaki sorular öncelikle öğrenciler tarafından olmak üzere cevaplanır ve açıklanır.

1. İki otomobilin çarpışması esnek midir? Momentum korunur mu? (**Çarpışmalara karşı otomobillerde tasarlanmış ezilme bölgeleri vardır. Bu ezilme bölgesinin çarpışma süresini uzatarak ortalama kuvveti azalttığını daha önce söylemiştik. Çarpışma öncesindeki toplam enerjinin bir kısmı araçlarda ezilmeye yol açarken harcanır ve toplam enerji korunmaz. Yani bu çarpışmalar esnek olmayan çarpışmalardır.**)
2. Esnek çarpışmaya örnekler veriniz (**Tam esnek çarpışmalara rastlamayız; fakat kısmen esnek çarpışmalara örnek verebiliriz. Bilyelerin çarpışması gibi**).
3. Esnek olmayan çarpışmalara örnekler veriniz (**Tam esnek olmayan çarpışmaya örnek vermek de zordur. Fakat kısmen esnek olmayan çarpışmalara örnek verebiliriz. Kartalın bir güvercini havada sorti yaparak pençesiyle yakalaması gibi**).
4. Bir tenis topu yüksekten bırakılınca momentumu korunur mu? Neden? (**Hayır; çünkü hava sürtünmesi sürekli dışarıdan bir kuvvet olarak etki etmektedir. Yani hem top aşağı inerken hem de yükselirken kesit alanıyla ve o anki hıza bağlı bir hava sürtünmesi etki etmektedir. Dışardan bir kuvvetin etkisinde momentum korunmaz.**)

Ders bitimine kadar konuyla ilgili problemler çözülür.

--------------------- 1 ders bitti ---------------------

Momentumun korunumu, esnek ve esnek olmayan çarpışmayla ilgili örnek problemler çözülür.

--------------------- 1 ders bitti ---------------------

Konu: MERKEZİ VE MERKEZİ OLMAYAN ESNEK ÇARPIŞMALAR

İlgili Kazanımlar

1. Hareketli bir cisimle duran cismin merkezi çarpışmasıyla ilgili soruları çözer.
2. Hareketli bir cisimle duran cismin kenetlenerek çarpışmasıyla ilgili soruları çözer.

Öngörülen zaman: 3 ders saati

Dersin İşlenişi

Öğretmen öğrencilere duran bir cisme hareketli bir cismin çarpması sonucu iki cismin de hareketlerinin nasıl olacağını göreceklerini söyler ve ders kitabında gösterildiği gibi tahtada aşağıdaki denklemleri momentum ve enerjinin korunumunu kullanarak çıkarımlarını yapar.

$$v_1' = \frac{m_1 - m_2}{m_1 + m_2} . v_1 \text{ ve } v_2' = \frac{2m_1}{m_1 + m_2} . v_1$$

1. V_1 hızındaki bir cisim durgun haldeki eşit kütleli bir cisme çarpınca, çarpışma sonrasında kendi hızının büyüklüğü “0” olurken diğer cisim v_1 ile aynı büyüklük ve yöndeki bir hızla hareket eder.
2. V_1 hızındaki bir cisim kendisinden hafif başka bir cisme merkezi çarpınca, çarpışma sonrasında kendisi geliş yönünde daha küçük bir hızla hareket ederken diğer cisim aynı yönde daha büyük bir hızla hareket eder.
3. V_1 hızındaki bir cisim kendisinden ağır başka bir cisim merkezi çarpınca, kendisi geliş yönüne ters daha küçük büyüklükte bir hızla hareket ederken diğeri de v_1 ile aynı yönde; fakat daha küçük büyüklükte bir hızla hareket eder.

Merkezi olmayan çarpışmalarda da x ve y eksenlerindeki toplam momentumların korunduğu belirtilir ve bununla ilgili soruların bu sayede çözüldüğü açıklanır. Bu çarpışmaların da esnek oldukları belirtilir.

------------------------ **1 ders bitti** ------------------------------

Öğretmen masa üzerinde aşağıdaki düzeneği kurar. Sonra sırasıyla eşit kütleli ve farklı kütleli bilyelerle merkezi çarpışmalar yaptırarak, gözlemlerini önceki derste verdiği denklemlerle açıklar.

Öğretmen aşağıdaki soruları sınıfta önce öğrencilerin cevaplamalarını ister. Sonra kendisi cevabı söyler.

1. Kırmızı ışıkta bekleyen bir otomobile arkadan bir minibüs çarparsa hızlarının büyüklükleri ve yönleri nasıl olur? (**Minibüs ilk hıza göre daha düşük bir hızla otomobilse daha büyük bir hızla harekete geçer**)
2. Kırmızı ışıkta duran bir otomobile benzer başka bir otomobil arkadan çarparsa hareket nasıl olur? (**Çarpan otomobil durur, diğeri aynı hızla harekete geçer**)

3. Kırmızı ışıkta bekleyen bir minibüse arkadan bir otomobil çarparsa hareketleri nasıl olur? (**Otomobil büyüklüğü daha küçük bir hızla geri sekerken minibüs ilk hızla aynı yönlü daha küçük bir hızla harekete geçer**)
4. Yukarıdaki çarpışmaların hepsinde sırasıyla bilyelerin birbirlerine uyguladıkları itmeleri ve kuvvetleri açıklayınız. (**Hepsinde de Newton'un 3. Yasasına göre araçlar birbirlerine eşit kuvvetler uygular. Ayrıca etkileşim süreleri de eşit olduğundan itmelerde eşit olur**)
5. Yukarıdaki çarpışmalar esnek midir? Neden? (**Hem momentum hem de enerji neredeyse korunduğundan çarpışmalar kısmen esnektir**)
6. Bu tür kazalara karşı otomobillerde ne tür önlem ya da önlemler alınmaktadır? (**Arkadan çarpmalarda yaslandığımız koltuk vücudumuzu ileri yönde çok kısa sürede yüksek hızlara çıkarır; yani hızlı bir momentum değişimi yaşarız. Bu sırada başımızın da vücudumuzla aynı anda aynı hıza çıkması gerekir. Bunu da koltuk başlıkları yapar. Aksi takdirde boyun kırılmaları yaşanmaktadır. Yani koltuk başlıkları bu tür kazalarda en önemli güvenlik unsurudur.**)
7. 3000 kg'lık bir minibüs 72 km/h hızla ilerlerken kırmızı ışıkta duran 1000 kglık bir otomobile çarpıyor.
    a. Hemen çarpışma sonrasında minibüsün hızı hangi yönde ne kadardır?
    b. Hemen çarpışma sonrasında otomobilin hızı ne kadardır?
    c. Otomobil minibüse ne kadar itme uygulamıştır?
    d. Minibüs otomobile ne kadar itme uygulamıştır?
    e. Çarpışma saniyenin 10'da 1'i kadar bir sürede gerçekleştiyse minibüs otomobile ne kadar kuvvet uygulamıştır?

------------------------- 1 ders bitti ------------------------------

Öğretmen bu çarpışmalarla ilgili problemler çözer.

------------------------- 1 ders bitti ------------------------------

APPENDIX K

LESSON PLANS FOR TRADITIONAL METHOD WITH CONTEXTUAL APPROACH GROUPS

Konu**: OTOMOBİLLERDE GÜVENLİK VE TRAFİK KURALLARI**

Malzemeler Oluklu eğik düzlem, kâğıt bardak, bilye, süreölçer, cetvel

İlgili Kazanımlar

1. İtme ve momentum değişimi arasındaki ilişkiyi problem çözümlerinde kullanır.
2. İtmeyi hesaplar.
3. İtmenin vektörel bir büyüklük olduğunu açıklar.
4. İtmenin uygulanan kuvvetle aynı yönlü olduğunu açıklar.
5. Kuvvet-zaman grafiğini kullanarak itmeyi bulur.
6. Momentumu hesaplar.
7. Momentumun vektörel bir büyüklük olduğunu belirtir.
8. Momentumun hızla aynı yönde olduğunu belirtir.
9. Momentum-zaman grafiğini kullanarak ortalama kuvveti bulur.

Konunun Ele Alınacağı Bağlam

1. Otomobillerde güvenlik
    a. Emniyet kemerinin işlevi
    b. Hava yastığının işlevi
    c. Konsolun esnek olması
    d. Ezilme bölgesi
2. Trafik kuralları
    a. Şehir içinde de emniyet kemeri kullanmanın önemi
    b. Hava yastığı olsa da kemer kullanımının gereksinimi
    c. Kamyon ya da otobüs gibi büyük araçların hız limitlerinin otomobillerden neden daha az olduğu

Öngörülen zaman: 5 ders saati

Dersin İşlenişi

1. Öğretmen derse girer. Elindeki araç gereçleri masanın üzerine koyar ve Trafik kazalarıyla ilgili ekte verilen ve Emniyet Genel Müdürlüğü'ne bağlı Trafik Hizmetleri Başkanlığı'nın web sayfasından alınan veriler öğrencilerle paylaşılır.

2. Öğrencilerin verileri incelemeleri için 1 dakika zaman verilir. Sonra onlara her yıl çok sayıda insanımızın trafik kazalarında öldükleri ya da yaralandıkları belirterek, yıllara göre kazaların sayısında çok artış olmasına rağmen ölüm sayısında bir miktar azalma olduğuna dikkat çekilir. Buna karşın yaralanmaların bir miktar arttığını belirtilir ve bunların nedeniyle ilgili öğrencilerin görüşleri alınır (***Kazalar kasko nedeniyle daha çok kaza resmi kayıtlara girmiş olabilir, emniyet kemeri kullanımı yaygınlaşmış olabilir, otomobillerin güvenliği artmış olabilir, v.b.***). Sonra onlara otomobil firmalarının can kaybını azaltmak için ne tür önlemler geliştirdikleri sorulur **Emniyet kemeri ve hava yastığı gibi**). Peş peşe şu sorular yönlendirilir ve kısaca tahminleri alınır. Bu soruların cevaplarının bu konudan sonra daha iyi anlaşılacağı belirtilir.
    a. Hava yastığı olan araçlarda emniyet kemeri kullanmaya gerek var mıdır?
    b. Düşük hızla seyir halindeyken emniyet kemeri kullanmaya gerek var mıdır?
    c. Kaza durumunda direksiyona ya da kapı kollarına tutunarak kaza etkisini azaltabilir miyiz?
    d. Kamyon gibi büyük motorlu taşıtların otomobillerle aynı hızlarda seyretmeleri doğru mudur?
    e. Sacı çok kalın olan ve çarpma anında kolayca ezilmeyen taş gibi sağlam bir araba mı yoksa ince saclı ve çarpma anında bir miktar ezilebilen arabalar mı daha güvenlidir?

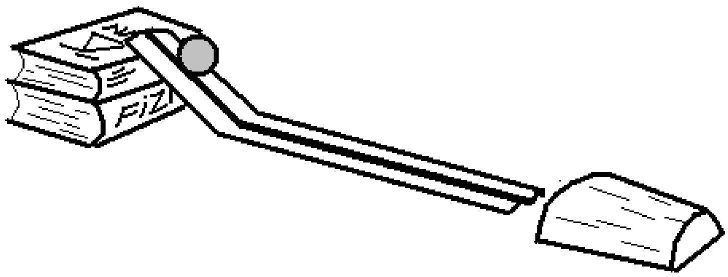
Öğretmen Newton'un ikinci yasasına kullanarak itme-momentum denklemini çıkarır ve aşağıdaki açıklamaları yapar.

- F. Δt itme olarak adlandırılır.
- Birimi N.s'dir.
- İtme de kuvvet gibi vektörel bir büyüklüktür ve kuvvetle aynı yönlüdür.
- Aynı şekilde momentum değişimi de vektöreldir ve uygulanan kuvvetle aynı

$$\mathbf{F} = m.\mathbf{a}$$
$$\mathbf{F} = m.\ \Delta\mathbf{V}/\Delta t$$
$$\mathbf{F}.\ \Delta t = m.\ \Delta\mathbf{V}$$
$$\mathbf{F}.\ \Delta t = m(\mathbf{V_2} - \mathbf{V_1})$$
$$\mathbf{F}.\ \Delta t = m\mathbf{V_2} - m\mathbf{V_1}$$

- m. ΔV momentum değişimidir ve itmeye eşittir.
- m.V'nin momentum olarak adlandırılır.
- Birimi kg.m/s'dir.
- Vektörel bir büyüklüktür ve hızla aynı yönlüdür.

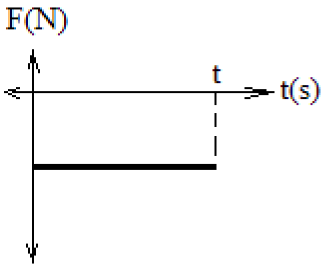
---------------------------------- 1 ders bitti ----------------------------------

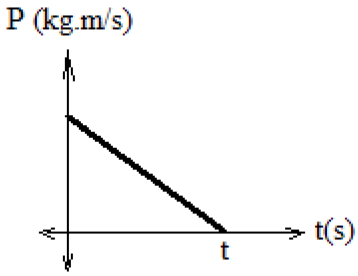


1. Yukarıdaki deney düzeneğini öğretmen masanın üzerine kurar. Farklı kütleli iki bilyeden hafif olanını göstererek "Bu bilyeyi eğik düzlemden serbest bırakırsam ne olur?" sorusunu sorar. Aşağı inerken hız kazanan bilyenin kâğıt bardağı iterek harekete geçireceğini ve sürüklenerek ilerleyen bardağın bir müddet sonra duracağı söylenir. Bilye serbest bırakır ve hareket gözlemlenir. Hareket itme ve momentum değişimi arasındaki ilişki kullanılarak açıklanır (**Eğik düzlemden yatay düzleme geçen bilye belli bir hız kazanmıştır ve neredeyse bu hızla bardağı harekete geçirir. Bu anda bilye ve bardak belli bir momentuma sahiptir. Bardak ve yer arasındaki sürtünme kuvvetinden dolayı bardak yavaşlamaya başlar ve durur. Yani momentumlarını kaybederler ve momentumları sıfır olur. Dolayısıyla bir momentum değişimi söz konusudur ve bu momentum değişimine neden olan hareket süresi boyunca etki eden sürtünme kuvvetinin neden olduğu itmedir**).
2. Sonra öğretmen bu deneyi daha ağır bir bilyeyle tekrarlarsa bardağın durma süresinin değişip değişmeyeceğini sorar. Öğrenci cevaplarından sonra daha ağır bir bilye ile etkinliği tekrarlar. Öğrencilere ağır bilye ile bardağın daha fazla yol gittiğini görüp görmediklerini sorar. Sonra olayı açıklar (**Daha büyük kütleli bilye aynı hızlı küçük bilyeye göre daha fazla momentuma sahiptir. Bardak durana kadar daha fazla momentum değişimi demektir bu. Bu da daha fazla itme anlamına gelir. Sürtünme kuvveti aynı olacağından artan hareketin süresi olacaktır ve daha fazla yol alınacaktır**).
3. Öğretmen "Aynı bilyeyi farklı yüksekliklerden bırakırsak bardağın durma süresi değişir mi?" sorusunu yöneltir. Cevaplardan sonra aynı büyüklükte bilyeleri farklı yüksekliklerden bırakır ve daha yüksekten bıraktığı bilyenin bardağı daha fazla ilerlettiğini söyler ve açıklama yapar (**Aynı kütleli fakat daha hızlı bilyenin momentumu daha fazla olacaktır. Bu da daha fazla momentum değişimi, dolayısıyla daha fazla itme anlamına gelir. Sürtünme kuvveti neredeyse aynı olacağından hareket süresi artacaktır ve daha fazla yol alınacaktır**).
4. İtme ve momentum değişimiyle ilgili ders kitabındaki örnekler sınıfta açıklanarak çözülür.

---1 ders bitti -----------------------------------

1. Öğretmen öğrencilere önceki derste yaptıkları gösteriyi hatırlatır ve bardak durana kadar geçen süreçteki kuvvet-zaman grafiğini ve momentum-zaman grafiğini çizer. Kuvvet-zaman grafiğinin altında kalan alanın itmeyi yani momentum değişiminin büyüklüğünü verdiği belirtilir ve açıklanır. Momentum-zaman grafiğindeyse eğimin ortalama kuvveti verdiği açıklanır.





2. Öğretmen daha önce sorduğu şu soruları tekrar sorar ve farklı öğrencilerin cevaplarını alır. Onların cevaplarını itme ve momentum değişimi arasındaki ilişkiye dayalı vermeleri için teşvik eder. Öğretmen öğrencilerden sonra kendisi cevap verir.
    a. Hava yastığı olan araçlarda emniyet kemeri kullanmaya gerek var mıdır?
    b. Düşük hızla seyir halindeyken emniyet kemeri kullanmaya gerek var mıdır?
    c. Kaza durumunda direksiyona ya da kapı kollarına tutunarak kaza etkisini azaltabilir miyiz?
    d. Kamyon gibi büyük motorlu taşıtların otomobillerle aynı hızlarda seyretmeleri doğru mudur?
    e. Sacı çok kalın olan ve çarpma anında kolayca ezilmeyen taş gibi sağlam bir araba mı yoksa ince saclı ve çarpma anında bir miktar ezilebilen arabalar mı daha güvenlidir?

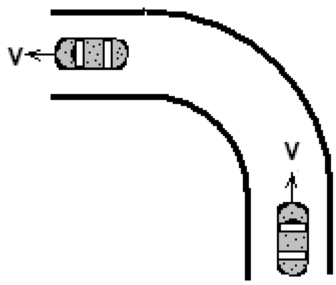
------------------------------ 1 ders bitti ---------------------------------

Aşağıdaki sorular öğrencilere sorulur ve cevaplandırılır.

1. Bungee jumpingde esneyen ip yerine esnek olmayan ve kopmayan bir ip kullanılsa ne olur? Esnek ip ne yapmaktadır?
2. İtme ve momentumun skaler büyüklük mü yoksa vektörel büyüklük mü olduklarını açıklayınız.
3. İtme ve momentum değişimi vektörel büyüklük olduklarına ve eşit olduklarına göre uygulanan kuvvetin ve momentum değişiminin yönleri arasında nasıl bir ilişki vardır?
4. Düzgün dairesel hareket yapan bir cismin momentumu sabit midir? Neden?
5. Yukarıdaki soruda momentum değişimi hangi yöndedir?
6. Bir trafik kazasında 90 km/h hızla giden bir otomobil bir ağaca çarparak aniden duruyor. Emniyet kemeri de 85 kg kütleli sürücüyü 400 ms'de durduruyor ve sürücünün camdan fırlamasını ya da konsola çarpmasını engelliyor.
    a. Emniyet kemeri tarafından sürücüye uygulanan ortalama kuvveti hesaplayınız.
    b. Bu kuvveti sürücünün ağırlığıyla karşılaştırınız ve böylece g-kuvvetini hesaplayınız.

c. Ciddi bir yaralanma olasılığı hakkında ne düşünüyorsunuz? (İnsan bedeni 8g kuvvetine kadar dayanıklıdır.)

7. Yandaki şekil bir dönemeci alan arabayı göstermektedir. Aşağıdakilerden hangisi yolun arabaya uyguladığı ortalama kuvvetin yönünü en iyi gösterir?



   a. ←
   b. ↙
   c. ↗
   d. ↑
   e. ↖

8. Bir penaltı atışında çok hızlı şut atmanın fiziksel bir açıklaması var mıdır? Açıklayınız.
9. 100 kg kütleli bir basketçi 80 cm zıpladıktan sonra yere bastığında basket ayakkabıları sayesinde 400ms'de tam olarak duruyor.
   a. Yer basketçinin ayaklarına ortalama ne kadar kuvvet uygulamıştır?
   b. Eğer sıradan bir ayakkabı olsaydı ve 10ms'de dursaydı ortalama ne kadar kuvvet uygulanırdı?

------------------------------ 1 ders bitti ----------------------------

Geri kalan zamanda kuvvet-zaman grafiği ve momentum-zaman grafikleri ile ilgili ders kitabındaki sorular çözülür.

------------------------------ 1 ders bitti ----------------------------

EK: GENEL KAZA İSTATİSTİKLERİ

Yılı	Kaza sayısı	Ölü sayısı	Yaralı sayısı
1999	465.839	6.130	125.586
2000	500.663	5.566	136.406
2001	442.960	4.386	116.202
2002	439.958	4.169	116.045
2003	455.637	3.959	117.551
2004	537.352	4.427	136.437
2005	620.789	4.505	154.086
2006	728.755	4.633	169.080
2007	825.561	5.007	189.057
2008	929.304	4.228	183.841

6 - 14 Aralık 2008 tarihleri arasındaki 9 günlük **Kurban Bayram tatili süresinde meydana gelen;**

- 69 ölümlü trafik kazasında,
- 113 vatandaşımız hayatını kaybetmiş,
- 180 vatandaşımız da yaralanmıştır.

2008 yılının 9 günlük (27 Eylül-5 Ekim 2008) Ramazan Bayram tatili süresinde meydana gelen;

- 89 ölümlü trafik kazasında,
- 127 vatandaşımız hayatını kaybetmiş,
- 210 vatandaşımız da yaralanmıştır.

Konu: **OTOMOBİLLERDE EZİLME BÖLGESİ**

İlgili Kazanımlar

1. Momentum korunumunu kullanır.
2. Esnek olmayan çarpışmayı açıklar.
3. Esnek çarpışmayı açıklar.

Konunun Ele Alınacağı Bağlam

Otomobillerde güvenlik

1. Ezilme bölgesi

Öngörülen zaman: 3 ders saati

Dersin İşlenişi

Öğretmen derse en son otomobillerde güvenlik konusunu ele aldıklarını anımsatarak derse başlar. Trafik kazalarının bir kısmının çarpışmalar şeklinde olduğunu ve otomobillerin daha güvenli hale getirilmesi için çarpışmalardaki fiziksel olayları iyi anlamak gerektiği ifade edilir. Arabalarda çarpışmalar sırasında güvenlik amacıyla bir ezilme bölgesi bırakıldığını hatırlatır. Ezilmenin olduğu bu çarpışmalarda momentum ve kinetik enerjinin korunup korunmadıklarını sorar. Bu aşamada sadece öğrencilerin fikirleri alınır. Bu sorunun cevabına daha sonra dönüleceği söylenir.

Öğretmen tarafından momentumun korunumu, esnek ve esnek olmayan çarpışmaları ders kitabındaki gibi anlatır ve açıklar.

(a) (b)

Öğretmen öğrencilerin görebileceği bir yerde (a) şeklindeki düzeneği kurar. Onlara yukarıdan bir bilye bırakması durumunda ne olacağını tahmin etmelerini ister. Sonra bir bilyeyi bırakır ve ne olduğunu gözlemlerler. Sonra öğretmen öğrencilere aynı anda yan yana iki ya da üç bilye bıraksaydı ne olacağını sorar. Öğrencilerin göreceği şekilde önce iki sonra üç bilyeyle gösteri tekrarlanır. Öğretmen öğrencilerden bu olayı momentumun korunumu, esnek ve esnek olmayan çarpışmayla ilgili öğrendiklerini kullanarak açıklamalarını ister. Mümkün olduğunca çok öğrenciden cevap istenir ve sonunda öğretmen açıklama yapar.

--------------------- 1 ders bitti ---------------------

Önceki derste işlenenleri öğrencilerden anlatmaları istenir. Sonra aşağıdaki sorular öncelikle öğrenciler tarafından olmak üzere cevaplanır ve açıklanır.

1. İki otomobilin çarpışması esnek midir? Momentum korunur mu? (**Çarpışmalara karşı otomobillerde tasarlanmış ezilme bölgeleri vardır. Bu ezilme bölgesinin çarpışma süresini uzatarak ortalama kuvveti azalttığını daha önce söylemiştik. Çarpışma öncesindeki toplam**

enerjinin bir kısmı araçlarda ezilmeye yol açarken harcanır ve toplam enerji korunmaz. Yani bu çarpışmalar esnek olmayan çarpışmalardır.)

2. Esnek çarpışmaya örnekler veriniz (**Tam esnek çarpışmalara rastlamayız; fakat kısmen esnek çarpışmalara örnek verebiliriz. Bilyelerin çarpışması gibi**).
3. Esnek olmayan çarpışmalara örnekler veriniz (**Tam esnek olmayan çarpışmaya örnek vermek de zordur. Fakat kısmen esnek olmayan çarpışmalara örnek verebiliriz. Kartalın bir güvercini havada sorti yaparak pençesiyle yakalaması gibi**).
4. Bir tenis topu yüksekten bırakılınca momentumu korunur mu? Neden? (**Hayır; çünkü hava sürtünmesi sürekli dışarıdan bir kuvvet olarak etki etmektedir. Yani hem top aşağı inerken hem de yükselirken kesit alanıyla ve o anki hıza bağlı bir hava sürtünmesi etki etmektedir. Dışardan bir kuvvetin etkisinde momentum korunmaz.**)

Ders bitimine kadar konuyla ilgili problemler çözülür.

--------------------- 1 ders bitti ---------------------

Momentumun korunumu, esnek ve esnek olmayan çarpışmayla ilgili örnek problemler çözülür.

--------------------- 1 ders bitti ---------------------

Konu: KOLTUK BAŞLIKLARI HAYAT KURTARIR

İlgili Kazanımlar

1. Hareketli bir cisimle duran cismin merkezi çarpışmasıyla ilgili soruları çözer.
2. Hareketli bir cisimle duran cismin kenetlenerek çarpışmasıyla ilgili soruları çözer.

Konunun Ele Alındığı Bağlam

Otomobillerde güvenlik

1. Koltuk başlıklarının önemi

Trafik kuralları

2. Trafik ışıklarına yaklaşırken hızımızı azaltmak son derece önemlidir.

Öngörülen zaman: 3 ders saati

Dersin İşlenişi

Öğretmen derse geçen derslerde trafik kazalarıyla ve otomobillerde kazalardaki ölüm ve yaralanmalara karşı alınan önlemlerle ilgili konuştuklarını hatırlatarak derse başlar. Ayrıca çarpışmalardan da bahsedildiği hatırlatılır. Sonra öğrencilere arkadan çarpmalarda nasıl zarar görebileceklerini sorar. Eylemsizlikten dolayı kafa aniden arkada kalır ve boyun kırılmaları olabileceğini, bunun da son derece tehlikeli sonuçları olabileceğini söyler. Bu tür olayların yaşanmaması için trafik ışıklarına yaklaşırken otomobillerin yavaşlamasının çok önemli olduğu söylenir. Sonra otomobillerde arkadan çarpmalara karşı en önemli tedbirin ne olduğunu sorar. Öğrenci tahminlerinden sonra koltuk başlıklarının önemi anlatılır.

Çarpma sırasında kafanın da vücutla beraber hareketini sağladığı, böylece boyun kırılmalarını engellediği açıklanır. Duran bir arabaya arkadan çarpmanın da değişik şekillerde olabileceğini belirten öğretmen tahtada aşağıdaki denklemleri momentum ve enerjinin korunumunu kullanarak ers kitabındaki gibi ispatlar.

$$v_1' = \frac{m_1 - m_2}{m_1 + m_2} . v_1 \text{ ve } v_2' = \frac{2m_1}{m_1 + m_2} . v_1$$

1. V_1 hızındaki bir cisim durgun haldeki eşit kütleli bir cisme çarpınca, çarpışma sonrasında kendi hızının büyüklüğü "0" olurken diğer cisim v_1 ile aynı büyüklük ve yöndeki bir hızla hareket eder.
2. V_1 hızındaki bir cisim kendisinden hafif başka bir cisme merkezi çarpınca, çarpışma sonrasında kendisi geliş yönünde daha küçük bir hızla hareket ederken diğer cisim aynı yönde daha büyük bir hızla hareket eder.
3. V_1 hızındaki bir cisim kendisinden ağır başka bir cisim merkezi çarpınca, kendisi geliş yönüne ters daha küçük büyüklükte bir hızla hareket ederken diğeri de v_1 ile aynı yönde; fakat daha küçük büyüklükte bir hızla hareket eder.

Merkezi olmayan çarpışmalarda da x ve y eksenlerindeki toplam momentumların korunduğu belirtilir ve bununla ilgili soruların bu sayede çözüldüğü açıklanır. Bu çarpışmaların da esnek oldukları belirtilir.

------------------------ 1 ders bitti ------------------------------

Öğretmen masa üzerinde aşağıdaki düzeneği kurar. Sonra sırasıyla eşit kütleli ve farklı kütleli bilyelerle merkezi çarpışmalar yaptırarak, gözlemlerini önceki derste verdiği denklemlerle açıklar.

Öğretmen aşağıdaki soruları sınıfta önce öğrencilerin cevaplamalarını ister. Sonra kendisi cevabı söyler.

1. Kırmızı ışıkta bekleyen bir otomobile arkadan bir minibüs çarparsa hızlarının büyüklükleri ve yönleri nasıl olur? (**Minibüs ilk hıza göre daha düşük bir hızla otomobilse daha büyük bir hızla harekete geçer**)
2. Kırmızı ışıkta duran bir otomobile benzer başka bir otomobil arkadan çarparsa hareket nasıl olur? (**Çarpan otomobil durur, diğeri aynı hızla harekete geçer**)
3. Kırmızı ışıkta bekleyen bir minibüse arkadan bir otomobil çarparsa hareketleri nasıl olur? (**Otomobil büyüklüğü daha küçük bir hızla geri sekerken minibüs ilk hızla aynı yönlü daha küçük bir hızla harekete geçer**)
4. Yukarıdaki çarpışmaların hepsinde sırasıyla bilyelerin birbirlerine uyguladıkları itmeleri ve kuvvetleri açıklayınız. (**Hepsinde de Newton'un 3. Yasasına göre araçlar birbirlerine eşit kuvvetler uygular. Ayrıca etkileşim süreleri de eşit olduğundan itmelerde eşit olur**)
5. Yukarıdaki çarpışmalar esnek midir? Neden? (**Hem momentum hem de enerji neredeyse korunduğundan çarpışmalar kısmen esnektir**)

6. Bu tür kazalara karşı otomobillerde ne tür önlem ya da önlemler alınmaktadır? (**Arkadan çarpmalarda yaslandığımız koltuk vücudumuzu ileri yönde çok kısa sürede yüksek hızlara çıkarır; yani hızlı bir momentum değişimi yaşarız. Bu sırada başımızın da vücudumuzla aynı anda aynı hıza çıkması gerekir. Bunu da koltuk başlıkları yapar. Aksi takdirde boyun kırılmaları yaşanmaktadır. Yani koltuk başlıkları bu tür kazalarda en önemli güvenlik unsurudur.**)
7. 3000 kg'lık bir minibüs 72 km/h hızla ilerlerken kırmızı ışıkta duran 1000 kglık bir otomobile çarpıyor.
    a. Hemen çarpışma sonrasında minibüsün hızı hangi yönde ne kadardır?
    b. Hemen çarpışma sonrasında otomobilin hızı ne kadardır?
    c. Otomobil minibüse ne kadar itme uygulamıştır?
    d. Minibüs otomobile ne kadar itme uygulamıştır?
    e. Çarpışma saniyenin 10'da 1'i kadar bir sürede gerçekleştiyse minibüs otomobile ne kadar kuvvet uygulamıştır?

------------------------- 1 ders bitti ------------------------------

Öğretmen bu çarpışmalarla ilgili problemler çözer.

------------------------- 1 ders bitti ------------------------------

APPENDIX L

LESSON PLANS FOR LEARNING CYCLE GROUP

Konu**: İTME VE MOMENTUM**

Malzemeler
Oluklu eğik düzlem, kâğıt bardak, bilye, süreölçer, cetvel, 10-15 tane yumurta, bir çarşaf, kırılan yumurtaları biriktirmek için bir kap

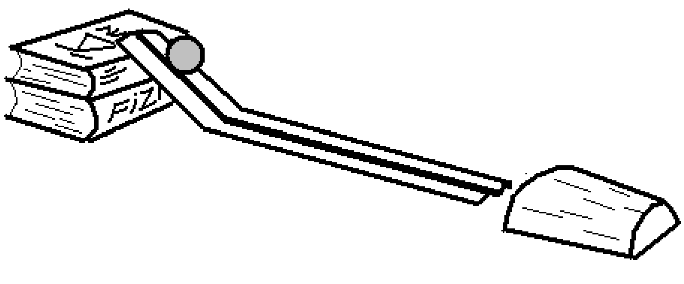
İlgili Kazanımlar

İtme ve momentum değişimi arasındaki ilişkiyi problem çözümlerinde kullanır.

İtmeyi hesaplar.

1. İtmenin vektörel bir büyüklük olduğunu açıklar.
2. İtmenin uygulanan kuvvetle aynı yönlü olduğunu açıklar.
3. Kuvvet-zaman grafiğini kullanarak itmeyi bulur.
4. Momentumu hesaplar.
5. Momentumun vektörel bir büyüklük olduğunu belirtir.
6. Momentumun hızla aynı yönde olduğunu belirtir.
7. Momentum-zaman grafiğini kullanarak ortalama kuvveti bulur.

Öngörülen zaman: 5 ders saati
Dersin İşlenişi
Aşama 1: ISINDIRMA



1. Öğretmen derse girer. Elindeki araç gereçleri masanın üzerine koyarak bir etkinlik yapacaklarını söyler. Öğretmen öğrencileri sınıf mevcuduna göre 4-6 kişilik gruplara ayırır. Yukarıdaki deney düzeneğini masanın üzerine kurar. Farklı kütleli iki bilyeden hafif olanını göstererek “Bu bilyeyi eğik düzlemden

serbest bırakırsam ne olur?" sorusunu gruplara yöneltir. Grup tahminlerini dinler (***Aşağı inerken hız kazanan bilyenin kağıt bardağı iterek harekete geçireceğini ve sürüklenerek ilerleyen bardağın bir müddet sonra duracağını söylemelerini bekliyoruz***). Bilyeyi serbest bırakır ve hareketi gözlemlerler. Sonra öğretmen bu deneyi daha ağır bir bilyeyle tekrarlarsa bardağın durma süresinin değişip değişmeyeceğini sorar. Buna göre muhtemel hipotezler şunlardır: Deney ağır bilyeyle tekrarlandığında durma süresi değişmez / azalır / artar. Öğretmen gruplara söyledikleri hipotezlerini (tahminlerini) not almalarını ister.

2. Öğretmen "Aynı bilyeyi farklı yüksekliklerden bırakırsak bardağın durma süresi değişir mi?" sorusunu yöneltir. Buna göre muhtemel hipotezler şunlardır: Daha yüksekten bırakılan bilye durma süresini değiştirmez / uzatır / kısaltır. Gruplar söyledikleri hipotezlerini tekrar not alırlar.

Aşama 2: ARAŞTIRMA

1. Öğretmen her grubun deney düzeneğini kurmasını ve kurdukları düzeneklerle hipotezlerini test etmelerini ister. Yani yaptıkları gözlemlerle hipotezlerinin doğru olup olmadığını belirlerler. Öğrenciler durma zamanını aynı deneyi 3-5 kez tekrarlayarak ölçerler ve ortalamayı hesaplarlar. Böylece sonuçlardaki hata miktarı azaltılmış olur.

Aşama 3: AÇIKLAMA

1. Öğretmen her gruba "Farklı kütleli bilyeler durma süresini nasıl etkiledi?" ve "Bu sonuç kurduğunuz hipotezle aynı mıdır?" diye sorar (***Öğrencilerden "Büyük kütleli bilyenin harekete geçirdiği bardak daha uzun sürede durur" demeleri beklenir***). Öğretmen farklı kütleli bilyelerin bardağa çarpmadan önceki hızlarını sorar (***Aynı yükseklikten bırakıldıkları için aynıdır***).
2. Öğretmen her gruba "Aynı bilyenin farklı yüksekliklerden bırakılması durma süresini nasıl etkiledi?" ve "Bu sonuç kurduğunuz hipotezle aynı mıdır?" diye sorar (***Öğrencilerden "Yüksekten bırakılan bilyenin harekete geçirdiği bardak daha uzun sürede durur" demeleri beklenir***). Öğretmen farklı yüksekliklerden bırakılan bilyelerin bardağa çarpmadan önceki hızlarını sorar (***Yüksekten bırakılan daha hızlıdır***).
3. Öğretmen öğrencilere bardak durana kadar nasıl bir hareket yaptığını sorar (***Yavaşlayan ya da negatif ivmeli bir hareket demelerini bekliyoruz***). Sonra böyle bir hareketin hangi durumda mümkün olduğunu sorar (***Net bir kuvvetin varlığında söz konusudur***).

---------------------------------- 1 ders bitti ----------------------------------

1. Öğretmen olayı fiziksel bir şekilde açıklamadan önce Newton'un ikinci yasasına kullanarak itme-momentum denklemini çıkarır ve aşağıdaki açıklamaları yapar.

- $F.\Delta t$ itme olarak adlandırılır.
- Birimi N.s'dir.
- İtme de kuvvet gibi vektörel bir büyüklüktür ve kuvvetle aynı yönlüdür.
- Aynı şekilde momentum değişimi de vektöreldir ve uygulanan kuvvetle aynı

$$\mathbf{F} = m.\mathbf{a}$$
$$\mathbf{F} = m.\ \Delta\mathbf{V}/\Delta t$$
$$\mathbf{F}.\ \Delta t = m.\ \Delta\mathbf{V}$$
$$\mathbf{F}.\ \Delta t = m(\mathbf{V_2} - \mathbf{V_1})$$
$$\mathbf{F}.\ \Delta t = m\mathbf{V_2} - m\mathbf{V_1}$$

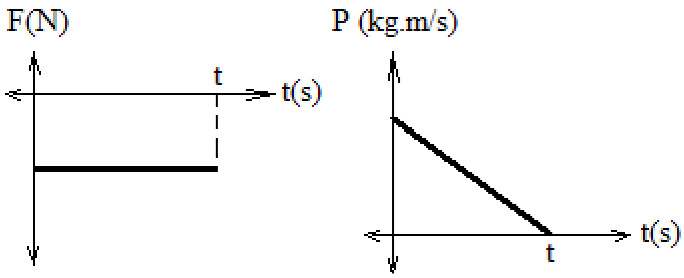
- $m.\ \Delta V$ momentum değişimidir ve itmeye eşittir.
- m.V'nin momentum olarak adlandırılır.
- Birimi kg.m/s'dir.
- Vektörel bir büyüklüktür ve hızla

2. Öğretmen deneydeki olayları fiziksel açıklamalarını kullanarak izah eder.

$$m.\Delta V = F.\Delta t$$

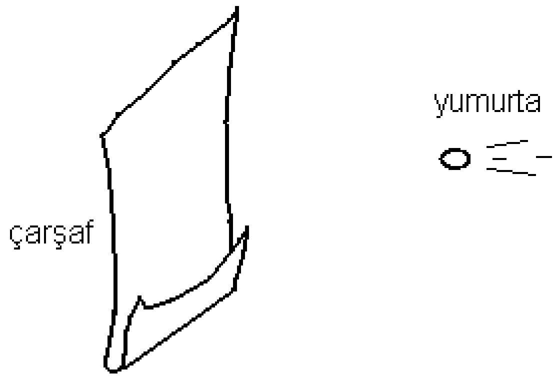
- Bilye bardak ikilisinin momentum değişimi bilyenin kütlesi ya da hızına bağlıdır.
- Sürtünme kuvveti neredeyse sabittir.
- Aynı yükseklitken bırakılan bilyelerden büyük kütleli olanının ve aynı kütleli bilyelerden yüksekten bırakılanın momentumu daha büyüktür.
- Durma süresi bardak ve bilye ikilisinin ilk momentumunun büyüklüğüne bağlıdır.

3. Öğretmen öğrencilerden bardak durana kadar geçen süreçteki kuvvet-zaman grafiğini ve momentum-zaman grafiğini çizmelerini ister. Aşağıdaki gibi grafikler çizmeleri beklenir. Kuvvet-zaman grafiğinin altında kalan alanın itmeyi yani momentum değişiminin büyüklüğünü verdiği belirtilir. Momentum-zaman grafiğindeyse eğimin ortalama kuvveti verdiği açıklanır.



-------------------------------- 1 ders bitti --------------------------------

Aşama 4: GENİŞLETME



Bu etkinlik için 5-10 tane yumurta, bir çarşaf, kırılan yumurtaları biriktirmek için de bir kap gerekmektedir. İki öğrenci çarşafı şekildeki gibi tutacaklar ve mümkün olduğunca her bir öğrenci bir yumurta alıp çarşafa fırlatacaktır. Onlara bu şekilde yumurtayı kırıp kıramayacaklarını sorulur ve denemeleri sağlanır. Sonuçta çarşafa çarpan yumurtalar kırılmayacaklar ya da öğrenci o kadar hızlı fırlatacaktır ki; yumurta elinde kırılabilecektir. Öğretmen onlara öncelikle çarşafa fırlatılan yumurtaların neden kırılmadığını sorar ve öğrendikleri kavramlarla açıklamalarını ister (***Belli bir hızda giden yumurta belli bir sürede çarşaf tarafından uygulanan itmeyle durdurulmaktadır. Çarşaf F. Δt = m. ΔV'deki Δt'yi artırdığından F küçülmektedir; dolayısıyla yumurta kırılmamaktadır***). "Peki bazı yumurtaların elimizde kırılmasının nedeni ne olabilir?" diye de sorulur (***Elimizle yumurtaya bir hız kazandırmaya çalışıyoruz. Çok hızlandırmak istediğimizde m. ΔV'yi artırıyoruz; fakat kısa sürede bunu yapıyoruz. Bu da büyük F anlamına geliyor ve yumurta kırılıyor***).

Aşama 5: DEĞERLENDİRME

1. Bungee jumpingde esneyen ip yerine esnek olmayan ve kopmayan bir ip kullanılsa ne olur? Esnek ip ne yapmaktadır?
2. Sacı çok kalın olan ve çarpma anında kolayca ezilmeyen taş gibi sağlam bir araba mı yoksa ince saclı ve çarpma anında bir miktar ezilebilen arabalar mı daha güvenlidir?
3. İtme ve momentumun skaler büyüklük mü yoksa vektörel büyüklük mü olduklarını açıklayınız.
4. İtme ve momentum değişimi vektörel büyüklük olduklarına ve eşit olduklarına göre uygulanan kuvvetin ve momentum değişiminin yönleri arasında nasıl bir ilişki vardır?
5. Düzgün dairesel hareket yapan bir cismin momentumu sabit midir? Neden?
6. Önceki soruda momentum değişimi hangi yöndedir?

---------------------------------- 1 ders bitti ----------------------------------

2 ders saati kadar işlenen konularla ilgili sınıf içinde soru çözünüz.

---------------------------------- 2 ders bitti ----------------------------------

Konu: **MOMENTUMUN KORUNUMU-ELASTİK VE İNELASTİK ÇARPIŞMALAR**

İlgili Kazanımlar

1. Momentum korunumunu kullanır.
2. Esnek olmayan çarpışmayı açıklar.
3. Esnek çarpışmayı açıklar.

Öngörülen zaman: 3 ders saati

Dersin İşlenişi

Aşama 1: ISINDIRMA

Öğretmen öncelikle öğrencileri 4-5 kişilik gruplara ayırır. Onlara bir tenis topunu gösterir ve onu yere masa yüksekliğinden serbest bıraktığında tekrar ne kadar yükseğe çıkabileceğini sorar. Öğrencilerin bütün farklı tahminlerini alır. Sonra onlara topu yere çok yakın bir mesafeden bırakırsa ne kadar yükseleceğini sorar ve tahminlerini alır.

Aşama 2: ARAŞTIRMA

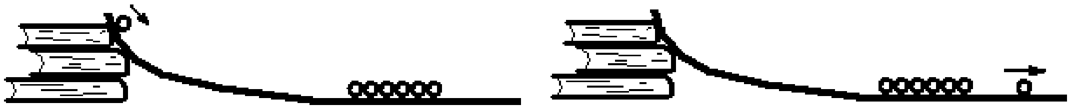
Öğretmen gruplardan tahminlerinin doğru olup olmadığını deneyerek bulmalarını ister.

Aşama 3: AÇIKLAMA

Öğretmen gruplardan gözlemlerini ve bulgularını açıklamalarını ister. Sonra gözlemlerini öncelikle topun mekanik enerjisi açısından açıklamalarını ister (**Top sıçradıktan sonra hemen hemen aynı yüksekliğe çıkabilmektedir. Bu da toplam mekanik enerjinin neredeyse korunduğu anlamına gelir**).

Daha sonra öğrencilere toplam momentumun korunup korunmadığını sorar (**Bu noktada öğrencilerin açıklamaları tahmini olacaktır; çünkü sadece topun momentumunu düşünebilirler. Sadece topun momentumunu düşünmeleri momentumun değiştiği sonucunu çıkarmalarını sağlayabilir ki; doğru bir açıklama olur. Ancak bizim sorduğumuz toplam momentumdur**). Öğretmen çarpışmanın top ve dünya arasında olduğunu söyler ve şu şekilde devam eder: **Topu serbest bırakmadan önce top ve dünyanın birbirlerine göre momentumları toplamı sıfırdır. Yani toplam momentum sıfırdır diyebiliriz. Serbest düşme sırasında top hız kazanır; ancak dünyanın kazanacağı hız kütlesinin topa kıyasla çok çok büyük olmasından kayda değer değildir. Çarpışmada top ve dünya birbirine aynı büyüklükte itme uygular. Bu itme dünyaya ters yönde kayda değer bir hız kazandırmazken topu neredeyse aynı yüksekliğe çıkarır. Sonuçta toplam momentum yine sıfırdır. Dışarıdan bir kuvvet etki etmedikçe meydana gelen bütün çarpışmalarda toplam momentum korunur ve buna momentumun korunumu denir. Hem mekanik enerji hem de toplam momentumun korunduğu bu tür çarpışmalara da esnek (elastik) çarpışma denir.** Bu açıklamayı takiben öğretmen öğrencilere “Peki ya tenis topu değil de dünyaya bir meteor çarpsaydı ne olurdu? ” diye sorar. Burada da enerjinin korunmadığını fakat momentumun korunduğunu sayfa 43’deki gibi açıklar (Hareketli bir cismin duran bir cisimle merkezi çarpışması sonucu kenetlenerek hareket etmesi). Bu tür çarpışmalara da esnek olmayan (inelastik) çarpışma denildiği söylenir ve bir sakızın yere düşmesi ya da suyun dökülmesi de birer örnek olarak verilir.

GENİŞLETME



(a) (b)

Öğretmen öğrencilerin görebileceği bir yerde (a) şeklindeki düzeneği kurar. Onlara yukarıdan bir bilye bırakması durumunda ne olacağını tahmin etmelerini ister. Sonra bir bilyeyi bırakır ve ne olduğunu gözlemlerler. Sonra öğretmen öğrencilere aynı anda yan yana iki ya da üç bilye bıraksaydı ne olacağını sorar. Bunuda onların gruplar halinde denemelerini ister. Daha sonra onlardan bu olayın esnek bir çarpışmamı yoksa esnek olmayan bir çarpışma mı olduğunu sorar ve açıklamalarını ister.

--------------------- 1 ders bitti ---------------------

Aşama 4: DEĞERLENDİRME

1. İki otomobilin çarpışması esnek midir? Momentum korunur mu? (**Çarpışmalara karşı otomobillerde tasarlanmış ezilme bölgeleri vardır. Bu ezilme bölgesinin çarpışma süresini uzatarak ortalama kuvveti azalttığını daha önce söylemiştik. Çarpışma öncesindeki toplam enerjinin bir kısmı araçlarda ezilmeye yol açarken harcanır ve toplam enerji korunmaz. Yani bu çarpışmalar esnek olmayan çarpışmalardır.**)
2. Esnek çarpışmaya örnekler veriniz (**Tam esnek çarpışmalara rastlamayız; fakat kısmen esnek çarpışmalara örnek verebiliriz. Bilyelerin çarpışması gibi**).
3. Esnek olmayan çarpışmalara örnekler veriniz (**Tam esnek olmayan çarpışmaya örnek vermek de zordur. Fakat kısmen esnek olmayan çarpışmalara örnek verebiliriz. Kartalın bir güvercini havada sorti yaparak pençesiyle yakalaması gibi**).
4. Topu yüksekten bırakınca momentum korundu mu? Neden? (**Hayır; çünkü hava sürtünmesi sürekli dışarıdan bir kuvvet olarak etki etmektedir. Yani hem top aşağı inerken hem de yükselirken kesit alanıyla ve o anki hıza bağlı bir hava sürtünmesi etki etmektedir. Dışardan bir kuvvetin etkisinde momentum korunmaz.**)

Momentumun korunumu, esnek ve esnek olmayan çarpışmayla ilgili birkaç örnek daha çözülür.

--------------------- 1 ders bitti ---------------------

Momentumun korunumu, esnek ve esnek olmayan çarpışmayla ilgili problemler çözülür.

--------------------- 1 ders bitti ---------------------

Konu: MERKEZİ VE MERKEZİ OLMAYAN ESNEK ÇARPIŞMALAR

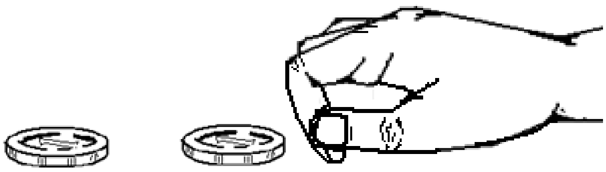
İlgili Kazanımlar

1. Hareketli bir cisimle duran cismin merkezi çarpışmasıyla ilgili soruları çözer.
2. Hareketli bir cisimle duran cismin kenetlenerek çarpışmasıyla ilgili soruları çözer.

Dersin İşlenişi: 4 ders saati

Aşama 1: ISINDIRMA

Öğretmen öncelikle öğrencileri 4-5 kişilik gruplara ayırır ve onlara ikisi aynı, birisi de farklı iki metal para gösterir (İki tane 1TL bir tane de 50KRŞ gibi). Masanın üzerindeki eşit kütleli paralardan biri durgunken diğeriyle merkezi çarpıştırılırsa ne olacağını sorar. Grupların tahminlerini alır ve herkesin göreceği şekilde merkezi çarpışmayı gerçekleştirir (***Çarpan para yerinde kalırken aynı hızla diğeri harekete geçer***).



Sonra sırasıyla gruplardan şunları yapmalarını ister:

1. Büyük paranın durgun haldeki küçük parayla merkezi çarpışması sonucu ne olacağını sorar. Gruplardan gelen tahminleri not almalarını ister.
2. Küçük paranın durgun haldeki büyük paraya çarpması durumundaki hareketi tahmin etmelerini ve not almalarını ister.
3. Merkezi olmayan çarpışmalarda da neler olacağını sorar ve tahminlerini not almalarını ister.

Aşama 2: ARAŞTIRMA

Öğretmen öğrencilerden yaptıkları tahminlerini yani hipotezlerini deneylerini yaparak test etmelerini ister. Her bir tahmin denenirken birkaç kez tekrarlamanın hataları azalttığından sonuçlarının doğruluğunu artıracağı belirtilir.

-------------------- 1 ders bitti ------------------------

Aşama 3: AÇIKLAMA

Öğretmen gruplardan sırasıyla büyük kütleli paranın durgun haldeki küçük kütleli paraya merkezi çarpması, küçük kütleli paranın durgun haldeki büyük kütleli paraya merkezi çarpması ve merkezi olmayan çarpışmalarla ilgili gözlemlerini açıklamalarını ister. Eşit kütleli paraların merkezi çarpışmasını öğretmen önceden göstermişti. Öğretmen çarpışmanın esnek olduğunu açıklar ve tahtada aşağıdaki denklemleri momentum ve enerjinin korunumunu kullanarak ispatlar.

$$v_1' = \frac{m_1-m_2}{m_1+m_2}.v_1 \text{ ve } v_2' = \frac{2m_1}{m_1+m_2}.v_1$$

1. V_1 hızındaki bir para durgun haldeki eşit kütleli bir paraya çarpınca, çarpışma sonrasında kendi hızının büyüklüğü "0" olurken diğer para v_1 ile aynı büyüklük ve yöndeki bir hızla hareket eder.
2. V_1 hızındaki bir para kendisinden hafif başka bir paraya merkezi çarpınca, çarpışma sonrasında kendisi geliş yönünde daha küçük bir hızla hareket ederken diğer para aynı yönde daha büyük bir hızla hareket eder.

3. V_1 hızındaki bir para kendisinden ağır başka bir paraya merkezi çarpınca, kendisi geliş yönüne ters daha küçük büyüklükte bir hızla hareket ederken diğeri de v_1 ile aynı yönde; fakat daha küçük büyüklükte bir hızla hareket eder.

Merkezi olmayan çarpışmalarda da x ve y eksenlerindeki toplam momentumların korunduğu belirtilir ve bununla ilgili soruların bu sayede çözüldüğü açıklanır. Bu çarpışmaların da esnek oldukları belirtilir.

--------------------- 1 ders bitti -------------------------

Aşama 4: GENİŞLETME

Öğretmen gruplardan aşağıdaki düzeneği kurmalarını ister. Sonra sırasıyla eşit kütleli ve farklı kütleli bilyelerle merkezi çarpışmalar yapmalarını ister. Öğretmen bu etkinlikteki gözlemleri bu sefer öğrencilerin açıklamalarını ister.

Aşama 5: DEĞERLENDİRME

1. Sabit bir hızla ilerleyen bir cisim kütlesi eşit durgun haldeki başka bir cisme merkezi çarpınca cisimler nasıl hareket ederler?
2. Sabit bir hızla ilerleyen bir cisim kendisinden ağır bir cisimle merkezi çarpışınca nasıl hareket eder?
3. Sabit bir hızla ilerleyen bir cisim kendisinden hafif bir cisimle merkezi çarpışma yapınca nasıl hareket eder?
4. Yukarıdaki çarpışmaların hepsinde sırasıyla bilyelerin birbirlerine uyguladıkları itmeleri ve kuvvetleri açıklayınız.
5. Yukarıdaki çarpışmalar esnek midir? Neden?
6. Kırmızı ışıkta bekleyen bir otomobile arkadan bir minibüs çarparsa hızlarının büyüklükleri ve yönleri nasıl olur?
7. Kırmızı ışıkta duran bir otomobile benzer başka bir otomobil arkadan çarparsa hareket nasıl olur?
8. Kırmızı ışıkta bekleyen bir minibüse arkadan bir otomobil çarparsa hareketleri nasıl olur?

--------------------- 1 ders bitti -------------------------

Öğretmen bu çarpışmalarla ilgili problemler çözer.

--------------------- 1 ders bitti -------------------------

APPENDIX M

LESSON PLANS FOR LEARNING CYCLE WITH CONTEXTUAL APPROACH GROUPS

Konu**: OTOMOBİLLERDE GÜVENLİK VE TRAFİK KURALLARI**

Malzemeler Oluklu eğik düzlem, kâğıt bardak, bilye, süreölçer, cetvel, 10-15 tane yumurta, bir çarşaf, kırılan yumurtaları biriktirmek için bir kap

İlgili Kazanımlar

1. İtme ve momentum değişimi arasındaki ilişkiyi problem çözümlerinde kullanır.
2. İtmeyi hesaplar.
3. İtmenin vektörel bir büyüklük olduğunu açıklar.
4. İtmenin uygulanan kuvvetle aynı yönlü olduğunu açıklar.
5. Kuvvet-zaman grafiğini kullanarak itmeyi bulur.
6. Momentumu hesaplar.
7. Momentumun vektörel bir büyüklük olduğunu belirtir.
8. Momentumun hızla aynı yönde olduğunu belirtir.
9. Momentum-zaman grafiğini kullanarak ortalama kuvveti bulur.

Konunun Ele Alınacağı Bağlam

1. Otomobillerde güvenlik
    a. Emniyet kemerinin işlevi
    b. Hava yastığının işlevi
    c. Konsolun esnek olması
    d. Ezilme bölgesi
2. Trafik kuralları
    a. Şehir içinde de emniyet kemeri kullanmanın önemi
    b. Hava yastığı olsa da kemer kullanımının gereksinimi
    c. Kamyon ya da otobüs gibi büyük araçların hız limitlerinin otomobillerden neden daha az olduğu

Öngörülen zaman: 5 ders saati

Dersin İşlenişi

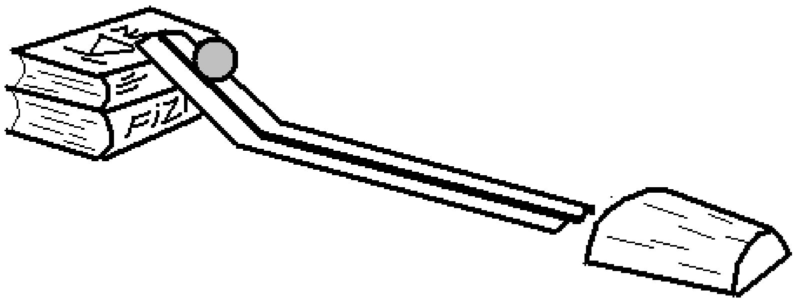
Aşama 1: ISINDIRMA

1. Öğretmen derse girer. Elindeki araç gereçleri masanın üzerine koyarak bir etkinlik yapacaklarını söyler. Öğretmen öğrencileri sınıf mevcuduna göre 4-6 kişilik gruplara ayırır. Trafik kazalarıyla ilgili ekte verilen ve Emniyet Genel

Müdürlüğü'ne bağlı Trafik Hizmetleri Başkanlığı'nın web sayfasından alınan veriler öğrencilerle paylaşılır.

2. Öğrencilerin verileri incelemeleri için 1 dakika zaman verilir. Sonra onlara her yıl çok sayıda insanımızın trafik kazalarında öldükleri ya da yaralandıkları belirterek, yıllara göre kazaların sayısında çok artış olmasına rağmen ölüm sayısında bir miktar azalma olduğuna dikkat çekilir. Buna karşın yaralanmaların bir miktar arttığını belirtilir ve bunların nedeniyle ilgili öğrencilerin görüşleri alınır (***Kazalar kasko nedeniyle daha çok kaza resmi kayıtlara girmiş olablir, emniyet kemeri kullanımı yaygınlaşmış olabilir, otomobillerin güvenliği artmış olabilir, v.b.***). Sonra onlara otomobil firmalarının can kaybını azaltmak için ne tür önlemler geliştirdikleri sorulur (**Emniyet kemeri ve hava yastığı gibi**). Peş peşe şu sorular yönlendirilir ve kısaca tahminleri alınır. Bu soruların cevaplarının bu konudan sonra daha iyi anlaşılacağı belirtilir.
    a. Hava yastığı olan araçlarda emniyet kemeri kullanmaya gerek var mıdır?
    b. Düşük hızla seyir halindeyken emniyet kemeri kullanmaya gerek var mıdır?
    c. Kaza durumunda direksiyona ya da kapı kollarına tutunarak kaza etkisini azaltabilir miyiz?
    d. Kamyon gibi büyük motorlu taşıtların otomobillerle aynı hızlarda seyretmeleri doğru mudur?
    e. Sacı çok kalın olan ve çarpma anında kolayca ezilmeyen taş gibi sağlam bir araba mı yoksa ince saclı ve çarpma anında bir miktar ezilebilen arabalar mı daha güvenlidir?

--------------------------------- 1 ders bitti ---------------------------------



3. Yukarıdaki deney düzeneğini masanın üzerine kurar. Farklı kütleli iki bilyeden hafif olanını göstererek "Bu bilyeyi eğik düzlemden serbest bırakırsam ne olur?" sorusunu gruplara yöneltir. Grup tahminlerini dinler (***Aşağı inerken hız kazanan bilyenin kağıt bardağı iterek harekete geçireceğini ve sürüklenerek ilerleyen bardağın bir müddet sonra duracağını söylemelerini bekliyoruz***). Bilyeyi serbest bırakır ve hareketi gözlemlerler. Sonra öğretmen bu deneyi daha ağır bir bilyeyle tekrarlarsa bardağın durma süresinin değişip değişmeyeceğini sorar. Buna göre muhtemel hipotezler şunlardır: Deney ağır bilyeyle tekrarlandığında durma süresi değişmez / azalır / artar. Öğretmen gruplara söyledikleri hipotezlerini (tahminlerini) not almalarını ister.

4. Öğretmen "Aynı bilyeyi farklı yüksekliklerden bırakırsak bardağın durma süresi değişir mi?" sorusunu yöneltir. Buna göre muhtemel hipotezler şunlardır: Daha yüksekten bırakılan bilye durma süresini değiştirmez / uzatır / kısaltır. Gruplar söyledikleri hipotezlerini tekrar not alırlar.

Aşama 2: ARAŞTIRMA

1. Öğretmen her grubun deney düzeneğini kurmasını ve kurdukları düzeneklerle hipotezlerini test etmelerini ister. Yani yaptıkları gözlemlerle hipotezlerinin doğru olup olmadığını belirlerler. Öğrenciler durma zamanını aynı deneyi 3-5 kez tekrarlayarak ölçerler ve ortalamayı hesaplarlar. Böylece sonuçlardaki hata miktarı azaltılmış olur.

Aşama 3: AÇIKLAMA

1. Öğretmen her gruba "Farklı kütleli bilyeler durma süresini nasıl etkiledi?" ve "Bu sonuç kurduğunuz hipotezle aynı mıdır?" diye sorar (***Öğrencilerden "Büyük kütleli bilyenin harekete geçirdiği bardak daha uzun sürede durur" demeleri beklenir***). Öğretmen farklı kütleli bilyelerin bardağa çarpmadan önceki hızlarını sorar (***Aynı yükseklikten bırakıldıkları için aynıdır***).
2. Öğretmen her gruba "Aynı bilyenin farklı yüksekliklerden bırakılması durma süresini nasıl etkiledi?" ve "Bu sonuç kurduğunuz hipotezle aynı mıdır?" diye sorar (***Öğrencilerden "Yüksekten bırakılan bilyenin harekete geçirdiği bardak daha uzun sürede durur" demeleri beklenir***). Öğretmen farklı yüksekliklerden bırakılan bilyelerin bardağa çarpmadan önceki hızlarını sorar (***Yüksekten bırakılan daha hızlıdır***).
3. Öğretmen öğrencilere bardak durana kadar nasıl bir hareket yaptığını sorar (***Yavaşlayan ya da negatif ivmeli bir hareket demelerini bekliyoruz***). Sonra böyle bir hareketin hangi durumda mümkün olduğunu sorar (***Harekete ters yönde net bir kuvvetin varlığında söz konusudur***).

--1 ders bitti -----------------------------------

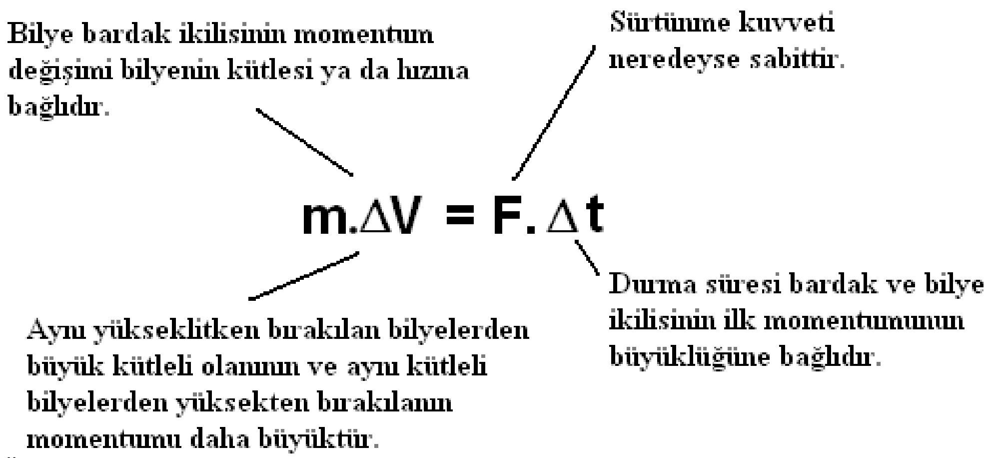
4. Öğretmen olayı fiziksel bir şekilde açıklamadan önce Newton'un ikinci yasasına kullanarak itme-momentum denklemini çıkarır ve aşağıdaki açıklamaları yapar.

- F. Δt itme olarak adlandırılır.
- Birimi N.s'dir.
- İtme de kuvvet gibi vektörel bir büyüklüktür ve kuvvetle aynı yönlüdür.
- Aynı şekilde momentum değişimi de vektöreldir ve uygulanan kuvvetle aynı yönlüdür

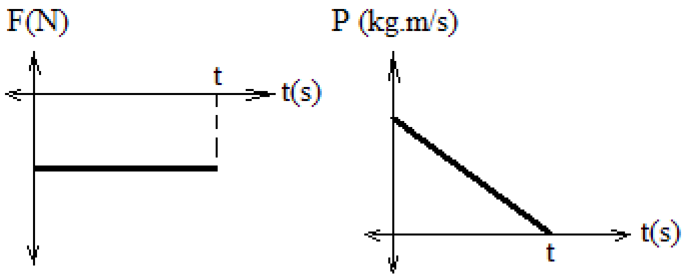
$$\mathbf{F} = m.\mathbf{a}$$
$$\mathbf{F} = m.\ \Delta\mathbf{V}/\Delta t$$
$$\mathbf{F}.\ \Delta t = m.\ \Delta\mathbf{V}$$
$$\mathbf{F}.\ \Delta t = m(\mathbf{V_2} - \mathbf{V_1})$$
$$\mathbf{F}.\ \Delta t = m\mathbf{V_2} - m\mathbf{V_1}$$

- m. ΔV momentum değişimidir ve itmeye eşittir.
- m.V'nin momentum olarak adlandırılır.
- Birimi kg.m/s'dir.
- Vektörel bir büyüklüktür ve hızla aynı yönlüdür.

5. Öğretmen deneydeki olayları fiziksel açıklamalarını kullanarak izah eder.



6. Öğretmen öğrencilerden bardak durana kadar geçen süreçteki kuvvet-zaman grafiğini ve momentum-zaman grafiğini çizmelerini ister. Aşağıdaki gibi grafikler çizmeleri beklenir. Kuvvet-zaman grafiğinin altında kalan alanın itmeyi yani momentum değişiminin büyüklüğünü verdiği belirtilir. Momentum-zaman grafiğindeyse eğimin ortalama kuvveti verdiği açıklanır.



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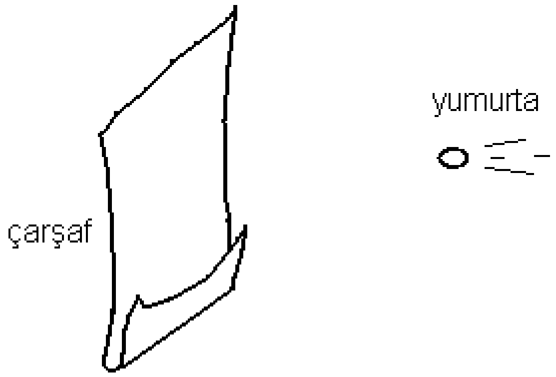
Aşama 4: GENİŞLETME



Bu etkinlik için 5-10 tane yumurta, bir çarşaf, kırılan yumurtaları biriktirmek için de bir kap gerekmektedir. İki öğrenci çarşafı şekildeki gibi tutacaklar ve mümkün olduğunca her bir öğrenci bir yumurta alıp çarşafa fırlatacaktır. Onlara bu şekilde yumurtayı kırıp kıramayacaklarını sorulur ve denemeleri sağlanır. Sonuçta çarşafa çarpan yumurtalar kırılmayacaklar ya da öğrenci o kadar hızlı fırlatacaktır ki; yumurta elinde kırılabilecektir. Öğretmen onlara öncelikle çarşafa fırlatılan yumurtaların neden kırılmadığını sorar ve öğrendikleri kavramlarla açıklamalarını ister (***Belli bir hızda giden yumurta belli bir sürede çarşaf tarafından uygulanan itmeyle durdurulmaktadır. Çarşaf F. Δt = m. ΔV'deki Δt'yi artırdığından F küçülmektedir; dolayısıyla yumurta kırılmamaktadır***). "Peki bazı yumurtaların elimizde kırılmasının nedeni ne olabilir?" diye de sorulur (***Elimizle yumurtaya bir hız kazandırmaya çalışıyoruz. Çok hızlandırmak istediğimizde m. ΔV'yi artırıyoruz; fakat kısa sürede bunu yapıyoruz. Bu da büyük F anlamına geliyor ve yumurta kırılıyor***).

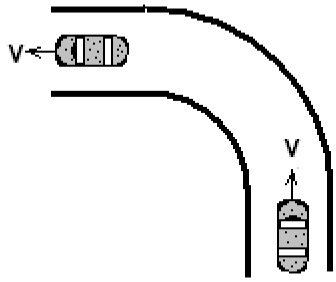
Aşama 5: DEĞERLENDİRME

1. Hava yastığı olan araçlarda emniyet kemeri kullanmaya gerek var mıdır?
2. Düşük hızla seyir halindeyken emniyet kemeri kullanmaya gerek var mıdır?
3. Kaza durumunda direksiyona ya da kapı kollarına tutunarak kaza etkisini azaltabilir miyiz?
4. Kamyon gibi büyük motorlu taşıtların otomobillerle aynı hızlarda seyretmeleri doğru mudur?
5. Sacı çok kalın olan ve çarpma anında kolayca ezilmeyen taş gibi sağlam bir araba mı yoksa ince saclı ve çarpma anında bir miktar ezilebilen arabalar mı daha güvenlidir?

---------------------------- 1 ders bitti --------------------------------

6. Bungee jumpingde esneyen ip yerine esnek olmayan ve kopmayan bir ip kullanılsa ne olur? Esnek ip ne yapmaktadır?
7. İtme ve momentumun skaler büyüklük mü yoksa vektörel büyüklük mü olduklarını açıklayınız.
8. İtme ve momentum değişimi vektörel büyüklük olduklarına ve eşit olduklarına göre uygulanan kuvvetin ve momentum değişiminin yönleri arasında nasıl bir ilişki vardır?
9. Düzgün dairesel hareket yapan bir cismin momentumu sabit midir? Neden?
10. Yukarıdaki soruda momentum değişimi hangi yöndedir?
11. Bir trafik kazasında 90 km/h hızla giden bir otomobil bir ağaca çarparak aniden duruyor. Emniyet kemeri de 85 kg kütleli sürücüyü 400 ms'de durduruyor ve sürücünün camdan fırlamasını ya da konsola çarpmasını engelliyor.
    a. Emniyet kemeri tarafından sürücüye uygulanan ortalama kuvveti hesaplayınız.
    b. Bu kuvveti sürücünün ağırlığıyla karşılaştırınız ve böylece g-kuvvetini hesaplayınız.
    c. Ciddi bir yaralanma olasılığı hakkında ne düşünüyorsunuz? (İnsan bedeni 8g kuvvetine kadar dayanıklıdır.)

12. Yandaki şekil bir dönemeci alan arabayı göstermektedir. Aşağıdakilerden hangisi yolun arabaya uyguladığı ortalama kuvvetin yönünü en iyi gösterir?



a. ←

b. ↙

c. ↗

d. ↑

e. ↖

13. Bir penaltı atışında çok hızlı şut atmanın fiziksel bir açıklaması var mıdır? Açıklayınız.
14. 100 kg kütleli bir basketçi 80 cm zıpladıktan sonra yere bastığında basket ayakkabıları sayesinde 400ms'de tam olarak duruyor.
    a. Yer basketçinin ayaklarına ortalama ne kadar kuvvet uygulamıştır?
    b. Eğer sıradan bir ayakkabı olsaydı ve 10ms'de dursaydı ortalama ne kadar kuvvet uygulanırdı?

Geri kalan zamanda kuvvet-zaman grafiği ve momentum-zaman grafikleri ile ilgili ders kitabındaki sorular çözülür.

------------------------------ 1 ders bitti -----------------------------

EK: GENEL KAZA İSTATİSTİKLERİ

Yılı	Kaza sayısı	Ölü sayısı	Yaralı sayısı
1999	465.839	6.130	125.586
2000	500.663	5.566	136.406
2001	442.960	4.386	116.202
2002	439.958	4.169	116.045
2003	455.637	3.959	117.551
2004	537.352	4.427	136.437
2005	620.789	4.505	154.086
2006	728.755	4.633	169.080
2007	825.561	5.007	189.057
2008	929.304	4.228	183.841

6 - 14 Aralık 2008 tarihleri arasındaki 9 günlük **Kurban Bayram tatili süresinde meydana gelen;**

- 69 ölümlü trafik kazasında,
- 113 vatandaşımız hayatını kaybetmiş,
- 180 vatandaşımız da yaralanmıştır.

2008 yılının 9 günlük (27 Eylül-5 Ekim 2008) Ramazan Bayram tatili süresinde meydana gelen;

- 89 ölümlü trafik kazasında,
- 127 vatandaşımız hayatını kaybetmiş,
- 210 vatandaşımız da yaralanmıştır.

Konu: **OTOMOBİLLER EZİLME BÖLGESİ**

İlgili Kazanımlar

1. Momentum korunumunu kullanır.
2. Esnek olmayan çarpışmayı açıklar.
3. Esnek çarpışmayı açıklar.

Konunun Ele Alınacağı Bağlam

Otomobillerde güvenlik

1. Ezilme bölgesi

Öngörülen zaman: 3 ders saati

Dersin İşlenişi

Aşama 1: ISINDIRMA

Öğretmen derse en son otomobillerde güvenlik konusunu ele aldıklarını anımsatarak derse başlar. Trafik kazalarının bir kısmının çarpışmalar şeklinde olduğunu ve otomobillerin daha güvenli hale getirilmesi için çarpışmalardaki fiziksel olayları iyi anlamak gerektiği ifade edilir. Arabalarda çarpışmalar sırasında güvenlik amacıyla bir ezilme bölgesi bırakıldığını hatırlatır. Ezilmenin olduğu bu çarpışmalarda momentum ve kinetik enerjinin korunup korunmadıklarını sorar. Bu aşamada sadece öğrencilerin fikirleri alınır. Bu sorunun cevabına daha sonra dönüleceği söylenir. Öğretmen bazı etkinlikler yapacaklarını belirterek öğrencileri 4-5 kişilik gruplara ayırır. Onlara bir tenis topunu gösterir ve onu yere masa yüksekliğinden serbest bıraktığında tekrar ne kadar yükseğe çıkabileceğini sorar. Öğrencilerin bütün farklı tahminlerini alır. Sonra onlara topu yere çok yakın bir mesafeden bırakırsa ne kadar yükseleceğini sorar ve tahminlerini alır.

Aşama 2: ARAŞTIRMA

Öğretmen gruplardan tahminlerinin doğru olup olmadığını deneyerek bulmalarını ister.

Aşama 3: AÇIKLAMA

Öğretmen gruplardan gözlemlerini ve bulgularını açıklamalarını ister. Sonra gözlemlerini öncelikle topun mekanik enerjisi açısından açıklamalarını ister (**Top sıçradıktan sonra hemen hemen aynı yüksekliğe çıkabilmektedir. Bu da toplam mekanik enerjinin neredeyse korunduğu anlamına gelir**).

Daha sonra öğrencilere toplam momentumun korunup korunmadığını sorar (**Bu noktada öğrencilerin açıklamaları tahmini olacaktır; çünkü sadece topun momentumunu düşünebilirler. Sadece topun momentumunu düşünmeleri momentumun değiştiği sonucunu çıkarmalarını sağlayabilir ki; doğru bir açıklama olur. Ancak bizim sorduğumuz toplam momentumdur; yani top ve dünyanın oluşturduğu sistemin momentumu**). Öğretmen çarpışmanın top ve dünya arasında olduğunu söyler ve şu şekilde devam eder: **Topu serbest bırakmadan önce top ve dünyanın birbirlerine göre momentumları toplamı sıfırdır. Yani toplam momentum sıfırdır diyebiliriz. Serbest düşme sırasında top hız kazanır; ancak dünyanın kazanacağı hız kütlesinin topa kıyasla çok çok büyük olmasından kayda değer değildir. Çarpışmada top ve dünya birbirine aynı büyüklükte itme uygular. Bu itme dünyaya ters yönde kayda**

değer bir hız kazandırmazken topu neredeyse aynı yüksekliğe çıkarır. Sonuçta toplam momentum yine sıfırdır. Dışarıdan bir kuvvet etki etmedikçe meydana gelen bütün çarpışmalarda toplam momentum korunur ve buna momentumun korunumu denir. Hem mekanik enerji hem de toplam momentumun korunduğu bu tür çarpışmalara da esnek (elastik) çarpışma denir. Bu açıklamayı takiben öğretmen öğrencilere "Peki ya tenis topu değil de dünyaya bir meteor çarpsaydı ne olurdu? " diye sorar. Burada da enerjinin korunmadığını fakat momentumun korunduğunu ders kitabında sayfa 43'deki gibi açıklar (Hareketli bir cismin duran bir cisimle merkezi çarpışması sonucu kenetlenerek hareket etmesi). Bu tür çarpışmalara da esnek olmayan (inelastik) çarpışma denildiği söylenir ve bir sakızın yere düşmesi ya da suyun dökülmesi de birer örnek olarak verilir.

--------------------- 1 ders bitti ---------------------

Aşama 4: GENİŞLETME

(a) (b)

Öğretmen öğrencilerin görebileceği bir yerde (a) şeklindeki düzeneği kurar. Onlara yukarıdan bir bilye bırakması durumunda ne olacağını tahmin etmelerini ister. Sonra bir bilyeyi bırakır ve ne olduğunu gözlemlerler. Sonra öğretmen öğrencilere aynı anda yan yana iki ya da üç bilye bıraksaydı ne olacağını sorar. Bunuda onların gruplar halinde denemelerini ister. Daha sonra onlardan bu olayın esnek bir çarpışmamı yoksa esnek olmayan bir çarpışma mı olduğunu sorar ve açıklamalarını ister.

Aşama 5: DEĞERLENDİRME

1. İki otomobilin çarpışması esnek midir? Momentum korunur mu? (**Çarpışmalara karşı otomobillerde tasarlanmış ezilme bölgeleri vardır. Bu ezilme bölgesinin çarpışma süresini uzatarak ortalama kuvveti azalttığını daha önce söylemiştik. Çarpışma öncesindeki toplam enerjinin bir kısmı araçlarda ezilmeye yol açarken harcanır ve toplam enerji korunmaz. Yani bu çarpışmalar esnek olmayan çarpışmalardır.**)
2. Esnek çarpışmaya örnekler veriniz (**Tam esnek çarpışmalara rastlamayız; fakat kısmen esnek çarpışmalara örnek verebiliriz. Bilyelerin çarpışması gibi**).
3. Esnek olmayan çarpışmalara örnekler veriniz (**Tam esnek olmayan çarpışmaya örnek vermek de zordur. Fakat kısmen esnek olmayan çarpışmalara örnek verebiliriz. Kartalın bir güvercini havada sorti yaparak pençesiyle yakalaması gibi**).
4. Topu yüksekten bırakınca momentum korundu mu? Neden? (**Hayır; çünkü hava sürtünmesi sürekli dışarıdan bir kuvvet olarak etki etmektedir. Yani hem top aşağı inerken hem de yükselirken kesit alanıyla ve o anki**

hıza bağlı bir hava sürtünmesi etki etmektedir. Dışardan bir kuvvetin etkisinde momentum korunmaz.)

--------------------- 1 ders bitti ---------------------

Momentumun korunumu, esnek ve esnek olmayan çarpışmayla ilgili örnek problemler çözülür.

--------------------- 1 ders bitti ---------------------

Konu: KOLTUK BAŞLIKLARI HAYAT KURTARIR

İlgili Kazanımlar

1. Hareketli bir cisimle duran cismin merkezi çarpışmasıyla ilgili soruları çözer.
2. Hareketli bir cisimle duran cismin kenetlenerek çarpışmasıyla ilgili soruları çözer.

Konunun Ele Alındığı Bağlam

Otomobillerde güvenlik

1. Koltuk başlıklarının önemi

Trafik kuralları

2. Trafik ışıklarına yaklaşırken hızımızı azaltmak son derece önemlidir.

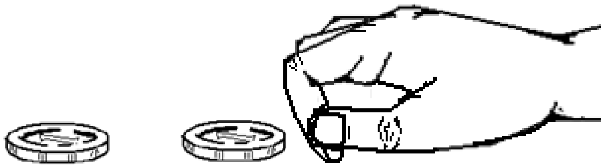
Dersin İşlenişi: 3 ders saati

Aşama 1: ISINDIRMA

Öğretmen derse geçen derslerde trafik kazalarıyla ve otomobillerde kazalardaki ölüm ve yaralanmalara karşı alınan önlemlerle ilgili konuştuklarını hatırlatarak derse başlar. Ayrıca çarpışmalardan da bahsedildiği hatırlatılır. Sonra öğrencilere arkadan çarpmalarda nasıl zarar görebileceklerini sorar (**Eylemsizlikten dolayı kafa aniden arkada kalır ve boyun kırılmaları olabilir ki; son derece tehlikeli sonuçları olabilir. Bu tür olayların yaşanmaması için trafik ışıklarına yaklaşırken otomobillerin yavaşlaması çok önemlidir**). Şimdi de otomobillerde arkadan çarpmalara karşı en önemli tedbirin ne olduğunu sorar (**Koltuk başlıkları çok önemli bir tedbirdir. Çarpma sırasında kafanın da vücutla beraber hareketini sağlar ve tehlikeli sonuçlardan korur**). Duran bir arabaya arkadan çarpmanın da değişik şekillerde olabileceğini belirten öğretmen öğrencilere şu sorulara sorar:

1. Kırmızı ışıkta bekleyen bir otomobile (1000 kg olsun) arkadan benzer başka bir otomobilin çarpması sonucu otomobillerin hızları nasıl olur?
2. Kırmızı ışıkta bekleyen bir otomobile (1000 kg olsun) arkadan bir minibüsün (3000 kg) çarpması sonucu otomobil ve minibüsün hızları nasıl olur?
3. Kırmızı ışıkta bekleyen bir minibüse arkadan bir otomobilin çarpması sonucu otomobil ve minibüsün hızları nasıl olur?

Sonra öğrencileri 4-5 kişilik gruplara ayırır ve onlara ikisi aynı, birisi de farklı iki metal para gösterir (İki tane 1TL bir tane de 50KRŞ gibi). Masanın üzerindeki eşit kütleli paralardan biri durgunken diğeriyle merkezi çarpıştırılırsa ne olacağını sorar. Grupların tahminlerini alır ve herkesin göreceği şekilde merkezi çarpışmayı gerçekleştirir (***Çarpan para yerinde kalırken aynı hızla diğeri harekete geçer***).



Sonra sırasıyla gruplardan şunları yapmalarını ister:

1. Büyük paranın durgun haldeki küçük parayla merkezi çarpışması sonucu ne olacağını sorar. Gruplardan gelen tahminleri not almalarını ister.
2. Küçük paranın durgun haldeki büyük paraya çarpması durumundaki hareketi tahmin etmelerini ve not almalarını ister.
3. Merkezi olmayan çarpışmalarda da neler olacağını sorar ve tahminlerini not almalarını ister.

Aşama 2: ARAŞTIRMA

Öğretmen öğrencilerden yaptıkları tahminlerini yani hipotezlerini deneylerini yaparak test etmelerini ister. Her bir tahmin denenirken birkaç kez tekrarlamanın hataları azalttığından sonuçlarının doğruluğunu artıracağı belirtilir.

------------------------ 1 ders bitti ------------------------------

Aşama 3: AÇIKLAMA

Öğretmen gruplardan sırasıyla büyük kütleli paranın durgun haldeki küçük kütleli paraya merkezi çarpması, küçük kütleli paranın durgun haldeki büyük kütleli paraya merkezi çarpması ve merkezi olmayan çarpışmalarla ilgili gözlemlerini açıklamalarını ister. Eşit kütleli paraların merkezi çarpışmasını öğretmen önceden göstermişti. Öğretmen çarpışmanın esnek olduğunu açıklar ve tahtada aşağıdaki denklemleri momentum ve enerjinin korunumunu kullanarak ispatlar.

$$v_1' = \frac{m_1 - m_2}{m_1 + m_2} . v_1 \text{ ve } v_2' = \frac{2m_1}{m_1 + m_2} . v_1$$

1. V_1 hızındaki bir para durgun haldeki eşit kütleli bir paraya çarpınca, çarpışma sonrasında kendi hızının büyüklüğü “0” olurken diğer para v_1 ile aynı büyüklük ve yöndeki bir hızla hareket eder.
2. V_1 hızındaki bir para kendisinden hafif başka bir paraya merkezi çarpınca, çarpışma sonrasında kendisi geliş yönünde daha küçük bir hızla hareket ederken diğer para aynı yönde daha büyük bir hızla hareket eder.
3. V_1 hızındaki bir para kendisinden ağır başka bir paraya merkezi çarpınca, kendisi geliş yönüne ters daha küçük büyüklükte bir hızla hareket ederken diğeri de v_1 ile aynı yönde; fakat daha küçük büyüklükte bir hızla hareket eder.

Merkezi olmayan çarpışmalarda da x ve y eksenlerindeki toplam momentumların korunduğu belirtilir ve bununla ilgili soruların bu sayede çözüldüğü açıklanır. Bu çarpışmaların da esnek oldukları belirtilir.

------------------------ 1 ders bitti ------------------------------

Aşama 4: GENİŞLETME

Öğretmen gruplardan aşağıdaki düzeneği kurmalarını ister. Sonra sırasıyla eşit kütleli ve farklı kütleli bilyelerle merkezi çarpışmalar yapmalarını ister. Öğretmen bu etkinlikteki gözlemleri bu sefer öğrencilerin geçen derste gördükleri denklemleri de kullanarak açıklamalarını ister.

Aşama 5: DEĞERLENDİRME

1. Kırmızı ışıkta bekleyen bir otomobile arkadan bir minibüs çarparsa hızlarının büyüklükleri ve yönleri nasıl olur? (**Minibüs ilk hıza göre daha düşük bir hızla otomobilse daha büyük bir hızla harekete geçer**)
2. Kırmızı ışıkta duran bir otomobile benzer başka bir otomobil arkadan çarparsa hareket nasıl olur? (**Çarpan otomobil durur, diğeri aynı hızla harekete geçer**)
3. Kırmızı ışıkta bekleyen bir minibüse arkadan bir otomobil çarparsa hareketleri nasıl olur? (**Otomobil büyüklüğü daha küçük bir hızla geri sekerken minibüs ilk hızla aynı yönlü daha küçük bir hızla harekete geçer**)
4. Yukarıdaki çarpışmaların hepsinde sırasıyla bilyelerin birbirlerine uyguladıkları itmeleri ve kuvvetleri açıklayınız. (**Hepsinde de Newton'un 3. Yasasına göre araçlar birbirlerine eşit kuvvetler uygular. Ayrıca etkileşim süreleri de eşit olduğundan itmelerde eşit olur**)
5. Yukarıdaki çarpışmalar esnek midir? Neden? (**Hem momentum hem de enerji neredeyse korunduğundan çarpışmalar kısmen esnektir**)
6. Bu tür kazalara karşı otomobillerde ne tür önlem ya da önlemler alınmaktadır? (**Arkadan çarpmalarda yaslandığımız koltuk vücudumuzu ileri yönde çok kısa sürede yüksek hızlara çıkarır; yani hızlı bir momentum değişimi yaşarız. Bu sırada başımızın da vücudumuzla aynı anda aynı hıza çıkması gerekir. Bunu da koltuk başlıkları yapar. Aksi takdirde boyun kırılmaları yaşanmaktadır. Yani koltuk başlıkları bu tür kazalarda en önemli güvenlik unsurudur.**)
7. 3000 kg'lık bir minibüs 72 km/h hızla ilerlerken kırmızı ışıkta duran 1000 kglık bir otomobile çarpıyor.
   a. Hemen çarpışma sonrasında minibüsün hızı hangi yönde ne kadardır?
   b. Hemen çarpışma sonrasında otomobilin hızı ne kadardır?
   c. Otomobil minibüse ne kadar itme uygulamıştır?
   d. Minibüs otomobile ne kadar itme uygulamıştır?
   e. Çarpışma saniyenin 10'da 1'i kadar bir sürede gerçekleştiyse minibüs otomobile ne kadar kuvvet uygulamıştır?

------------------------- 1 ders bitti ------------------------------

Öğretmen bu çarpışmalarla ilgili problemler çözer.

------------------------- 1 ders bitti ------------------------------

APPENDIX N

KEY WORDS USED IN THE LITERATURE REVIEW

Context-based instruction + science Context-based instruction + physics Context-based instruction + gender Context-based approach + science Context-based approach + physics Context-based approach + gender Contextual instruction + science Contextual instruction + physics Contextual instruction + gender Contextual approach + science Contextual approach + physics Contextual approach + gender Learning cycle + science + achievement Learning cycle + science + attitude	Learning cycle + science + motivation Learning cycle + science + gender Learning cycle + physics + achievement Learning cycle + physics + attitude Learning cycle + physics + motivation Learning cycle + physics + gender Science teaching + gender Physics teaching + gender Teaching + approach + method Gender difference + physics Gender difference + science

APPENDIX O

PERMISSION LETTER

T.C.
ANKARA VALİLİĞİ
Milli Eğitim Müdürlüğü

BÖLÜM : İstatistik Bölümü
SAYI : B.B.08.4.MEM.4.06.00.06-312/115062 24/12/2009
KONU : Araştırma İzni
Haki PEŞMAN

ORTA DOĞU TEKNİK ÜNİVERSİTESİNE

İlgi : a) MEB Bağlı Okul ve Kurumlarda Yapılacak Araştırma ve Araştırma Desteğine Yönelik İzin ve Uygulama Yönergesi.
b) Üniversitenizin 08/12/2009 tarih ve 16977 sayılı yazısı.

Üniversiteniz Ortaöğretim Fen ve Matematik alanları eğitimi EABD doktora programı öğrencisi Haki PEŞMAN'ın **"Bağlam temelli fizik öğretimi ile öğretim yönteminin etkileşimi"** konulu tez ile ilgili çalışma yapma isteği Müdürlüğümüzce uygun görülmüş ve araştırmanın yapılacağı İlçe Milli Eğitim Müdürlüğüne bilgi verilmiştir.

Mühürlü anketler (2 sayfa) ekte gönderilmiş olup, uygulama yapılacak sayıda çoğaltılması ve çalışmanın bitiminde iki örneğinin (CD/disket) Müdürlüğümüz İstatistik Bölümüne gönderilmesini rica ederim.

Gülçin UYSAL
Müdür a.
Müdür Yardımcısı

EKLER :
Anket (2 sayfa)

İl Milli Eğitim Müdürlüğü-Beşevler
İstatistik Bölümü
Bilgi İçin: Nermin ÇELENK

Tel : 212 66 40/200----223 75 22
Fax: 223 75 22
istatistik06@meb.gov.tr

APPENDIX P

DATA ANALYZED

approach	method	gender	quan_scores	concept_scores	postaffect	preaffect	pre_year_ach
1	0	0	12	9	4.23	4.11	77.5
1	0	1	12	8	4.23	4.84	73
1	0	1	10	4	3.5	4.01	63.5
1	0	1	12	10	4.01	3.64	91.5
1	0	1	11	11	4.91	4.53	78.5
1	0	0	12	9	3.44	3.37	70
1	0	0	7	7	3.5	3.51	62.5
1	0	1	12	10	5	5	92.5
1	0	1	8	8	4.61	4.02	80.5
1	0	1	9	10	3.81	3.69	72
1	0	1	12	10	3.77	3.87	81
1	0	1	9	8	3.76	3.59	62.49
1	0	0	12	9	3.84	3.69	48.5
1	0	0	11	8	3.18	3.19	54
1	0	1	13	7	4.22	3.81	63
1	0	1	13	6	3.84	4.06	53.5
1	0	1	9	9	3.99	3.64	65.5
1	0	0	11	9	3.74	3.6	71
1	0	0	11	9	3.51	3.55	73.5
1	0	0	11	9	4.36	4.48	85.5
1	0	0	12	8	4.57	4.78	85
1	0	1	10	3	4	4	74.5
1	0	0	11	8	4.04	4.18	80
1	0	1	9	8	4.18	4.29	57.5
1	0	0	10	9	2.84	3.29	53.5
0	1	0	11	8	3.53	3.51	83
0	1	1	12	8	3.47	3.2	43
0	1	1	12	8	4.03	4.38	80.5
0	1	0	12	7	4.21	3.91	62.49
0	1	0	13	9	3.45	3.74	59.5
0	1	0	13	10	4	4.09	63.5
0	1	0	12	9	3.81	3.54	66
0	1	0	13	9	3.47	3.16	42.5
0	1	0	9	6	4.04	3.44	88.5

0	1	0	10	7	3.81	3.81	85
0	1	1	12	10	3.65	3.56	52
0	1	1	12	2	3.78	3.55	64
0	1	1	10	8	4.34	3.56	47.5
0	1	1	13	7	3.46	3.92	64.5
0	1	0	12	8	4.59	4.31	93
0	1	0	10	9	3.78	3.74	48
0	1	1	5	1	3.9	3.99	94
0	1	1	11	10	3.69	3.77	65
0	1	0	12	8	3.48	3.36	79
0	1	0	12	7	3.46	3.14	60.5
0	1	1	13	8	3.31	3.46	63.5
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0	1	1	13	9	4.86	5	64
0	1	1	13	8	3.09	3.06	53
0	1	0	12	8	3.27	3.43	80.5
0	1	0	13	9	4.47	3.42	74
0	0	1	9	8	4.61	3.69	92.5
0	0	0	12	9	4.32	3.69	62.5
0	0	0	13	9	4.21	3.91	71.5
0	0	0	9	6	3.65	4.03	90
0	0	1	12	4	3.92	3.69	88
0	0	1	11	8	3.35	2.73	64
0	0	1	12	6	3.7	3.59	58.5
0	0	1	7	5	4	3.69	58.5
0	0	1	12	8	4.15	3.69	63
0	0	0	13	10	3.44	2.76	74
0	0	0	13	10	3.54	2.81	71.5
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0	0	0	13	11	2.46	2.81	72.5
0	0	0	10	8	3.24	3.46	70.5
0	0	1	8	9	4.57	3.69	87
0	0	0	9	6	3.52	3.33	66
0	0	0	9	6	5	4.93	62.49
0	0	1	2	5	3.94	2.96	61.5
0	0	0	12	7	3.9	3.41	93.5
0	0	1	12	7	2.29	3.79	57
0	0	0	12	10	4.16	4.16	87
0	0	0	12	9	2.09	2.56	67

0	0	0	12	9	2.76	2.57	72.5
0	0	0	12	10	2.48	2.28	63
1	1	0	13	7	4.38	4.53	94
1	1	1	10	12	4.19	4.19	90
1	1	0	9	9	3.49	3.86	72.5
1	1	0	9	8	3.61	3.06	67.5
1	1	1	12	9	3.59	3.39	85.5
1	1	1	9	7	4.43	3.36	62.5
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1	1	1	11	8	4	3.84	62
1	1	1	11	10	4.59	4.09	71.5
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1	1	0	12	5	3.41	3.71	54
1	1	1	13	10	4.64	4.94	67.5
1	1	1	11	11	4.04	3.69	78.5
1	1	1	12	10	4.09	3.69	71
1	1	1	14	11	3.91	4.09	93.5
1	1	1	13	9	4.04	3.99	64.5
1	1	1	13	9	4.35	4.8	97.5
1	1	1	12	10	4.09	3.84	58.5
1	1	0	12	5	1.26	4.51	56.5
1	1	0	13	4	4.11	3.64	92.5
1	1	0	12	4	4.16	4.16	85
1	1	1	11	9	4.45	3.74	62.49
1	1	1	8	7	3.89	3.39	58.5
0	0	1	3	2	4.36	4.16	60
0	0	0	8	7	3.58	3.43	56
0	0	0	7	5	4.06	3.69	30.5
0	0	0	8	5	3.81	3.69	79.5
0	0	0	11	5	3.64	3.69	68.5
0	0	0	9	1	3.4	3.67	43
0	0	1	10	5	4.15	4.21	62.49
0	0	0	6	4	2.44	3.36	39
0	0	1	5	9	3.74	4.17	62.49
0	0	1	8	4	4.44	4.54	85
0	0	1	8	4	4.21	4.06	81
0	0	1	4	6	3.74	3.42	62.49
0	0	0	1	3	3.49	3.51	22.5
0	0	0	1	6	2.71	3.69	32.5
0	0	0	6	1	1.89	4.33	38.5
0	0	1	7	3	3.1	3.27	46
0	0	1	5	3	3.98	4.24	37
0	0	0	7	3	4.36	4.63	66.5

0	0	1	8	6	4.54	4.53	66
0	0	1	7	2	3.94	3.69	41
1	1	1	5	8	3.9	4.15	33.5
1	1	1	5	6	3.46	3.66	52.5
1	1	1	9	6	3.86	4.18	60
1	1	1	6	2	3.23	3.71	45
1	1	0	3	4	2.43	2.5	46.5
1	1	0	5	3	3.17	3.2	94
1	1	0	5	6	3.91	3.99	57.5
1	1	0	3	3	3.22	3.11	40
1	1	1	9	9	3.96	3.86	62.49
1	1	0	5	4	2.79	2.65	33.5
1	1	1	4	7	3.44	3.01	75
1	1	0	4	4	3.45	3.34	49
1	1	1	6	7	3.53	3.74	63
1	1	0	5	7	3.68	3.69	53
1	1	1	6	8	2.49	2.83	62.5
1	1	0	3	6	2.31	2.54	62.49
1	1	0	2	5	3.36	3.71	48
1	1	0	3	2	3.85	4.26	62.49
1	1	1	4	4	2.72	3.69	26
1	1	1	7	4	3.29	3.69	34
1	1	0	8	4	3.86	3.69	39
1	1	0	6	6	3.41	3.69	39.5
1	1	0	5	2	2.34	3.69	56
1	0	1	6	6	3.64	3.47	60.5
1	0	0	9	9	3.94	3.99	49
1	0	1	5	7	3.45	3.8	31.5
1	0	0	4	6	3.42	3.41	39
1	0	1	7	10	4.49	4.41	95
1	0	1	6	6	4.31	3.97	75.5
1	0	1	6	5	4.09	3.59	46
1	0	1	7	7	3.52	3.63	35.5
1	0	1	6	5	2.62	2.81	35.5
1	0	1	6	4	3.1	3.69	47.5
1	0	0	9	9	3.01	3.16	73.5
1	0	0	8	9	3.89	3.68	73
1	0	0	7	7	3.62	3.07	50
1	0	0	9	6	4.11	3.28	70
1	0	1	7	9	4.19	3.85	62.49
1	0	0	6	6	3.34	3.39	42.5
1	0	0	8	8	4.22	3.64	41.5
1	0	0	10	7	2.25	2.61	80.5

1	0	1	6	6	3.95	4.37	69.5
1	0	0	10	8	2.71	3.61	64.5
1	0	1	8	8	4.2	3.99	42
1	0	0	9	9	4.04	4.08	85.5
1	0	1	3	8	4.03	3.78	34.5
1	0	0	7	5	3.58	3.37	52.5
1	0	1	8	9	4.24	4.24	63
1	0	1	9	8	4.39	3.98	40
1	0	1	5	3	4.09	4.24	45
1	0	0	7	4	3.94	3.39	45
0	1	1	8	8	3.64	3.49	49
0	1	0	4	1	3.58	3.86	51
0	1	0	4	0	3.14	3.24	49
0	1	0	4	1	3.5	3.2	59
0	1	0	7	7	4.36	3.62	90.5
0	1	0	4	2	3.6	3.11	53
0	1	1	6	8	4.35	4.32	63
0	1	1	6	5	3.56	3.93	33.5
0	1	1	4	3	3.12	3.07	37.5
0	1	1	5	6	3.69	3.98	57
0	1	1	8	6	3.56	3.86	55.5
0	1	1	6	8	4.14	4.27	55.5
0	1	1	7	4	3.66	3.38	57
0	1	1	6	6	3.76	3.59	62.49
0	1	1	4	1	2.84	2.28	31.5
0	1	1	2	3	2.37	2.76	26.5
0	1	1	4	7	3.14	3.38	62.49
0	1	1	3	5	3.73	3.53	32
0	1	1	7	5	4.51	4.59	36
0	1	0	9	6	3.83	4.09	72
0	1	0	5	2	4.84	4.64	48.5

CURRICULUM VITAE

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Surname, Name: Peşman, Haki
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EDUCATION

Degree	Institution	Year of Graduation
Ph.D.	METU, Physics Education	2012
MS	METU, Physics Education	2005
BS	METU, Physics Education	2001
High School	Taşlıçay High School, AĞRI, & İbrahim Bodur High School, ÇANAKKALE, & Koçarlı High School, AYDIN	1995
Middle School	Taşlıçay High School, AĞRI	1992
Elementary School	Kılıçkaya Village Elementary School, Şuhut, AFYON, & Uzunyazı Village Elementary School, Doğubeyazıt, AĞRI, & Taşlıçay Village Elementary School, Taşlıçay, AĞRI	1989

WORK EXPERIENCE

Year	Place	Enrollment
2001-2003	Eşme Şehit Adem Çiftçi Multi-Program High School, UŞAK	English Teacher
2003-2004	Sincan High School, ANKARA	English Teacher
2004-2006	Polatlı Atatürk High School, ANKARA	English Teacher
2006	Polatlı Anatolian Vocational High School for Girls, ANKARA	Physics Teacher
2007-present	METU, Department of Secondary Science and Mathematics Education	Research Assistant

FOREIGN LANGUAGES
English

PUBLICATIONS

Peşman, H., & Bülbül, M. Ş. (2012). Postmodern bir drama uygulaması: Mekanik kavramları kullanılarak hazırlanmış kavram ağı. *e-Journal of New World Sciences Academy, 7*(1), 453-458.

Peşman, H., Eryılmaz, A. (2010). Development of a three-tier test to assess misconceptions about simple electric circuits. *Journal of Educational Research, 103*(3), 208-222.

Pesman, H., & Yerdelen, S (2010). Investigating factors affecting high school students' physics self-efficacy. In M. F. Taşar & G. Çakmakçı (Eds.), *Contemporary science education research: learning and assessment* (pp. 405-408). Ankara, Turkey: Pegem Akademi.

Peşman, H., & Özdemir, Ö. F. (2010). Lise öğrencilerinin fizik dersiyle ilgili tutum, motivasyon ve öğrenme başarilari arasindaki ilişkilerin yapisal modellemesi. In M. Ş. Bülbül (Ed.), *Türkiye'de Fizik Eğitimi Alanındaki Tecrübeler, Sorunlar, Çözümler ve Öneriler* (pp. 18-28). Retrieved from http://www.ssme.metu.edu.tr/scientific_activities/9786058842007.pdf

Ünal, C., Peşman, H., & Özdemir, Ö. F. (2010). What is the north star of teachers? Curriculum or national exams. In M. F. Taşar & G. Çakmakçı (Eds.), *Contemporary science education research: international perspectives* (pp. 185-187). Ankara, Turkey: Pegem Akademi.

POSTER PRESENTATIONS

Peşman, H., & Özdemir, Ö. F. (2010, June). *The effect of teaching method on the effect of contextual approach: A factorial design*. Poster presented at 2010 National Summer Conference – Integrating Science and Mathematics Education Research into Teaching, University of Maine, Orono, Maine.