THE EFFECTS OF CONTEXT BASED APPROACH TO TEACHING ON STUDENTS' PHYSICS ACHIEVEMENTS, MOTIVATION FOR LEARNING PHYSICS AND ATTITUDES TOWARDS PHYSICS

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DECLARATION

I hereby declare that the present PhD thesis is based on my original work except for quotations and citations, which are, accepted as a mere formality. I also declare that the thesis has not been previously or concurrently submitted to any Universities or other institutions. The word count is 54249 words.

ABSTRACT (ENGLISH)

The purpose of this study is to investigate the effects of context based approach (CBA) on 10th grade students' physics achievements, motivation for learning physics and attitudes towards physics. The study was conducted in December 2014 with 312 students. A total of seven physics teachers, five high schools, and eight classes from Tirana, and Skutari (Shkodër) were participated in the study. The classes were assigned to control groups and to experimental groups randomly. The control groups took instruction by traditional method with non-contextual approach and experimental groups took instruction by traditional method with contextual approach.

Therefore, a distinction between teaching approach (contextual vs. non-contextual) was made and it was used as independent variable. Students' prior physics achievement, attitudes towards physics content and motivations to learn physics are controlled. Pretests and posttests were used for assessing students' achievements on Newton's Laws of Motion content, attitude towards Newton's Laws of Motion content and motivation to learn physics. Multivariate Analysis of Covariance (MANCOVA) were used to analyze the effects of contextual approach. The results showed that there was statistically significant mean difference between groups on the collective dependent variables achievement, attitudes towards physics and motivation to learn physics scores.

Key words: *Context based approach, contextual approach, contextual learning, context based learning, physics education, Newton's Laws of Motion, attitude, motivation*

ABSTRAKTI (ALBANIAN)

Qëllimi i këtij studimi është të hetojë efektet e metodës (qasjes) së bazuar në kontekst (MBK) në rezultatet, motivimin për të mësuar Fizikë dhe mendimin e përgjithshëm mbi Fizikën të nxënësve të klases së 10-të. Studimi u zhvillua në Dhjetor 2014 dhe përfshiu 312 studentë gjithsej. Në këtë studim u përfshinë gjithashtu shtatë mësues fizike nga pesë shkolla te mesme dhe tete klasa nga Tirana dhe Shkodra. Përzgjedhja dhe përcaktimi i grupeve të kontrollit dhe eksperimentimit që do të merreshin me klasat specifike u bë në mënyrë rastësore. Mbi grupet e kontrollit u aplikuan metoda tradicionale të mësimdhënies me qasje jokontekstuale, ndërsa në ato eksperimentale, në ndryshim nga grupi i parë, u aplikuan metoda tradicionale por me qasje kontekstuale.

Në këtë mënyrë u mundësua një dallim ndërmjet qasjeve kontekstuale apo jo në mësimdhënie dhe ky dallium u përdor si variabël e pavarur. Rezultatet, motivimi dhe perceptimi i studentëve ndaj Fizikës janë monitoruar paraprakisht. Provime të zhvilluara para dhe pas eksperimentimit të këtyre metodave mundësuan përcaktimin e nivelit të njohurive të studentëve mbi ligjet njutoniane të lëvizjes, perceptimin e nxënësve mbi të njejtat ligje, si dhe motivimin e përgjithshëm të nxënësve për të mësuar Fizikë. Për të analizuar efektet e qasjes kontekstuale u përdor metoda Multivariate Analysis of Covariance (MANCOVA). Rezultatet e kësaj të fundit tregojnë se, duke iu referuar variablave të varura të përbashkëta: arritje, perceptimi ndaj Fizikës dhe motivim për të mësuar Fizikë, mesatarisht ka një ndryshim statistikisht të rëndësishëm ndërmjet grupeve.

Fjalë kyçe: *Context based approach, contextual approach, contextual learning, context based learning, physics education, Newton's Laws of Motion, attitude, motivation*

DEDICATION

to my grand parents

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Ahmed Fatih Ersoy

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LIST OF ABBREVIATIONS

TMCA: Traditional Method with Contextual Approach

TMNCA: Traditional Method with Non-Contextual Approach

IV: Independent variable

DV: Dependent variable

EV: Extraneous variable

PRENLMAT: Students' pretest scores on Newton's Laws of Motion achievement test

PREATT: Students' pretest scores on attitude toward Newton's Laws of Motion course test

PREMOT: Students' pretest scores of physics motivation test

POSTNLMAT: Students' posttest scores on Newton's Laws of Motion achievement test

POSTATT: Students' posttest scores on attitude toward Newton's Laws of Motion course test

POSTMOT: Students' posttest scores of physics motivation test

OCL: Observation check list

CHAPTER I

1. INTRODUCTION

Physics tries to describe and explain things that happen in the real world. Almost every physics course includes some discussion of how science ideas can help to explain some everyday events occurring around us (Sönmez, 2015; Wilkinson, 1999a).

During the last decades some new terms are evolved in science education such as process approach, inquiry oriented, student-centered and thematic approach are now commonly used phrases. The contextual approach (CBA) or context based learning (CBL) is one of these terms. Here the term context based or placing physics in context means, to discuss and explore real-life situations and use them to draw out the physics. The context therefore becomes the central focus of a topic and must be referred to during the teaching process (Wilkinson, 1999c)

Applications or daily life examples are used of discussed almost in every courses. For example, in traditional courses first ideas or concepts are presented, next applications are discussed. The basis is to see how the ideas can be applied will help students come to an understanding of the ideas themselves.

Applications were used in object lessons in early 1800's where teachers produced an object such as a candle or soap and this is used for discussion about how the objects made, where its raw materials came from, and so on. 'The Science of Common Things' used examples drawn from the everyday lives of pupils as the starting point. The idea that we might start science teaching from applications and contexts has become important in the 1970s. The first systematic attempts to produce context led teaching materials for secondary school science was named as ‘A Way of Knowing’ developed for use in schools in Saskatchewan in Canada, and the IPN Curriculum Physik for years 9 and 10 in the German school system. This was followed in the early 1980s in Dutch secondary schools by the PLON physics courses and the first of the Salters’ courses in the UK. In 1988 contextualized science courses named ChemCom and CEPUP were developed in the USA. In several countries ‘Science in Society’ and ‘Science, Technology and Society’ approaches which are concerning less with pure science knowledge and more with the impact of science on everyday life influenced the development of these contextual approaches (Millar, 2002). Another new approach to context based education is involved in Victorian Certificate of Education (VCE) Physics where the context was defined as groups of not only related situations and phenomena but also applications of technology and issues of society, which may be come across by the students in the present or later. In other words contexts are familiar to students and relevant to their experiences (VCAA, 2015).

According to (Whitelegg & Parry, 1999) placing physics learning in real-life contexts is not about learning of abstract concepts that have no place in the out of school lives of students, but is about developing an understanding of physics that leads to an understanding of the way things work in real life. Contexts were also intended to engage the learner actively in the learning process, and they encouraged students to pose questions relating to their experience (Wilkinson, 1999b).

“Students learn effectively, and see relevance in learning science, when they have opportunities to develop and use their science ideas and skills, first in a variety of familiar contexts and later in other challenging situations” (Science in the New Zealand Curriculum, 1993).

1.1. The Main Research Question

What the effect of context based approach is compared to non-context based approach using the traditional instruction as method on 10th grade level of private high school students’ physics achievement on Newton’s Laws of Motion concept, motivation to learn physics, and attitude towards physics course in Albania?

1.2. Sub-Research Questions

The three sub-problems are stated below as follows:

1. What is the effect of instructions (contextual approach, and non - contextual approach) on 10th grade private high school students’ physics achievement in Newton’s Laws of Motion concept in Albania?

2. What is the effect of instructions (contextual approach, and non - contextual approach) on 10th grade private high school students’ attitude towards physics course in Albania?

3. What is the effect of instructions (contextual approach, and non - contextual approach) on 10th grade private high school students' motivation to learn physics in Albania?

The above-stated problem will be tested with the help of following hypotheses; accordingly they are stated in null form.

1.3. Hypotheses

1.3.1. Null Hypotheses

1: Students' scores on physics achievement posttest

2: Students' scores on motivation for learning physics posttest

3: Students' scores on attitude towards physics course posttest

CA: contextual approach

CNA: non - contextual approach

1.3.1.1. Null Hypothesis 1

$H_{0\ (1,2,3)}: \mu_{CA}-\mu_{NCA} = 0$

The formula stands for that there is no statistically significant difference between the posttest mean scores of 10th grade level of private high school students taught by the contextual approach, and those taught by non - contextual approach on the population means of the collective dependent variables of physics achievement posttest scores, attitude towards physics course posttest scores, and motivation for learning physics posttest scores when the effects of students' physics achievement pre-test scores, attitude towards physics course pre-test scores, motivation for learning physics pretest scores and physics grades are controlled.

1.3.1.2. Null Hypothesis 2

$H_{0\,(1)}$: μ_{CA}-$\mu_{NCA} = 0$

The formula involves in that there is no significant difference between the posttest mean scores of 10^{th} grade level of private high school students taught by contextual approach and those taught by non - contextual approach on the population means of the physics achievement posttest scores, when the effects of students' physics achievement pre-test scores, attitude towards physics course pre-test scores, motivation for learning physics pretest scores, and physics grades are controlled.

1.3.1.3. Null Hypothesis 3

$H_{0\,(2)}$: μ_{CA}-$\mu_{NCA} = 0$

The formula emphasizes that there is no statistically significant difference between the posttest mean scores of 10^{th} grade level of private high students taught by contextual approach and those taught by non - contextual approach on the population means of the attitude towards physics course posttest scores, when the effects of students' physics achievement pre-test scores, attitude towards physics course pre-test scores, motivation for learning physics pretest scores, and physics grades are controlled.

1.3.1.4. Null Hypothesis 4

$H_{0\,(3)}$: μ_{CA}-$\mu_{NCA} = 0$

The formula expresses that there is no statistically significant difference between the posttest mean scores of 10th grade level of private high students taught by contextual approach and those taught by non - contextual approach on the population means of the motivation for learning physics posttest scores, when the effects of students' physics achievement pre-test scores, attitude towards physics course pre-test scores, motivation for learning physics pretest scores, and physics grades are controlled.

1.3.2. Alternative Hypotheses

1: Students' scores on physics achievement posttest

2: Students' scores on motivation for learning physics posttest

3: Students' scores on attitude towards physics course posttest

CA: contextual approach

CNA: non - contextual approach

1.3.2.1. Alternative Hypothesis 1

$H_{1\,(1,\,2,\,3)}$: μ_{CA}-$\mu_{NCA} \neq 0$

The formula stands for that there is statistically significant difference between the posttest mean scores of 10th grade level of private high students taught by the contextual approach, and those taught by non - contextual approach on the population means of the collective dependent variables of physics achievement posttest scores, attitude towards physics course posttest scores, and motivation for learning physics posttest scores when the effects of students' physics achievement pre-test scores, attitude towards physics course pre-test scores, motivation for learning physics pretest scores and physics grades are controlled.

1.3.2.2. Alternative Hypothesis 2

$H_{1\,(1)}: \mu_{CA} - \mu_{NCA} \neq 0$

The formula involves in that there is significant difference between the posttest mean scores of 10^{th} grade level of private high students taught by contextual approach and those taught by non - contextual approach on the population means of the physics achievement posttest scores, when the effects of students' physics achievement pre-test scores, attitude towards physics course pre-test scores, motivation for learning physics pretest scores, and physics grades are controlled.

1.3.2.3. Alternative Hypothesis 3

$H_{1\,(2)}: \mu_{CA} - \mu_{NCA} \neq 0$

The formula emphasizes that there is statistically significant difference between the posttest mean scores of 10^{th} grade level of private high students taught by contextual approach and those taught by non - contextual approach on the population means of the attitude towards physics course posttest scores, when the effects of students' physics achievement pre-test scores, attitude towards physics course pre-test scores, motivation for learning physics pretest scores, and physics grades are controlled.

1.3.2.4. Alternative Hypothesis 4

$H_{1\,(3)}$: $\mu_{CA} - \mu_{NCA} \neq 0$

The formula expresses that there is statistically significant difference between the posttest mean scores of 10th grade level of private high students taught by contextual approach and those taught by non - contextual approach on the population means of the motivation for learning physics posttest scores, when the effects of students' physics achievement pre-test scores, attitude towards physics course pre-test scores, motivation for learning physics pretest scores, and physics grades are controlled.

1.4. Definition of Important Terms

1.4.1. Variables

1.4.1.1. Independent Variable

There is one independent variable in the study. The approach to teaching is independent variable of the study. It has two levels, traditional method with non - contextual approach and traditional method with non - contextual approach)

1.4.1.2. Dependent Variables

Physics achievement posttest scores (POSTNLMAT), attitude towards physics course posttest scores (POSTATT) and motivation for learning physics post test scores (POSTMOT) are dependent variables.

POSTNLMAT: It will be measured by physics achievement test. This test will cover only the Newton's Laws of Motion unit that is the content of 10th grade. Items will reflect the objectives of Newton's Laws of Motion unit. The test will be administered at the end of the treatment.

POSTATT: It will be measured by physics attitude test towards Newton's Laws of Motion unit. The test will be administered at the end of the treatment.

POSTMOT: It will be measured by a motivation test for learning physics. This test will cover only physics learning. The test will be administered at the end of the treatment.

1.4.1.3. Extraneous Variables

There are three extraneous variables in the study. These are students' physics achievement pretest scores (PRENLMAT), students' attitudes towards physics pretest scores (PREATT), students' physics motivation for learning physics pretest scores (PREMOT). These extraneous variables in the study are used as covariates for statistical matching.

Same measurement scales are used in the pretests and the posttest of the study, the same units are used to report results of test scores and pretest scores are used as covariate where posttest scores are used as dependent variable (Bonate, 2000, p. 93; Fraenkel, Wallen, & Hyun, 2012, pp. 295, 626; Tabachnick & Fidell, 2007, p. 21).

PRENLMAT: It will be measured by physics achievement test prior to treatment. This test will cover only the Newton's Laws of Motion unit that is the content of 10th grade. Items will reflect the objectives of Newton's Laws of Motion unit. It will be used as a covariate in the statistical analysis.

PREATT: It will be measured by physics attitude test towards Newton's Laws of Motion unit prior to treatment. This test will cover only the Newton's Laws of Motion unit. It will be used as a covariate in the statistical analysis.

PREMOT: It will be measured by a motivation test for learning physics. This test will cover only physics learning prior to treatment. It will be used as a covariate in the statistical analysis.

1.4.2. Teaching Method and Teaching Approach

The difference and relations between teaching methods and teaching approaches were not clearly defined in physics education however, it had been mentioned by Kortland (2002) that there is no specific teaching methods suggested in Physics Curriculum Development Project in the Netherlands (PLON) (Peşman, 2012). E. M. Anthony and Norris (1969) describes method as an ordered plan for lesson presentation, which is based upon, the selected approach and adds, "an approach is axiomatic, a method is procedural". Method can also be classified as wider selections and forms of instruction (Strain, 1986). Methods are description for the teachers as an arrangement of practices "in the form of a syllabus, textbook, program, curriculum" (E. M. Anthony & Norris, 1969) and method is based on approach and carried out by techniques (Strain, 1986).

The approach deals with the subjects' nature, which is being taught, and it may involve more than one method (Anthony, 1963; as cited in Peşman, 2012).

The aim of the study and the model depicted by Anthony is on the same track. The teaching model and the teaching approach are highly connected with each other. The teaching method is the inclusive design of the teaching implementation and the teaching approach is ideas and principles about the nature of instruction (Peşman, 2012).

In this study, "teaching method" states the expressions, which have similar meanings such as:

- teaching strategies (Danielson, 2008);
- teaching techniques (Wise & Okey, 1983);
- learning methods and strategies (Hartley, 2001);
- instructional methods and strategies (Treagust, 2007);
- instructional technology (Smaldino et al., 2005);
- instructional systems (Willett et al., 1983) (as cited in Üstün, 2012).

1.4.3. Traditional Method

The traditional method is widely known and used by teachers. It can be effective when implemented carefully. Abraham (1998) stated that the traditional methods starts with informing students regarding the contents being taught (as cited in Peşman, 2012).

The teacher mediates the learning environment. Lessons start with the description of the concepts. Equations used in problem solving are described, formulas are given and respective examples are solved (Serin, 2009).

The information transferred to students with textbooks and instruction where students are rarely active (Wilkinson, 1999a). The roles of students mainly are to listen the course to solve algorithmic problem exams, and to take notes (Peşman, 2012).

Teacher defines and explains the concepts, writes the respective equations to transfer respective facts and concepts while students are expected to be passive listeners to take notes and write the examples which are given by teachers additionally teacher may ask questions regarding the concepts and the example questions (Sönmez, 2015).

During a lesson given via traditional method the teachers are not expected to use any other method, any other activity rather than lecturing, using board and asking questions to the students (Şakir, 2013).

1.4.4. Non-Contextual Approach Given via Traditional Method

This curricular delivery model sets the expectations for what is to be accomplished in learning objectives for skills or units of study. This term anticipates specific teacher behaviors associated with traditional instruction such as lecture, drill, and practice or seatwork. Delivery may take the form of programmed instruction. Students work individually. Assessment and evaluation consist of tests, quizzes, and other direct measures of skill to performance (Wilkinson, 1999a).

The students rely on their teachers to decide what, when, and how to learn. This approach to instruction works relatively well (Kulik & Kulik, 1991).

In a traditionally designed instruction method, the lectures are designed as teacher-centered which means, teacher is in the center as the source of knowledge. As stated by Jonassen (1991), students are receiving the information that is coming from the teachers and the textbooks so that they are all passive in traditional method and according to Novak (1999) students should be treated as if they have holes in their minds and they need this holes to be filled with information (as cited in Sönmez, 2015).

During the implementation of this approach only direct instruction is used and there are no other teaching methods are implemented (Üstün, 2012).

This approach requires traditional way of instruction as method where instructor defines the concepts, explains the equations and formulas necessary to solve problems, solves problems, and gives daily life examples if possible.

1.4.5. Contextual Approach Given via Traditional Method

Context based learning involves science – technology - society (STS) approach to content and a constructivist approach to learning and teaching. This term anticipates specific teacher behaviors associated with collaborative and facilitative learning in a socio-cultural setting. It helps students create or construct their own understandings of concepts and content according to Sternberg and Williams as cited in Wilkinson (1999a) by reference to a practical theme. Assessment and evaluation consist of collaborative problem solving, projects, and direct measures of mastery such as skills tests (Wilkinson, 1999a).

As in the traditional way the content is not ordered; the context determines the organization of the physics content and this leads to same physics concepts being thought in more than one unit, but in different contexts (Whitelegg & Parry, 1999).

A common feature of physics courses of the 1980s was the use of applications in the teaching of concepts. At first glance, this might seem to be an example of the inclusion of the contextual dimension of physics in the curriculum, however, this is not the case; using contexts would imply beginning with a relevant example of reality and then using aspects of this reality to provide a launching pad for the teaching of the concepts of the curriculum. The use of applications on the other hand, implies teaching the concepts first, and using applications as examples to illustrate those concepts. Thus teaching applications is not the same as teaching contextually (Wilkinson, 1999a).

This study involves traditional method where teachers are the mediator of instruction and contextual approach where the new content is being expected to be gathered from the daily life examples (Bennett, Hogarth, & Lubben, 2003; Bennett & Holman, 2003; Gilbert, 2006; Peşman, 2012; Taasoobshirazi & Carr, 2008; Whitelegg & Parry, 1999; Wilkinson, 1999a, 1999b). Later on necessary equations are described and exemplary problems are solved.

1.5. Significance of the Study

Besides its advantages, contextual approach requires time for implementation. Consequently, a contextual approach should be carefully developed in a structured curriculum in an education system.

The significance of this study is that if it can be shown that contextual approach provides motivation; effective in enhancing the achievement and attitude of students in our setting we may provide an additional instructional strategy will be available to policy makers, curriculum developers, and teachers.

CHAPTER II

2. LITERATURE REVIEW

In the literature review of the study, first of all teaching approach and the teaching method distinction is made. Traditional instruction and the context based instruction is defined. After all, literature on attitude and motivation in physics is reviewed.

Science teaching has undergone various changes since last twenty years, especially the development of a wide range of materials, which are utilized for context and applications that appear as a starting point in order to develop understanding of scientific ideas. The approaches such as; ‘context-based’, ‘applications-led’ are variously featured or using ‘Science, Technology and Society’ (STS) links and, in addition to their emphasis on using contexts ad applications as starting points, they also all make extensive use of student-centered learning strategies (Bennett et al., 2003).

The science lessons offered in many schools appeared to be failing to stimulate children’s interest and most of the students seemed to be ending their studies with a view of science as dull and irrelevant to their concerns. The demands of higher education have tremendous effects on courses. Secondary science lacked relevance to students’ concerns and largely failed in order to make links with students` lives and interests (Millar, 1993).

According to (Gilbert, 2006) a context based curricula should avoid an overloaded curriculum, enable students to develop coherent mental schemata, enable transfer, relate personal relevance of students, choosing a balanced set of curriculum emphases.

Vygotsky claimed that, (as cited in Whitelegg & Parry, 1999), ‘a mature concept is achieved when the scientific and everyday versions have merged’(Whitelegg & Parry, 1999). As it is described earlier, this definition suits with the broadest description of context based learning is the social and cultural environment in which the student, teacher and institution are situated (Whitelegg & Parry, 1999).

Context based learning improve students’ interest, motivate them, and stimulate their interest in science by encouraging them to get involved in physics with the help of its relevance to life outside school, and provide staff a tool that offers a wide range of approaches (Bennett et al., 2003; Edwards, 2000; Millar, 2002; Whitelegg & Parry, 1999; Wilkinson, 1999c). Evidence gives suggestion such as ‘students learn more successfully’ (Edwards, 2000) or at least their understanding of science ideas enhanced, and their affective responses are also improved (Bennett et al., 2003) in case the material is given in context, and the respective girl students show tendency to learn in this way (Edwards, 2000; Wilkinson, 1999c).

By choosing a context accessible to students or building on a context expected by respective students themselves, give much power to learning. Besides, according to Maslow, the nature of the learning process becomes less didactic; more negotiated and may satisfy the student’s social needs, and promote students’ self-esteem and prestige (Whitelegg & Parry, 1999).

According to Solomon (as cited in Millar, 1993) some of the physics educators have highlighted that many students divide their learning, because they might use one set of ideas while problem solving in the lab or class environment and another set of ideas for expressing everyday life situations. The context based learning is likely to help pupils to apply physics ideas to everyday phenomena through considering the learning in various contexts (Millar, 1993).

The success of the course is related to the teachers' personal passion for the approach; some of the teachers are likely to ignore it, and although they may know significance of it, since it enhances the interest of the students towards physics, some teachers do not believe that it is helpful for understanding easily (Whitelegg & Parry, 1999). Although the approach may not be as successful as the designers had hoped most teachers seem to have fairly positive views about the contexts because many teachers (VCE Physics) need to be better informed about what actually constitutes a contextual approach (Wilkinson, 1999c).

The curriculum restructuring is the main encounter of educators and curriculum developers around the world more than 60 years resulted in two distinct phases of reforms, according to (Prince & Felder, 2007) one of which is the fist phase focused on the development of secondary science courses as "an objective, culture-free, value-neutral, intellectual pursuit explored by the most dispassionate of men (gender choice deliberate)". Many students are likely not to attend the courses, which have abstraction in their contents. Chemistry is one of them and this course is known as difficult, boring, and abstract. At the same time, even though it is central and useful science, but it is considered as irrelevant (Ware, 2001).

According to Nelson (1988) recent studies indicating that the scientific scientific literacy is terribly low:

- Only half of our 17-year-olds think science is useful;
- Only 5% of adults report that they understand basic scientific concepts or science policy issues;
- More than 40% of adults believe in astrology, lucky numbers, and flying saucers;
- Some 35% of adults believe that society should exert a greater control over science and technology, and more than 70% think that society should curtail the activities of scientists.

A second wave of curriculum innovations were started because of the dissatisfactions of the 1960s reform which was motivated by a report from the USA, ‘A Nation at Risk’, published in 1983, In this reform, most projects were smaller scale, for example, in relation to active learning, ‘Chemistry in the Community’ (ChemCom) known as the North-American project, also the British Salters’ Chemistry project focused on the design of the most courses as a reform in 1980s, especially through introducing (open-) inquiry tasks in the school lab. Moreover, efforts were given in order to make science much more meaningful for students through finding connections between science concepts and processes that are taken from real-life situations (De Jong, 2007).

2.1. Teaching Method and Teaching Approach

According to (Kortland, 2005) there is no special education method used for context based approach. Science and physics education literature was reviewed carefully there was almost no study which described the relationship between teaching method and teaching approach. There was only one study which pointed out this relation and reviewed how teaching method and teaching approach are related (Peşman, 2012). Anthony (1963) represented and identified the relationship approach, method, and technique (as cited in Peşman, 2012). Especially, correlative assumptions, which handle with central part of language teaching and learning. Herein, there is axiomatic approach, which reflects the central part of subject matter in order to be taught (Peşman, 2012). Regarding method, there is a multipurpose plan for presentation of the language materials through which respective teacher cannot find any contradictions, at the same time; everything is based on absolutely chosen approach that is knowns as axiomatic and a method of procedure. It shows that there are many methods within one approach (Peşman, 2012). On the other hand, there is implementational technique, which finds its place within classroom context. This technique has its own respective trick and stratagem in order to obtain an immediate objective. Actually, the main idea is that the techniques are in need of having consistency with a method, and accordingly in tune with an approach as well (Peşman, 2012).

It can be summarized that teaching method and technique include the whole plan and implementation of teaching while the teaching approach is known as a set of correlated considerations and beliefs in relation to the nature of teaching in addition many teaching methods might find a place within a teaching approach (Peşman, 2012).

2.2. Traditional Teaching Method

In traditional approaches, an ordinary format appears as teaching the science first and then in relation to it consider industrial applications and social implications (Watts, Alsop, Zylbersztajn, & Silva, 1997) (if at all). Traditional physics instruction appears as a failure in order to achieve these goals (McDermott, 1991; Taasoobshirazi & Carr, 2008).

Traditional physics education provides little conceptual understanding of physics concepts with respect to most of the physics education researchers even if it is dealt with by many various talented and well-known physics instructors (Hake, 1998).

The traditional method refers to expository teaching while informing is conducted with the help textbooks, lecturing, or various ways of media. Regarding highly academic courses, which were carried out through much chalk and talk, unfortunately less classroom demonstrations, and nearly no activities for students` learning (Wilkinson, 1999a). The instructor reviews previous learning, presents new physics content, solves some exemplary physics problems related to the content, and provides active practice in problem solving for all students. Moreover, the teacher may or may not use demonstrations. On the other hand, the students give ears to the lecture, they take notes, and also they rarely ask questions. In general, they are passive and not involved in any student-centered activities, in best-case conditions, they conduct confirmatory physics experiments (Hake, 1998; Peşman, 2012; Taasoobshirazi & Carr, 2008; Ünal, 2008).

Taasoobshirazi and Carr (2008) lists the issues concerning traditional physics instruction reviewed in the literature as follows:

- Students are being asked, “to solve quantitative physics problems in class, on homework assignments, or on tests” (Taasoobshirazi and Carr, 2008).
- The main focus of instruction is “equations and calculations to solve the problems” (Taasoobshirazi and Carr, 2008).
- Students are believed to capture “the conceptual relationships in the problems as they solve them step-by-step on the board” (Taasoobshirazi and Carr, 2008).

As a result of this kind of physics instruction students end up with beliefs of that physics is taught through memorization and computations and students will be missing the deeper conceptual relationships, which are available in the problems (as cited in Peşman, 2012).

Hake (1998) defined interactive engagement methods, which have intentions to improve students’ conceptual understanding with the aid of heads-on (always) and hands-on (usually) activities that offer immediate feedback via discussion with peers and/or instructors and defines traditional instruction that makes little or no use of interactive engagement methods where traditional instruction considers passive-student lectures, recipe labs, and algorithmic problem exams (Hake (1998).

In a traditional high school, the instructor explains the material, makes due calculations of problems on the board, and occasionally carry out lab demonstrations (Briscoe & Prayaga, 2004; Kang & Wallace, 2005; Peşman, 2012; Taasoobshirazi & Carr, 2008; N. Ültay & Çalık, 2012). During the lectures students may give ears to the lecture, write down notes, but they rarely ask questions or they make comments (Kang & Wallace, 2005). In such a learning environments students are expected as if they have to climb a ladder at a time the whole rungs of the ladder (overloaded curriculum) (N. Ültay & Çalık, 2012).

In traditional physics classrooms, the respective students are given problems in order to make calculation in a quantitative solution fashion (Briscoe & Prayaga, 2004). When solving these problems it is required to find the correct equation, manipulate it, and calculate to find an answer (Redish, Saul, & Steinberg, 1998; Tytler, 2007) which yields often students in failing to understand the deeper conceptual relationships (Larkin, McDermott, Simon, & Simon, 1980), believing that physics is focused on memorization and computation (Edwards & Whitelegg, 2001) and difficulties in transferring knowledge to different contexts (Gilbert, 2006).

Research has states that most students are confused about the basic concepts of mechanics while the topic such as; optics, thermodynamics, electricity, and magnetism are taught by traditional way and therefore, the tendency leads to the use of poor problem-solving strategies (McDermott, 1991). Furthermore, traditional physics instruction is likely to make students poorly motivated as well (McDermott, 1991; Peşman, 2012; Taasoobshirazi & Carr, 2008).

Besides of all researchers are stating that traditional instruction provides students with little conceptual understanding even though the instruction is given by the talented and popular physics instructors (Hake, 1998).

According to Black & Atkin and OECD The researches about students' interest about science courses yields two fundamental problems (as cited in Acar & Yaman, 2011). One of these is the students' interest about physics, chemistry, biology courses. One other problem is students have difficulties about understanding science courses and they are the courses where students have lower achievement (Acar & Yaman, 2011). Student interest is an important factor on students' motivation and achievement (Krapp, 2002) low interest on science courses causes low motivation and achievement in science courses which also have negative effects on the aims contemporary science education which raising science literate individuals (Acar & Yaman, 2011).

2.3. Context Based Approach

After mid 90's education was thought to be the transfer of academic information to students. Chalk and talk type demonstrations with almost no student interaction and activities and not involving recent improvements in science were causing students to have less links in between real life contexts and technology (Lijnse, Kortland, Eijkelhof, Genderen, & Hooymayers, 1990).

In order to make students achieve deeply understanding, time-honored aims of physics instruction are considered essential, since they improve concrete problem-solving skills, and enhance students' motivation as well as attitude (Murphy & Whitelegg, 2006; Peşman, 2012; Taasoobshirazi & Carr, 2008). Especially after 1960's new approaches and researches are initiated and the improvements are started to be applied to education programs and course procedures. Analyzing the countries, which are trying to improve their science curricula, it is observed the same common ground. With respect to this students should be able to (Acar & Yaman, 2011):

- know fundamental concepts, principles and theories, describe and comprehend;
- know and use the ways to access to information regarding science courses;
- analytically and rationally evaluate environment, situations and problems using scientific tools and approaches;
- aware about social responsibilities, capable of making observations and giving decisions on problems based scientific fundaments.

These concerns about goals of physics instruction, context-based instruction has become one of the most common approaches to instruction across a number of countries such as Australia, Belgium, Bulgaria, Canada, China (Hong Kong), England and Wales, Finland, France, Germany, Greece, Hungary, Israel, Ireland, Italy, Japan, Korea, Malaysia, The Netherlands, New Zealand, Norway, Poland, Portugal, Russia, Scotland, Singapore, Slovakia, Slovenia, South Africa, Spain, Switzerland, Swaziland and the USA (Acar & Yaman, 2011; Bennett & Holman, 2003; Bennett & Lubben, 2007; Peşman, 2012; E. Ültay & Ültay, 2012; Wilkinson, 1999a). Since 2008, also Ministry of National Education of Turkey has been developed and administered contextual approach. As we review the literature the projects like Event Centered Learning, Large Context Problem Approach, Physik im Kontext, PLON, Salters' Science Course, Salters Horners Advanced Physics, SLIPP, The Applications-Led Approach, and Victorian Certificate of Education can be listed as examples of context based approach to learning.

Wilkinson (1999a) states that the developers of Victorian Certificate of Education implied that context based approach sourced from worldwide science technology and society movement and states also context based approach makes possible to apply science technology and society approach because it can supply suitable contexts to technology applications and contents.

According to Bennett and Lubben (2007) context based approach sourced from the literature which has accepted by science technology and society approach.

Students were unsuccessful in applying knowledge that they have to problems which are personal, real, social and life (Sanger & Greenbowe, 1996). Individuals accused to be science illiterate when they do not understand real life scientific problems and principles like thinning of ozone layer, global warming, and acid rains, but most of the adults even if they have graduated from high school or college cannot understand these. Science technology and society approach emphasizes the contexts sourced from real life contexts, which helps students to use their knowledge about real life contexts like acid (Çekiç Toroslu, 2011).

Victorian Certificate of Education is one of the context based approach to physics education not only based on science technology and society approach but also based on constructivist learning. According to constructivist approach learning takes place when a student establishes a link with the new information and previous knowledge (Wilkinson, 1999a).

Jerome S. Bruner, Jean Piaget, C. Argyris, R. J. Spiro, D. A. Kolb, J. H. Flavell, R.C. Shank are main contributors constructivist learning theory which can be summarized as "Learning occurs in the mind" (Malach & Malčík, 2013). Constructivism assumes that students are always constructing and reconstructing the theories with experiences. Education should start with students' aim, believes, learning strategies. This approach is student centered and instructor is facilitator and this situation is contradicting with traditional instruction (Wilkinson, 1999a).

The central ideas of constructivism are student is active in learning, students develop hypothesis and test them, reconstructs these with their experiences. Learning is dynamic and a social process. Students are coming to class with constructed knowledge of years' experience. A context can be learned any when scientific information merges with the daily experience (Ng & Nguyen, 2006). Stinner (2006) emphasized that context based learning approach should be linked constructivist learning theories.

Finkelstein (2001) supported that context should be placed at center of student learning. Contexts are being shaped in learning procedures and shapes the students. Students learns the content from the context. It is impossible to separate the context from the learning process where the contexts are being used. Learning and context which defines learning mutually being shaped and should coexist this is described with the following (Finkelstein, 2001).

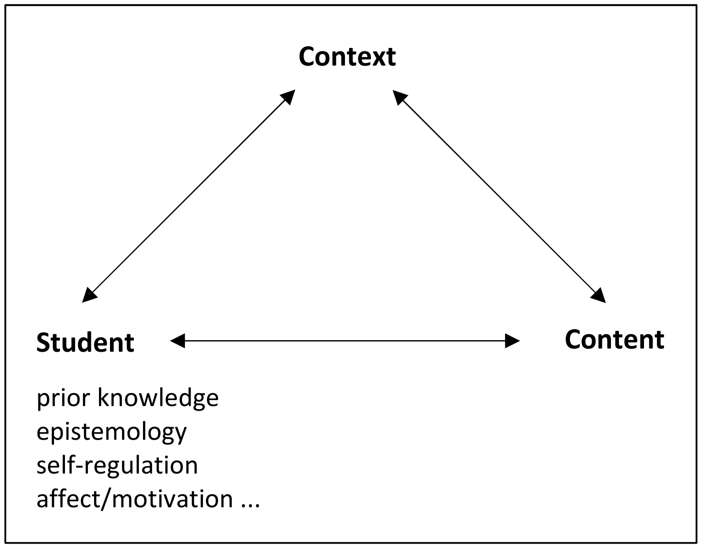


Figure 2.1 - Contextual Constructivist Model of Learning (Finkelstein, 2001)

According to Oxford Online Dictionary, context is defined as the circumstances, which are helpful for forming the context of not only an event, but also statement, or idea, since this is the way of understanding the circumstances in context fashion.

Wilkinson (1999c) states that developers of Victorian Certificate of Education courses define the context as the situation or fact that students are being faced as a part of their daily experiences, the Technologies that they are being faced or will be facing, the individual or social subjects which are important for students or all of the situations, facts, technological applications and social issues that students are facing today or will face in the future (Wilkinson, 1999c). Those definitions are also being used by Queensland Physics Programme (Çekiç Toroslu, 2011).

Contexts are the situations, which are helping students for giving meaning to concepts, laws, and rules. The source of the context should be analyzed in order to fully describe a context (De Jong, 2006). The sources of the contexts are grouped in four groups as individual, social, professional application, and science and technology as given in Table 2.1.

Table 2.1 - Four origins of contexts Origin of a context (De Jong, 2006)

Source of the Context	**Example of a context**
Personal domain	Personal health care
Social and society domain	Acid rain effects on the environment
Professional practice domain	Practices of chemical engineers
Scientific and technological domain	Historical models and theories

Pearsall defines the daily meaning of context as the situation shaped by an event, word, thought, or the terminology which can be totally understood and context is the segment which describes the word or an incident which comes before and after (as cited in Çekiç Toroslu, 2011). While Gilbert (2006) defines the function of the context as the situation which makes the words and sentences meaningful. Speaking is the context of making explanation, diagram, animation, or a photograph can also be a context.

Çekiç Toroslu (2011) defines context as focal points, which helps students to understand physics concepts in a better way.

In a traditional classroom, a teacher lectures, solves some problems, may perform demonstrations, and rarely links content with daily life. In the meantime, students give ears to the teacher, they jot down notes, and they rarely ask questions (Peşman & Özdemir, 2012). Most of the time researchers claimed that traditional physics instructions is ineffective on achieving major goals of physics instruction which are students' understanding of physics concepts, problem-solving skills, and motivation in physics (McDermott, 1991; Peşman, 2012; Taasoobshirazi & Carr, 2008). These issues have forced researchers to develop alternative teaching methods (Peşman & Özdemir, 2012).

As an example, Context-based instruction stated as "using concepts and process skills in real-world contexts that are relevant to students from diverse backgrounds" (Glynn and Koballa Jr (2005). Context based approach starts with a daily life situation or problem, makes the learning necessary, and aims to use content and its relations to context as a tool to solve situation or problem. Tough students can make a link between daily life and scientific concepts (Acar & Yaman, 2011). Based on practice, the science education might be with the aid of implementing contextual teaching and learning. So that, students' preparation have been significantly enhanced and it provides various real-life contexts for the good of students' teaching and learning (Glynn & Koballa Jr, 2005).

The effect of traditional and interactive engagement methods on students' conceptual understanding of physics compared by Hake (1998) where it has found that the interactive engagement methods were significantly better in promoting students' conceptual understanding.

Attempting to teach students the intensive theoretical knowledge results in students perceiving the subject to be dry and abstract which also affects students' motivation and attitudes (Ulusoy & Onen, 2014). Which often leads students ask, "What is the relation of this topic with real life", "Why do I need to know this?" or "Will I ever use this in the next time?" when studying a subject. Context based learning anticipates to answer these questions (Glynn & Koballa Jr, 2005; N. Ültay & Çalık, 2012).

According to J. M. Ramsden (1997) context based approach in science education becoming more popular among students because it is more attractive to students and more close to their experiences.

Physics is a course, which explains and describes the real World occurrences. To place the physics in the contexts not only explains the real world occurrences but also defines the boundaries of physics. Contexts are preferred as they are the focal points of the content (Wilkinson, 1999c).

Context based learning approach, according to Kortland (2005), a course should be initiated with students' "lifeworld" with an emphasis on technological objects and natural phenomena.

While a curriculum is designed or its boundaries are being defined, thinking about physics' context dimension is not the same applications of physics contexts are being involved in physics education curricula. Having physics contexts in the center or education curricula is actually requires having contexts in the center of education curricula to teach the context of interest (Wilkinson, 1999a, 1999c).

Large Context Problem which has been developed by Stinner (1994a) starts with a context which is interesting for students and related with their experiences and well-constructed and this approach is pedagogically more healthy.

The gap between day-to-day life experiences and what the course includes can be filled by introducing topics by relating them to daily life events which increasing the quality of education (Acar & Yaman, 2011; Ulusoy & Onen, 2014; N. Ültay & Çalık, 2012) without lessening conceptual understanding (King & Ritchie, 2013).

Situated cognition, gives importance to the context in which something is learned, can be accepted as the starting point of context-based instruction (Greeno, 1998). Contexts are used as the starting points for developing scientific thoughts in the context-based approach (Bennett & Lubben, 2007).

Presenting scientific concepts through selected daily life events is the main aim of the context-based approach, while avoiding the implementation of a heavy curriculum and establishing a teaching program of events that have relations with the daily life experiences of students and as a result expecting an increase in motivation as well as their willingness to learn (Gilbert, 2006; Özay Köse & Çam Tosun, 2011; Palmer, 1997). This approach not only positively influences the interests and attitudes of students towards science but also raises the awareness of the relationship between real life issues and science while it is more effective in fostering the motivation, problems solving, and students` achievements (Glynn & Koballa Jr, 2005; Gutwill-Wise, 2001; Smith & Bitner, 1993; Ulusoy & Onen, 2014).

The daily life events and relating these events to science concepts is the main focus of the context-based approach. Selecting proper contexts and teaching through these contexts would help to maintain the students’ attention in the lessons (Ünal, 2008).

Teaching is expected to facilitate students' learning through extracts from daily life events and experiences according to the context-based approach. Students who perform activities using daily life tools along with their theoretical or experimental knowledge may develop scientific skills (Ulusoy & Onen, 2014). For example throwing a tennis ball with different angles. Turbidity, pH, colorimetric analysis, norms for Escherichia coli concentration, the representative sampling of swimming water (Gilbert, 2006). Standing up in an accelerating vehicle.

These types of experiments are in line with context-based learning and they have positive influences on students' experimental skills and course achievement levels. The constructivist and sociocultural learning theorists highly emphasized the importance of context-based learning where it is suggested that the context-based learning is quite effective in students' constructing, transferring and implementing knowledge through their own experiences and can be modeled in four groups (Gilbert, 2006) as given in Table 2.2.

Table 2.2 - Four model of context (Gilbert, 2006)

	Model	Description of the Model
Model 1	Context as the direct application of concepts	A common use of the word context is to denote the application of concepts, or the consequences of that application, to illustrate their use and significance.
Model 2	Context as reciprocity between concepts and applications	Concepts related to their applications, where applications also affect the meaning attributed to the concepts.
Model 3	Context as provided by personal mental activity	When the students empathize with this type of context, they can value the description of it.
Model 4	Context as the social circumstances	A context is situated as a cultural entity in society.

Taasoobshirazi and Carr (2008) while reviewing the context based physics instruction pointed out followings:

- Students are being prevented from “viewing physics as an abstract topic irrelevant to their everyday life” (Whitelegg & Edwards, 2001; Wilkinson, 1997) and their motivation will be supported if physics materials are instructed contextually (Whitelegg & Edwards, 2001; Wilkinson, 1997);

- Students are viewing physics material and problems as “something to memorize or compute” (Whitelegg & Edwards, 2001). If the contexts are integrated in physics materials during physics instruction, students are being expected to move away from this point of view, as a result it is also expected that students will engage in better problem solving. (Whitelegg & Edwards, 2001);

- Context based physics instruction increases the students’ motivation and makes use of better strategies. If is compared with traditional instruction, context based physics instruction is expected to increase students’ achievement (Wilkinson, 1997);

- The enduring goals of physics instruction are “supporting student motivation, problem solving, and achievement” (Murphy & Whitelegg, 2006; Redish, 2003). The efforts to achieve these goals are all significant.

According to Demircioglu, Demircioglu, and Calik (2009) the context-based approach has aims of developing and sustaining a sense of wonder and curiosity of respective students about the real-life situations.

Context based approach to learning makes content of education curricula more interesting and funny causing increase in understanding of students. Context based approach aims to raise students which are capable of using the knowledge they own and science literate (Acar & Yaman, 2011).

Context-based problems require personalization in order to solve within a real-life context. At the same time, they involve in more reading, thinking, and analysis, and they also are likely to take more time in order to solve more than traditional textbook problems (Taasoobshirazi & Carr, 2008).

Gilbert (2006), based on the explanations of Duranti and Goodwin (1992), defined the context as a focal event embodied in its cultural context. In order to understand, interpret and describe properly cultural setting, speech situation, or shared background assumptions should be provided so now the context can be described as the phenomenon surrounding the focal event which provides appropriate interpretation of focal event. As Gilbert (2006) cited, Duranti and Goodwin (1992, pp. 6/8) listed four attributes of the educational context:

- classroom environment is considered as a place where students with their mental capacity encounter focal event within th framework of not only social and spatial but also temporal activities;

- classroom environment is known as a place where the students experience various behaviors through which the learning task is addressed with the help of focal event approach and in the frame of talk and then the learning takes place;
- a specific language appears as a must through which the talk and the focal event take place in the classroom;
- the is classroom is the place where the students and teachers share their extra – situational background knowledge.

Gilbert (2006) has given some examples, to make clear what was the contextual approach and the attributes of a context. Table 2.3 summarizes them in relation to the attributes. For instance, in the context of earthquake, it is possible to study earthquake resistant buildings and their flexibilities. Similarly, in physics, Newton's first and second laws, force and pressure, and collisions may be studied in the context of football.

In general, context based instruction is commonly starts with introducing the context than the content where context determines the concept to be learnt (Edwards & Whitelegg, 2001; Gilbert, 2006; Millar, 1993; Peşman & Özdemir, 2012).

The positive expectations about the outcome of context-based approach made this approach so common especially about students' science related affective variables (Bennett & Lubben, 2007; Edwards & Whitelegg, 2001; Gilbert, 2006; Millar, 1993; Peşman, 2012; Peşman & Özdemir, 2012; Taasoobshirazi & Carr, 2008). Research has shown that students usually find physics impersonal, objective, and irrelevant to real-life situations (Lye, Fry, & Hart, 2001; Peşman & Özdemir, 2012). Taasoobshirazi and Carr (2008) mentioned that the context-based physics seemed to be proposed in response to these perceptions.

Table 2.3 - Exemplary Educational Contexts Given by Gilbert (2006) (as cited in Peşman, 2012)

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 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.

In the same way, Gilbert (2006) after analyzing the problems faced in last 20 years of science education proposed a list described what made the context based approach a necessity:

1. Overload: As the scientific knowledge increasing rapidly, education curricula are becoming overloaded. This overloaded curricula become an isolated pile of facts from the scientific origin;

2. Isolated facts: The curricula that is taught to the students without permitting them have link the interaction between the isolated facts. As a result, students are not aware how to bring the isolated facts together. The isolated facts obstruct the formation of reliable cognitive schemes. Besides students cannot give meanings to what they learn;

3. Lack of transfer: Students can solve the problems, which are being solved in similar ways. If the same concepts are shown in different ways students are becoming unsuccessful. As a result, students are less likely to transfer what they have learned to real life situations even they fail to transfer nothing at all;

4. Lack of relevance: Students are learning irrelevant content and they do not know why they have learned. These contents have no meaning to students;

5. Inadequate emphasis: The basic emphasis on the educational curricula accepted to be inadequate for advanced studies. In addition, this content will not be

applicable to students who will not be working in the same field. In addition, traditional approach is deficient in helping students to develop scientific literacy.

Not only Gilbert but also other researchers expressed similar explanations about contextual approach and its necessity (Acar & Yaman, 2011; Edwards & Whitelegg, 2001; Millar, 1993; Özay Köse & Çam Tosun, 2011; Peşman, 2012; Pilot & Bulte, 2006b; Waltner, Wiesner, & Rachel, 2007; Wilkinson, 1999a).

Besides the hopes that the contextual approach can improve students' conceptual understanding, problem-solving skills, and motivation, research must supply evidence for such a claim. Therefore, several researchers have focused on analyzing the effect of the contextual approach on students' possible gains (Acar & Yaman, 2011; Çekiç Toroslu, 2011; Değermenci, 2009; Demircioglu et al., 2009; Ekinci, 2010; Kasanda et al., 2005; Özay Köse & Çam Tosun, 2011; Peşman, 2012; Tekbiyik, 2010; Tekbiyik & Akdeniz, 2010; Ünal, 2008; Yayla, 2010).

There are some empirical studies, which analyses the effects of context based instruction. Bennett and Lubben (2007) reviewed 24 experimental studies about science instruction with the contextual approach and concluded that all the studies shows that context based instruction seems to be beneficial in terms of students' attitude and motivation and comparable to traditional instructions in terms of understanding concepts.

After reviewing 10 studies Taasoobshirazi and Carr (2008) they have drawn attention to methodological problems, such as not using pre-tests, lack of control group, and lack of random assignment and for future research, they have suggested better designed experimental studies taking the methodological issues into account and context based instruction should be integrated group work with implementation is to conduct.

Çekiç Toroslu (2011) has listed context lased learning approach strategies and specifications of these strategies as follows:

- Context based learning approach gives importance to problem solving;
- Learning and teaching needs, which are coming in front at home, society and workplaces;
- Shows students' learning procedures and how to inspect and manage resulting in students become self-managing and inspecting learners;
- Learning is related and linked with different contexts in students' lives;
- Encourages students to form groups and teams to learn from and with themselves;
- Makes appropriate evaluations;
- Context based learning approach uses critical thinking;
- Systematical approaches are being used to solve a problem, to make a situation clear or during research;
- Student differences are taken into account;
- Learning becomes lifelong.

Context based learning approach and the contexts functions are defined in the groups (De Jong, 2006) Table 2.4.

Table 2.4 - Context based approaches and functions of contexts (De Jong, 2006)

Teaching approach	Order of presentation	Function of context
Traditional	Contexts follow concepts	Illustration Application
More modern	Contexts precede concepts	Orientation Motivation
Recent	Contexts precede concepts and (other) contexts follow them	All functions mentioned above

2.4. Comparison of Context Based Learning Approach and Traditional Approach

Context based learning approach mainly differs from traditional approach where content leads the teaching (Çekiç Toroslu, 2011). This well described by Whitelegg as Wilkinson (1999c) cited, context based approach, contrary to traditional approach, directs to a untraditional organization of the physics content where the context shapes the physics content. Different from the most of the traditional textbooks where the content traditionally ordered, physics concepts are being taught more than one time in different contexts. Similarly Parchmann et al. (2006) add that contexts are ignored in most of the traditional textbooks where content and homework are becoming important and these are not being linked with original questions.

As stated before there is no special education method used for context based approach (Kortland, 2005) but if compared to traditional approach, curricula based on context based learning approach emphasizes on more applications and research.

Contexts are the starting point of developing science applications and scientific thought in context based learning approach while traditional approach starts with scientific content than short information is given about respective applications (Bennett et al., 2003).

Jardine describes Application-Led physics course, a context based approach developed in Scotland, as a course changing the order of traditional physics teaching, and applications are used as a starting point (as cited in Wilkinson, 1999a).

Traditional approach aims students to gain knowledge regarding a content in the classroom on the contrary informal contexts which are extra school activities may increase students' interest (Uitto, Juuti, Lavonen, & Meisalo, 2006).

2.5. Students and Teachers in Context Based Learning Approach

According to Çekiç Toroslu (2011) teacher and student roles can be listed as follows:

- Students are actively get involved in lessons;
- Students control and manage the learning process;
- Students investigate, and evluate teachers;
- Students constructs the knowledge and relationships of knowledge themselves;
- Students gains the knowledge through formation of teams and groups;
- Teachers role is making the learning process easier as facilators.

2.6. Why to Use Contexts and Context Based Approach

Basically, using contexts makes learning interesting and more understandable. Researchers are mostly in favor of using context – based approach. Some of the important concerns about advantages of the context – based approach is listed as follows:

- According to Hart (1995) the contexts links the daily life events and complexity of physics applications and actively involves the students in learning (as cited in Wilkinson, 1999c).

- Hart and Boydell (1988), (as cited in Wilkinson, 1999a), connects the real life experiences of students with physics.

- Interest in physics can be increased with a curriculum where real world contexts are being proposed and associated with tasks, especially girls are favored (Rennie & Parker, 1996).

- According to Rennie & Parker (1993) real world facts becomes more accessible to students as physics where contexts are omitted physics becomes abstract and distant from experience of students, and task and task interrelations are provided by contexts, (as cited in Wilkinson, 1999a).

- According to Baesley (2009), problem solving, critical thinking and decision making abilities are improved with context based approach (as cited in Çekiç Toroslu, 2011).

- Contexts are not only interesting but also increases the freedom of students and teachers (Lye et al., 2001).

- Maslow states that, self-esteem of students may be promoted as well as students' social needs met, while the nature of the learning process becomes less didactic and more negotiated (as cited in Whitelegg & Parry, 1999).

- Increasing social awareness may be possible with use of contexts (Whitelegg & Parry, 1999), for example context of sustainability may enhance environmental awareness.

- Campbell et al. (1994a) stated that placing science into contexts besides motivating more students to study science encourages them to learn science in the rest of their lives while presenting them real view of science.

- Proper contexts excite and motivate the students (Stinner, 1994b).

- Real life contexts are reported to be increasing the motivation, confidence, enthusiasm, and enjoyment of students; they also find contexts were socially relevant. Besides girls find it more enjoyable and physics would be relevant for their careers (Murphy & Whitelegg, 2006).

- The general view and conception regarding the context based approach is that the real life contexts are increasing the interests of students besides Lavonen, Byman, Juuti, Meisalo and Uitto'nin (2005) showed that not only real life contexts but also fictive contexts are also increasing students' interests (Çekiç Toroslu, 2011).

2.7. When Context Based Approach is Vulnerable

There are so many researches show the effectiveness (Smith & Bitner, 1993) of context based approach in students' achievement, self-esteem, confidence, motivation, interest, excitement, social awareness, problem solving, critical thinking and decision making abilities, and active involvement (Campbell et al., 1994a; Çekiç Toroslu, 2011; Murphy & Whitelegg, 2006; Peşman, 2012; Stinner, 1994b; Whitelegg & Parry, 1999; Wilkinson, 1999a) but still traditional approach is mandated in syllabus and curriculum documents. Most of the researchers reported the effectiveness of context based approach but a few of them have reported disadvantages and limitations (Çekiç Toroslu, 2011).

- According to Dreyfus & Jungwirth (1980) topical content takes more attention rather than the logical structure of the problem if everyday context is chosen (as cited in Park & Lee, 2004).

- The number of the words in the problems using daily life contexts may become a disadvantage and may increase difficulties of problem solving (Rennie & Parker, 1996).

- Curriculum developers and teachers are not convinced of the effectiveness of context based approach (King & Ritchie, 2013).

- Teachers have lack of understanding of what context based approach represents (King, 2007).

- It is not fully understood how the respective students learn in a context based learning classroom (Bennett et al., 2003).
- When context based approach (Large Context Problem) is tried to be incorporated text book centered teaching problems are being faced (Stinner, 1994a).
- More time required for context based approach with respect to conventional textbook approach (Stinner, 2006).

Korsunsky (2002) pointed out using physics contexts in mathematics problems and the potential pedagogical difficulties as follows:

- the contexts involving external knowledge of physics especially contradicting the external physics knowledge;
- oversimplified thinking that the student might learn or incorrect physics in which there are contradicting ideas are totally confusing the external physics knowledge students;
- confusing contexts of physics concepts when students are in a contradiction with their external physics knowledge;
- the improper/inappropriate use of physics-related real-life situations as the context of the problems;
- physics contexts are used in problem settings are very popular in recently published textbooks;

- the poor use of physics contexts in mathematics education.

After the implementation of context based approach in Australia (The Physics Study for the) Lye et al. (2001) conducted a case study to describe what does it mean the context based approach to students and teachers and pointed out some concerns and limitations regarding context based approach. While Wilkinson (1999c) has also addressed some disadvantages of the Victorian Certificate of Education:

- teacher report that the use of contexts not increasing student understanding;
- teachers are rarely allowing students to decide the context;
- students are finding difficult to link content leaned in a context to other contexts;
- artificial contexts may not provide natural examples for the application of particular concepts;
- being limited by one context or within the range of the contexts that the study provides;
- tension between the context to be described and the overloaded content to be covered which also makes difficult to develop contexts;
- when two alternative contexts are existed the questions regarding contexts assumed to be having same difficulty this courses difficulties in preparing exam questions;

- context teaching and the assessment can be difficult especially several thousand people are being assessed;
- availability of textbooks which are poorly fit to teaching requirements;
- inconsistency between the textbook publishers/writers and the external examinations at year 12 in the treatment of contexts;
- implementation of the context based approach is limited with the lack of suitable and genuinely context based resources;
- the coverage of the context limits the understanding of the students.

2.8. How to Choose Contexts

Context based approach to learning and researches in the field shown that how valuable the context based learning is. The advantages and the disadvantages have been listed. It is obvious that, in order to achieve the advantages and the so mentioned effectiveness the choice of context is crucial. The basic points described by the researchers as follows (Çekiç Toroslu, 2011; De Jong, 2006; Murphy & Whitelegg, 2006; Peşman & Özdemir, 2012; Stinner, 2006; Whitelegg & Parry, 1999; Wilkinson, 1999c):

- teacher should allow students to decide contexts;
- syllabi and curricula should not limit teachers one context or within the range of the contexts;

- the coverage of the context should be well defined;
- student differences should be taken into account;
- context should be chosen to suit not only boys but also girls and the students from different cultures;
- students'' population, school resources, social environment, technology effects are also significant elements to be taken into account while choosing contexts;
- context should be familiar to students and well known;
- context should not diverge students' attention from the content;
- contexts should not be complex and confusing;
- interesting and motivation increasing contexts should be chosen;
- students should be familiar and can interact easily with the contexts;
- contexts shouldn't be sophisticated yet descriptive enough to cover the content.

2.9. Applications of Contexts Based Learning Approach

There are worldwide applications and projects using context based approach. Wide range of applications and researches are being made. Some of those applications are well known and widely applied, and shaping the curricula. In this part these applications of context based learning is summarized.

2.9.1. PLON - Physics Curriculum Development Project

Large number of physics teacher who have heard of major projects abroad requested urgent curriculum development and this initiated PLON in 1973 (Lijnse & Hooymayerst, 1988).

PLON Project aiming to prepare students not only to further education and future jobs they will do but also prepare as a citizen/consumer in a technologically developing democratic society (Kortland, 2005).

The PLON curricula is a context based approach which takes students' "lifeworld" as a starting point emphasizing technological artefacts and natural phenomena supplemented with an emphasis on socio-scientific issues and the nature of science (Kortland, 2005). General structure of a PLON unit is given in (Kortland, 2005).

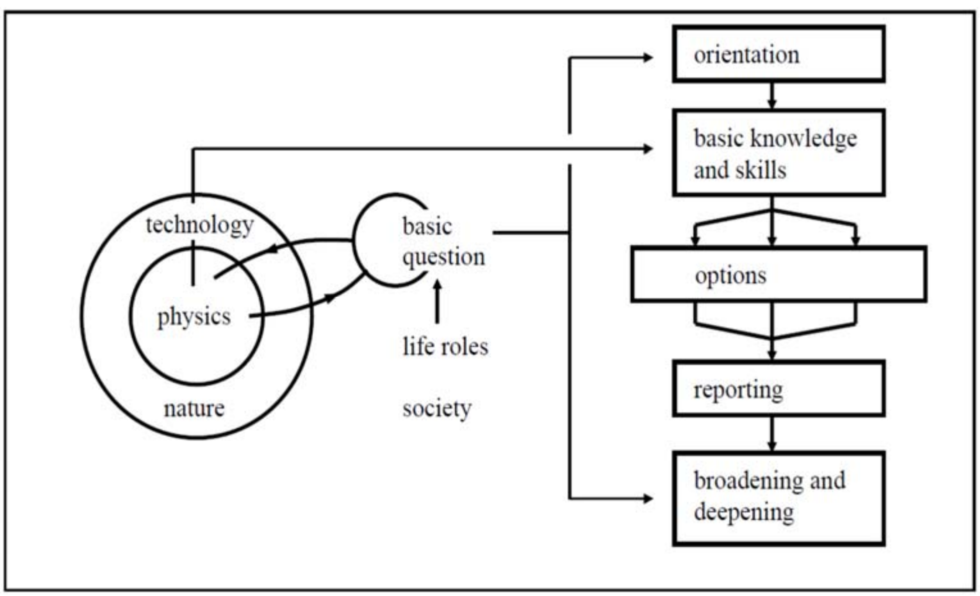


Figure 2.2 - General structure of a PLON unit (Kortland, 2005)

The philosophy of the physics curriculum summarized as (Lijnse & Hooymayerst, 1988):

- Recognizable, relevant for, and usable knowledge and skills of a great deal, which are usable in a students' personal and social everyday life, both now and in the future.

- image of physics as a science image should be given which is intellectually adequate and up to date;

- physics should be actively and reflectively taught as a human activity with a certain cultural, historical and philosophical, as well as ethical and social understanding;

- for the students who will continue studying physics in higher education basic concepts and skills should be included;

- teachers' interests, teaching styles and abilities; students' interests, abilities and plans for the future should be recognized;

- broad range of learning activities and active and varied learning climate, which keeps pupils actively involved, should be used.

Kortland (2005) classified STS and/or context based learning approaches and compared with PLON courses in terms of STS contents and course structure ().

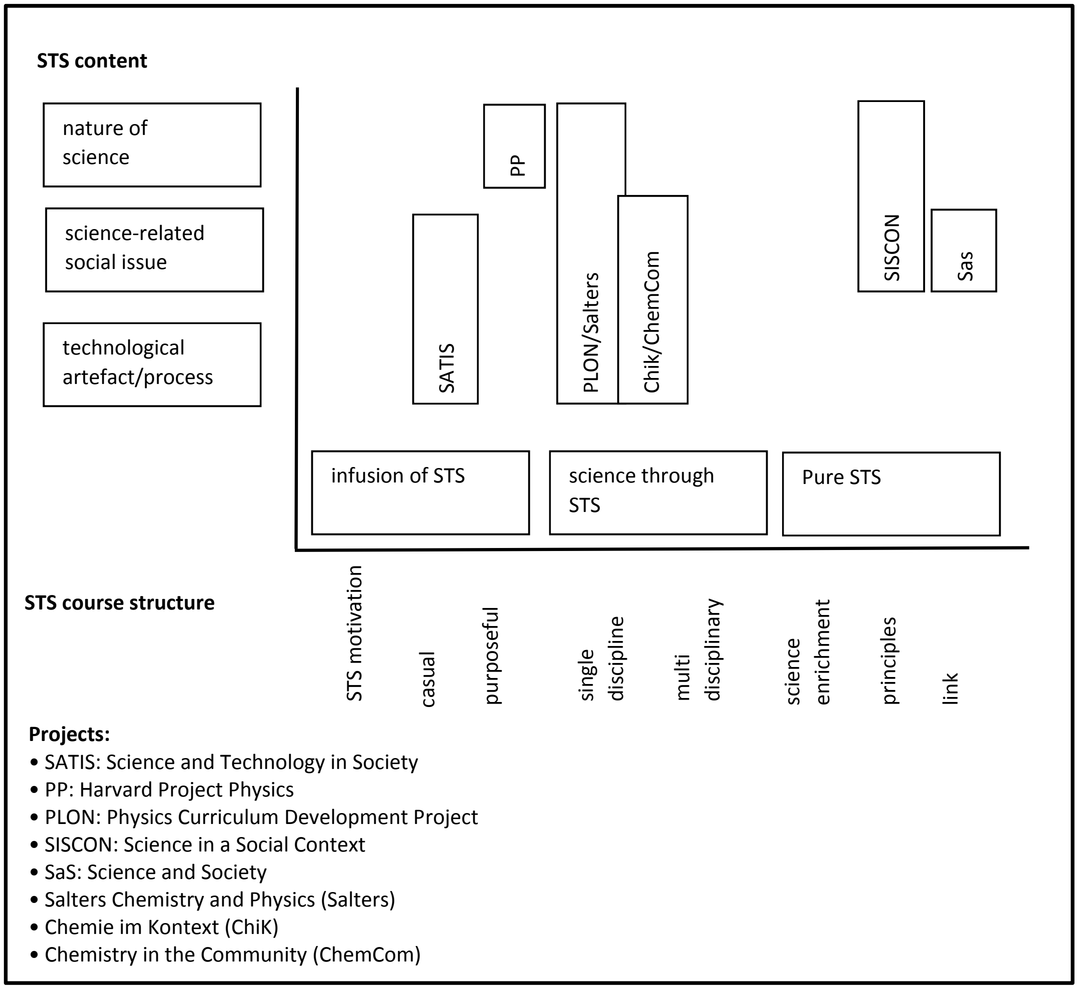


Figure 2.3 - A classification of context based and/or STS science courses (Kortland, 2005)

Science is being taught in daily life related contexts while placing more emphasis on relevancy of content for pupils (Lijnse, 1997). Consumer physics and pupil relevant contexts by means of social scientific issues are integrated in the physics curriculum itself while structure of physics and the structure of the contexts is balanced (Lijnse, et al., 1990). Physics contents involve in the local environment of the students and also the technological environment that surrounds them (Lijnse et al., 1990).

The curriculum is in a thematic structure and this is its main characteristic and consists of ten thematic units where each of them written around a central theme. An example of a context in a PLON unit of Light Sources is to decide which light source is economical to be used in house according to Eijkelhof and Kortland (as cited in Wilkinson, 1999a). The general format of a thematic teaching unit (Figure 2.4) involves the steps of orientation, basic knowledge and skills, options, reporting broadening and deepening as given in the (Lijnse et al., 1990).

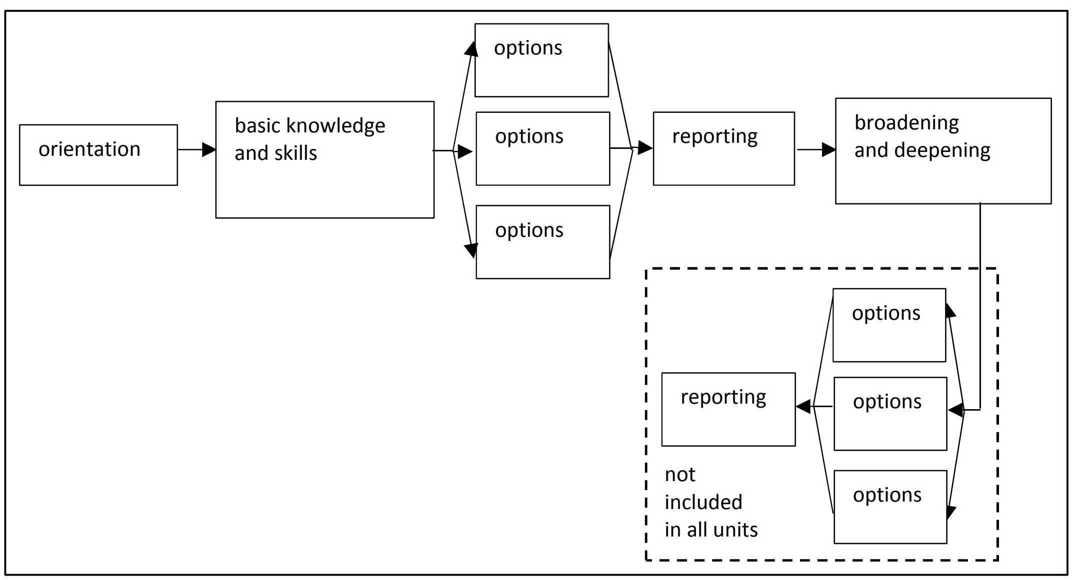


Figure 2.4 - General format of a thematic teaching unit (Lijnse et al., 1990)

This thematic structure gives flexibility into the curriculum and it relates the knowledge of physics to an everyday life context which are useful for (Lijnse et al., 1990):

- use in everyday life;
- presenting an authentic view of physics;
- triggering the various interests among students;
- preparing students for further education.

An example and emphases of PLON HAVO curriculum is given in Figure 2.5.

The PLON curriculum for HAVO (grades 10-11, average ability stream) consists of the ten units listed in the matrix below. In that matrix – based on an earlier description of this curriculum (Kortland, 1987) – is visible which of the five additional curriculum emphases are to some degree present in each of these units.

The core of the seven curriculum emphases could be summarized as follows:
- Everyday Coping (EC) – functioning, maintenance of technological artefacts, natural phenomena
- Structure of Science (SS) – intellectual enterprise: development of scientific knowledge
- Science, technology & decisions (STD) – STS: science/technology-related social issues
- Scientific Skill Development (SSD) – means of scientific inquiry
- Correct Explanations (CE) – ends of scientific inquiry
- Self as Explainer (SE) – process of explanation, cultural/historical context
- Solid Foundation (SF) – prerequisite for further study

Teaching units	**Curriculum Emphases**						
	EC	**SS**	**STD**	**SSD**	**CE**	**SE**	**SF**
Comparing				x			x
Weather changes	x				x		x
Music	x				x		x
Traffic	x			x	x		x
Electrical machines	x				x		x
Energy and quality			x		x		x
Matter			x	x	x	x	x
Light sources	x	x		x	x		x
Ionizing radiation			x		x		x
Electronics			x		x	x	x

Figure 2.5 - An example: the PLON HAVO curriculum (Kortland, 2005)

2.9.2. Large Context Problem Approach (LCP)

The large context problem (LCP) approach started in the 1980s (Ng & Nguyen, 2006) in Canada. Learning capabilities and student motivation are aimed to be increased in large context problems. LCP is an approach to physics learning, designed by Stinner (as cited in Reiner, 2006). In order to capture students' imagination one unifying central idea a contexts is required (Stinner, 2006). After finding that students' can be motivated by a context that unifies the central idea, the LCP approach was developed as a response to this discovery and LCP's were developed for each given major topic in physics, such as kinematics (Stinner, 2012).

Instructional concepts are presented in contexts. For example stories, as door openers, a historical situation gives rise to various interesting science problems to be considered and solved by students (Metz, Klassen, McMillan, Clough, & Olson, 2007).

Teachers in collaboration with students design contextual settings. What makes LCP so attractive is that the relevant questions and problems are generated naturally on the based on context. Teachers may feel as a researcher and students may feel as if they are getting involved in an on-going research program while designing contexts on this scale. In the figure it is described how a concept developed by teachers and students (Stinner, 1990). With respect to a conventional textbook approach, a contextual approach in teaching physics may be more time consuming where this may increase the understanding of the student. At the same time, it can enhance the quality of interaction between the student and the teacher during the teaching process (Stinner, 2003). The students' learning can occur in large context where the large context problem itself becomes a 'testing ground' (Stinner, 1990). Examples of LCP's developed by Stinner (2003) are listed below where students makes their choice among these large context problems which one attract them (Stinner, 1990):

- Physics and the Bionic Man;
- The Physics of Star Trek;
- Physics and the Dam Busters;
- Hitchhiking on an Asteroid;
- Calculating the Age of the Earth and the Sun;
- Pursuing the Ubiquitous Pendulum;
- Sudden Impact: The Physics of Asteroid/Earth Collisions;
- The Story of Force: From Aristotle to Einstein.

In the teaching of physics, the centrality was demanded by the textbooks now the large context problem, takes on a central position, surrounded and diversely connected to the other contexts. The problems suggested by large context problem enlarge understanding of students' basic principles and laws of and an opportunity to generalize beyond the obvious problems the large context generates. As an example, 'Physics and the Bionic Man' context may help students to investigate the current research in relation to the physics of bionic parts. 'Physics on the Moon' may lead students to understanding of the physics of moon-architecture and the adaptation to low-gravity environment (Stinner, 1990).

According to Stinner, students find LCP's significantly more interesting and motivating with respect to traditional lectures, cookbook style labs, end-of chapter problems, or take-home assignments (as cited in Metz et al., 2007).

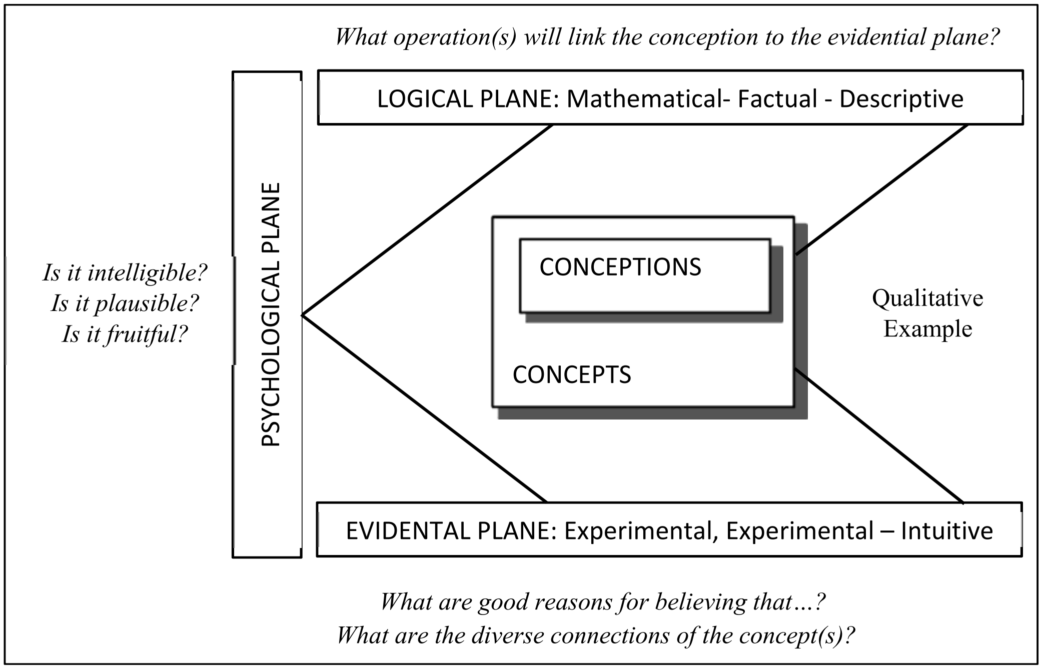


Figure 2.6 – A model of context development in science (Stinner, 1995)

Winchester presented Master of Teaching Program (MT Program) where LCPs used with different point of views of O'Neill, Stinner, McMaster and University of Calgary (as cited in Çekiç Toroslu, 2011).

2.9.3. The Applications-Led Approach:

In the late 1980s a new approach to teaching physics was developed where physics is introduced through its impact on everyday life in Scotland (UK) (Wilkinson, 1999a).

In each lesson, students are invited to explain the familiar situation but which is an everyday application of the science concept. After study of science concepts, the conceptual understanding that students have gained are applied by referring back to the initial example to be explain. Highly interactive materials are used in order to increase motivation. A whole class or small group discussion are important with or without teacher involvement. Activities like role-play exercises, story-telling exercises, experimental design, creative writing, practical investigations and model making is used to encourage students' active engagement (Lubben, Campbell, & Dlamini, 1996). In most of the approaches applications are sometimes added towards the end. However, it is equally possible to reverse this (Figure 2.7), starting with applications and developing understandings of students (Lubben et al., 1996).

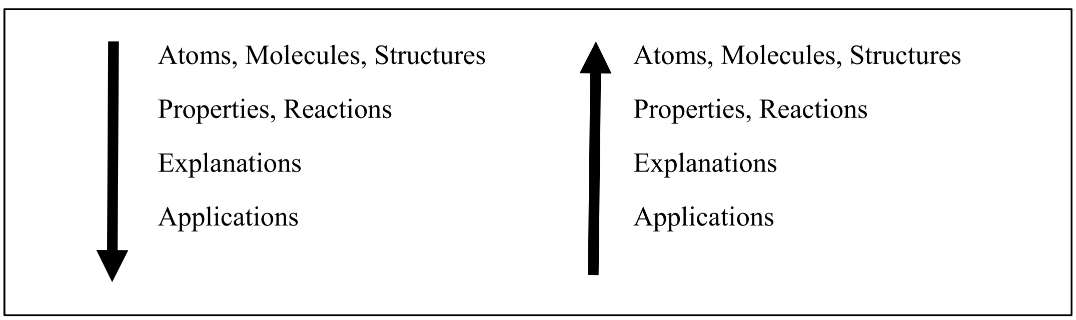


Figure 2.7 - A change of direction (Lubben et al., 1996)

Reid (2000) cites a saying of Fensham to describe the application led approach as “a view of science from the position of society rather than one from within the science itself” where two criteria for selection of content is being referred: “the content should have social meaning and usefulness for the majority of learners and should assist learners to share in the wonder and excitement that has made the development of science such a great human and cultural achievement" (Reid, 2000).

Reid (2000) also mentions about Williams ideas where he describes the application led approach and the function of science education is to lead to a deep appreciation of the nature of man in his surroundings, physical and biological.

Five main areas targeted to increase students' attitude in chemistry education with application led approached utilized (Reid, 1980, 2000):

- Historical implications;
- Domestic (our daily lives) implications;
- Industrial implications;
- Economic implications;
- Socio-moral implications.

'Applications-led' it is not the same as teaching in context where the actual topics to be studied are determined by the applications. Here it is aimed to select applications, which are real and relevant to the lifestyles of the learners, and this will enable them to live autonomous lives in the future. While students make sense of the world around as they know it (Mbajiorgu & Reid, 2006; Reid, 2000).

The example of physics teaching of application led approach traditional topics such as mechanics, waves, electricity and magnetism have been replaced by the topic "Health physics" where the uses of ultrasonic is introduced to students (Wilkinson, 1999a).

Carter and Jardine (1989) drew attention to those using modem technologies, such as microcomputers interfaced to physics equipment, enabled basic laws of physics to be demonstrated quickly and effectively. In order to show how the physics is relevant to society and how to develop practical problem solving and technological skills? this Scottish course is concerned with physics in action where pure and applied physics are integrated (as cited in Wilkinson, 1999a).

2.9.4. Event Centered Learning

In 1991, two institutions in Brazil and The UK started a joint project to improve ordinary research interests in the field of secondary school science and teacher education and also in postgraduate studies, including the UK and Brazil. Event Centered Learning was developed in order to use the teaching of issues available in Science, Technology and Society (STS) (Watts et al., 1997).

Actual situations are simulated in the event centered approach where students are making usually different decisions for a single event. Community events are approximated and generalized in the event centered instructional design by supplying a single event then requiring the students to analyze the event from different angles (Browning & White, 1986).

A set of teaching strategies for each life-event are being used in event centered instructional design (Browning & White, 1986) where events are the center of the learning experience and each of the major elements of science needs to be drawn from that (Watts et al., 1997):

- Decision making;
- Structured discussion;
- Verbal rehearsal;
- Workbook tasks;
- Role playing;
- Homework;
- Expansion games.

Event centered learning, according to Watts, Alsop, Zylbersztajn, & Silva,; Cruz & Zylbersztajn, is an example of use of role playing and drama in education. (Ødegaard, 2003).

Except books, articles and TV, the followings such as newspaper reports and well-known accounts are utilized to search for the real events or circumstances with the help of active classroom tasks, for instance TV shows exhibited while using role-play and drama. There two modules developed in two countries on nuclear technology issues one of which is

1897 radioactive accident in Goiania, Brazil and the other module is power plant construction policies in Brazil (Watts et al., 1997).

A comprehensive introduction of the Goiania accident in event centered learning approach meant investigation of different aspects of radiation and its effects where social and technological issues are included. Event centered learning approach caused significant changes in educational dynamics because it demanded an interaction between school subjects (de Souza Cruz & Zylbersztajn, 2002).

Some of the essential properties of event centered learning approach are (Watts et al., 1997):

- Events are chosen to be a base to the teaching materials;
- Events should be “salient and evocative”;
- Events should be compact in relation to its science content while they are attractive to catch students’ interest, and stimulating discussion and debate;
- The events should combine combinations of related scientific matter, issues regarding social import and notable circumstances;
- Except books, articles and TV, the followings such as newspaper reports and well-known accounts can be used as source of real events or situations;
- The tasks provided for learning reconstructed to simulate real events;

- Sometimes a slight dramatization may deepen appeal of events without losing the essence.

In order to understand new experiences events are used to organize learners' knowledge in explanatory frameworks where constructive and non-threatening atmosphere of discussion and debate facilitate learners' "unorthodox ideas" to be explored. As a result, a whole discussion of scientific issues that are available within a compelling context is being made in classroom activities.

In case of Brazil, event centered learning approach learner takes the responsibility of learning while integrating the technological and social issues with the science concepts (Watts et al., 1997).

Two modules developed in Brazil for event centered learning approach The Goiania Accident and the construction of ANGRA III (Watts et al., 1997).

Module 1, The Goiania accident can be summarized as a contamination of Cesium 137 in an abandoned health clinic. After a while people in the neighborhood started to show symptoms of illness such as; skin rashes, diarrhea, vomiting. After a while almost 112,000 people were considered to be tested and five people have died. As a task, the students asked prepare and present a television programme for common people. The program developed the perspectives in terms of science, technology, and society. Specifically, these concepts are pickled (Watts et al., 1997):

- atomic structure (electrons, nucleus, charge and mass);

- radiation from matter (e-m radiation, nuclear particles);
- the effects of nuclear emission in matter (ionization of atoms, molecular dissociation, effects of nuclei);
- background radiation (cosmic radiation, u-v rays, natural and artificial radioactive materials);
- units of measurement (Curie, Becquerel, Roentgen, Rad, Sievert), biological damage.

Module 2: the construction of ANGRA III (Watts et al., 1997)

A group of undergraduate physics aimed to develop a role play, accordingly the Congress commission imitated while they are deciding the future of the ANGRA III power plant. The students made use of real life events to discuss the nuclear policies of Brazil and nuclear reactors through considering the physics and technology.

As a summary event, centered learning approach puts the events to center while events gathered from TV and articles but also newspaper reports, books and well-known accounts. These happenings are simulated by making a TV programme about a nuclear accident, investigating the risks, cost, risks/benefits of nuclear plant (Ødegaard, 2003). This integrates the technology and society issues science concepts (Wilkinson, 1999a).

2.9.5. Supported Learning in Physics Project - SLIPP:

The Supported Learning in Physics Project (SLIPP) initiated by Open University with the collaboration of the Institute of Physics (IOP), the Institution of Electrical Engineers (IEE) and the DfEE where Ford of Britain, Esso UK, Nuclear Electric, Essex TEC, the IEE, IOP and DfEE (Wilkinson, 1999a) were the main sponsors. SLIPP was developed as a response to these issues for students through the UK Open University in 1994-5 (Whitelegg, 1996).

There was descending number of students studying physics and there was some concerns of industry about the graduates (Whitelegg, 1996). The intention of SLIPP was, according to Whitelegg “to place physics learning in real life contexts so students could learn that physics wasn't about abstract concepts that had no place in their out-of-school lives, but that an understanding of physics led to an understanding of the way things work in real life” (as cited in Wilkinson, 1999a). Students can “make connections to their lives out of school and college” easily for the subjects like “biology, psychology, economics, law and environmental science” and they “do not have the same problems” that physics have as the “students’ leisure and general interests and career plans” (Whitelegg, 1996).

The SLIPP is a project where real life contexts are used for motivating the respective students to learn by increasing their interest in physics. The SLIP Project curriculum provide a self-study programme and consists of eight books to be used with the help of their teachers. For example, in the working title of “Physics for Sport”, “the concept of equilibrium of forces is taught” where rock climbers and how they use their hand and some tools to climb a wall is used as the context. While developing SLIPP content the real life contexts are chosen before the content being planned to be taught (Edwards, 2000; Edwards & Whitelegg, 2001). In the following Figure 2.5 some other examples are given (Whitelegg, 1996). Therefore, the content is not ordered as in most of the traditional textbooks, as a result the same content can be repeated in more than one context while students' learning can be reinforced and provides more links among different domains. On the other hand, one unit may not be covered in depth in or the complexity may differ. As a result, full coverage or complexity can be found on another unit (Edwards, 2000; Edwards & Whitelegg, 2001). As the contexts were ordering the physics content, only the content which "is needed to understand the context were covered". This was the aim of Victorian Certificate of Education, VCE, but SLIPP obeyed this. Unlike the application led approach the "context was integral to the learning and not separable from it" (Murphy & Whitelegg, 2006).

Whitelegg reported that the participating students liked the context approach and felt that the material was well presented and user friendly (as cited in Wilkinson, 1999a). Even teachers were feeling to be able to work with the new approach. Subjects are becoming more relevant and interesting for the students while real life contexts are in use (Wilkinson, 1999a).

Table 2.5 - Contexts and physics content areas covered by the SLIPP units (Whitelegg, 1996)

Contexts	Working titles	Main physics content areas
Listening to a (classical, jazz or rock) concert in a modern concert hall	Physics, Jazz and Pop	oscillations, SHM, waves, ideal gases, communications
Safe transportation of people and goods	Physics on the Move	statics, dynamics, energy, kinematics, Newton's laws, forces
Rock climbing, springboard diving and scuba diving	Physics for Sport	statics, dynamics, forces, vectors, oscillations, SHM, ideal gases, energy, structure and properties of solids, bulk properties
Making a meal	Physics of Food	thermal physics, electromagnetism, geometrical optics, energy, electricity, structure and properties of solids
Space exploration	Physics of Space	quantum phenomena, gravitational fields, light, nuclear processes, geometrical optics, radioactivity
Development and use of the mobile phone	Physics of Fields	Electromagnetism, electric and gravitational fields, electricity, circular motion
Life on Earth for a sustainable future	Physics in the Environment	quantum phenomena, thermal physics, electricity, $E = mc^2$, fission and fusion
How fast is the river? How large a pipe do I need?	Physics of Flow	fluid flow, electricity, electromagnetism

Whitelegg and Edwards found that (as cited in Murphy & Whitelegg, 2006):

- Girls found the SLIPP recognizable and valuable while reporting that physics become more interesting comprehensible. In this case, particularly, the teacher reinforced the approach;
- Boys were unwilling to engage with the approach they had concerns about passing their exams where they thought these would not help them to pass their exams.

In traditional instruction the students are giving up before the learning becomes meaningful; on the contrary the SLIPP units introducing physics content through real-life situations before the theory which is becoming more commonly preferred in classrooms (Whitelegg, 1996).

SLIPP aims increasing interests of students in physics learning in order to do so the teaching stars with the real life contexts (Whitelegg, 1996). It was reported by the students of University of Durham, learning process becoming more joyful with respect to students who has less freedom as learning is being controlled by them (Whitelegg, 1996). SLIPP not only offers freedom to students but teachers are also more flexible with the Teachers' Guide helping them how to observe self-determination of students and their progress (Whitelegg, 1996).

The SLIPP units, an example given in Table 2.6, first the theme is decided for each unit. To have a wide appeal particularly across the genders, each context was cautiously chosen where contexts may cover some more optional content. As a result the units becomes very different to standard texts interesting as well as in an unusual arrangement (Edwards, 2000).

Table 2.6 - The content of Physics Phones Home (Edwards, 2000)

Section title	**Content**
Introduction	Introduction to the mobile phone - the theme of the unit.
Cellular telephone systems	What goes on behind the button presses when you make a call? How phones and base stations interact. Transmitting and receiving signals. Mixing voices with radio waves and how calls are improved by digitization.
Radio wave transmission	The mobile phone as a transceiver, producing and receiving signals. Some of the electrical ideas that are behind the design and operation of mobile phones.
Radio wave reception	How the mobile phone selects the right signal to listen to when there are so many radio signals enveloping us.
Long-distance communication	The transmitter in a mobile phone is relatively weak so how do we manage to speak to someone on the other side of the world. The role of satellites.
Looking back to the future	A forward-looking review of telecommunications from the first microphone through mobile phone networks today.
Some principles of cell phones	A closer look at cell organization, why cells are small, how we stop signals interfering between one cell and another, and a short project on why communication satellites need to be in particular orbits.
Conclusion	A brief summary of the unit.

The context of energy and the environment can be an example. Parry and Skelding were writes of the unit “Physics in the Environment” where Malcolm Parry was one of the authors, to discuss energy uses fossil fuel consumption rates and resources and the unsustainability as a starting point. This places the topic immediately in a context that involves people, values, and opinion. The topics of thermodynamics, equilibrium, blackbody radiation, aerodynamics, and calorimetry are also discussed while scientific background provided. Also possibility of an environmental disaster with political and technological policy are discussed (Whitelegg & Parry, 1999).

2.9.6. The Victorian Certificate of Education (VCE):

The Victorian Certificate of Education (VCE) was introduced in 1992. It is a two-year program and replacement of the one-year Higher School Certificate (HSC), which has applied between the years 1985-1991. In order to assess performance of year 11 and 12 students a wide range of subjects and assessment strategies were introduced for mathematics subjects and Victorian Certificate of Education science for the good of working independently on extended problems and at the same time for oral communication and research tasks. These changes are also applied to other states in Australia (Brown & Penney, 2012; Cox, Leder, & Forgasz, 2004). Blackburn stated the change was oriented from the needs and wishes of all students by using a variety of teaching and assessment strategies (Cox, 1997).

As the Victorian Certificate of Education has initiated, The VCE Physics course also began in the early 1990s. Adoption of a context-based approach was the most important change in the VCE Physics course from the previous one (Wilkinson, 1999b).

After the first implication of the VCE Physical Education in 1992, it is now the fifth iteration of the study design since from the beginning of introduction of the course study. There were change in social, economic, cultural, and educational where the VCE program was being developed. Victorian Curriculum and Assessment Authority (VCAA) describes the study as facilitating "the integration of theoretical knowledge with practical application through participation in physical activities" (Wilkinson, 1999b). There are four units, where one of them summarized in the Table 2.7, in the senior curriculum in Victoria. In order to support learning practical activities are offered for better study design. These are listed as 'Advice to Teacher' as follows (Brown & Penney, 2012) where 10 to 15 hours of class time dedicated to practical works:

- use heart rate monitors, or take a pulse manually, to collect heart rate data to analyze in relation to the response of the cardiovascular system at rest and during exercise;
- participate in a variety of activities to record and report on the acute effects of exercise on the cardiovascular and respiratory systems;
- play a game of 'Simon Says' to investigate factors affecting balance and stability;

- wear a pedometer for a week to monitor physical activity levels; keep a diary or log of the steps take);
- use a valid observational instrument, for example (System for Observing Fitness Instruction Time) SOFIT, to assess the amount of time students engage in moderate to vigorous physical activity during a physical education lesson;
- visit a tertiary institution to experience use of high technology fitness-testing equipment to analyze fitness components;
- perform a battery of fitness tests testing a range of health and skill-related fitness components.

Table 2.7 - An example of Arnoldian dimensions of movement and the VCE Physics Education: anticipated and potential expression

Study design assessment task	**Current or anticipated expression**	**Potential or 'alternative' expression**
Education 'about' movement		
Unit 3 Outcome 1 – Analyze individual and population levels of sedentary behavior and participation in physical activity, and evaluate initiatives and strategies that promote adherence to the National Physical Activity Guidelines (Brown & Penney, 2012).	e.g. case studies, outlining information about participants' age, gender, types of activities they spend most of their time doing (e.g. work), physical activities they participated in, etc. Students respond to a series of questions that relate to the case studies, such as measures of physical activity, whether they are meeting (National Physical Activity Guidelines) NPAG's, strategies that could be implemented to increase (Physical Activity) PA, a social ecological model critique of existing strategies, etc. These questions are all either short or long answer (Brown & Penney, 2012).	This dimension is focused on cognitive knowledge. A senior physical education assessment task in this Arnoldian domain must be balanced between socio-cultural (historical, philosophical, pedagogical) and biophysical foundational (anatomy, exercise physiology, biomechanics) knowledge. To achieve breadth via such 'ways of knowing', appropriate tasks should be formative and frequent. For example, in each of the VCEPE units there should be an assessment (work) requirement where multiple components are given: 1. Introductory activities (a) What do you know about the unit? (b) Historical/philosophical issues (c) Internet and media analysis 2. Responses to case studies (a) Analysis, evaluation, response 3. Recall test (Brown & Penney, 2012).

After interviewing 40 teachers regarding their perceptions on the Victorian Certificate of Education, Brew, Rowley, and Leder, found that a number of teachers were finding difficulties while some other teachers were saying that they implementing the curricula but actually not where they also claim about heavy workloads actually the main reason was lack of training and the burden on content coverage. Just to overcome these issues Martin advised that there is need for greater professional development on course content and assessment (as cited in Handal & Herrington, 2003).

According to (Whitelegg and Parry (1999); Wilkinson (1999c)) the number of Year 12 students has increased by %25 in 1992 where previously O'Keefe reported that before 1988, the students attending Year 12 increased, while the students attending physics classes were in decrease (as cited in Çekiç Toroslu, 2011).

VCE physics introduced a new approach to teaching in an attempt to reflecting sufficient technological consequence of physics as well as showing how physics is important to students' daily experience (Christina Hart, 2002). The aim of using this approach was to assist students to make stronger connections between physics and its daily applications (C Hart & Boydell, 1988).

According to the VCE program an example list of contexts are as follows (Beasley; Cooper, Yeo, & Zadnik, 2003; Çekiç Toroslu, 2011; Lye et al., 2001; Vignouli, Hart, & Fry, 2002):

- Drugs, Medicine and People;

- The Air We Breathe;
- Fertilizers and Pesticides;
- Choosing the Right Material;
- Forensic Chemistry;
- The Health of Our River;
- The Manufacture and Analysis of Beer;
- Wine & Spirits;
- The Sugar Cane Industry;
- Marine Chemistry;
- Metals and Mining;
- The Air We Breathe;
- On you own two feet;
- Wheels;
- From Aristotle to Newton and beyond;
- Transport and safety;

- Sport and dance;
- Seeing with the eyes;
- Extending visual capacities;
- Photography;
- Music making and sound reproduction;
- Speaking, hearing and listening;
- Environmental radiation;
- Medicine applications;
- Nuclear power.

2.9.7. Salters' Science Course:

In 1980s the context-based approaches towards science teaching initiated (Bennett & Lubben, 2007). Around these years, in 1983, in order to make more science attractive to students in school, there was a meeting of teachers and science educators at the University of York and Science Education Group developed detailed science, chemistry, and physics courses (Campbell et al., 1994b; Millar, 1993; Parker, Swinbank, & Taylor, 2000; Swinbank, 1997):

- Science focus: Covers all areas of science for ages 11- 14;

- Science: The Sa1ters' approach'-Covers all areas of science for ages 14-16;
- Chemistry: The Salters' Approach-Provides a chemistry program for ages 13- 16;
- Salters' advanced chemistry: A chemistry program to university entry level, for ages 16-19;
- Salters' Horners Advanced Physics: A physics program to university entry level, for ages 16-19.

The contexts are selected to study the ideas and concepts where they make contributions to the lives of students and the others across the world; help students gain better comprehension of the natural environment. This means the courses start with the perspectives of the students' lives where they are students' own experiences or experienced via the media (Bennett & Lubben, 2007; Campbell et al., 1994b).

Salters Science which fits the National Curriculum requirements of England and Wales for 14- to 16-year-old students is a two-year examination course. A broad use of context emphasizing an approach based on teaching scientific principles (Mayoh & Knutton, 1997).

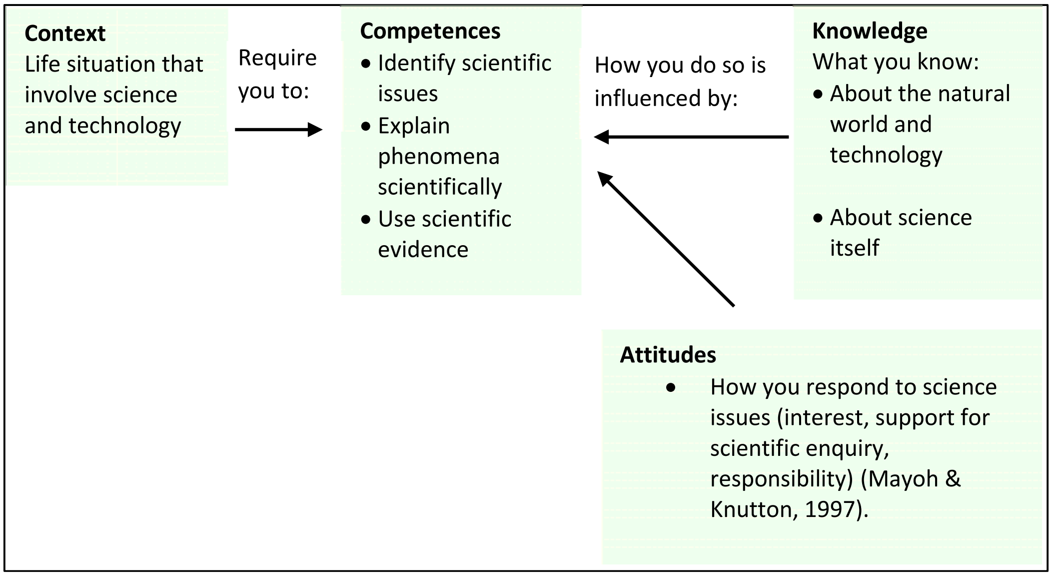


Figure 2.8 - According to OECD Framework for PISA 2006 science assessment (as cited in Ratcliffe & Millar, 2009)

When the science that is being taught in schools needed to be more interesting and to be more relevant to students' daily lives, and to engage them actively in science courses context-based approach, often termed 'active learning' approach came into sight where the 'Salters approach' is one of the examples. According to Campbell et al. the developers of the Salters Approach decided not to use single specific framework through considering the pedagogic or cognitive theory. There are number of different theoretical ideas and perspectives in order to select curriculum content, to understand the learning mechanisms of young people, and to point out the ways of improving and supporting education. Contexts are used in story lines (Table 2.8) with the basic science ideas as contents to be taught (Bennett & Holman, 2003; Bennett & Lubben, 2007).

Table 2.8 - Main storylines and chemical ideas in the first five units of the course (Bennett & Lubben, 2007)

Storyline	Chemical ideas used
The Elements of Life is a study of the elements in the human body, the solar system and the universe	Amount of substance Atomic structure Atomic spectroscopy Periodic Table: periodicity, Group 2 Chemical bonding Shapes of molecules
Developing Fuels is a study of fuels and the contribution that chemists make to the development of better fuels.	Reacting masses and molar volumes Thermochemistry Homologous series Alkanes Structural isomerism Catalysis Entropy (qualitative)
From Minerals to Elements is a study of the extraction and uses of two elements, bromine and copper.	Ions in solution Reacting masses and molar concentrations Electronic configuration (s, p and d orbitals) Types of reactions (redox, precipitation, acid-base) Molecular and giant (network) covalent structures
The Atmosphere is a study of two important chemical processes, the depletion of ozone in the upper atmosphere and the greenhouse effect in the lower atmosphere.	Interaction of matter and radiation Rates of reaction (qualitative) Halogenoalkanes Reaction mechanisms: nucleophilic substitution, radical reactions Chemical equilibrium
The Polymer Revolution tells the story of the development of addition polymers, many of which were the result of 'accidental' discoveries.	Addition polymers Alkenes Reaction mechanisms: electrophilic addition Alcohols Geometric isomerism Intermolecular forces Properties of polymers in relation to structure

During course hours some context are covered through discussions. In Like other context based approaches the Salters Approach also involves in not only discussions and decision-making exercises, but also presentations and simulations which are reported to have important effect in cognitive and affective domains of students (Bennett & Holman, 2003). Summary of the physics based units in the Salters' GCSE Science course is given in

Table 2.10 (Millar, 1993).

Table 2.9

Activity	Outline	Key Points
Teacher student discussion 1	Students are shown some radiographs. The ionizing effect of X-rays is discussed.	There are hazards associated with the use of X-rays. X-rays cause ionization of particles, including atoms in body cells.
Text related activity	Students read three brief case studies of patients and use their knowledge of the hazards associated with X-rays to answer questions relating to each of the case histories.	Safety precautions are taken when X-rays are used. These often involve the use of lead to absorb the X-rays.
Group discussion	Students discuss their ideas about the meaning of the word 'radiation'	
Oral reporting/teacher-student discussion 2	Students report back on the outcomes of their discussion. The meaning of the word 'radiation' is clarified, and the term 'ionizing radiation' is introduced.	Radiation means the spreading out of waves or rays from a center. X-rays are one form of radiation. X-rays are an ionizing radiation. When an object absorbs radiation, it does not become a source of the radiation it has absorbed.
Homework suggestion	Students could summarize the results of the discussions on radiation.	

an example of a teacher-student discussion about X-rays and its harmful effects are given where students work in small groups and they can clarify what radiation means (Campbell et al., 1994b).

Like other context based approaches the Salters Approach also involves in not only discussions and decision-making exercises, but also presentations and simulations which are reported to have important effect in cognitive and affective domains of students (Bennett & Holman, 2003). Summary of the physics based units in the Salters' GCSE Science course is given in

Table 2.10 (Millar, 1993).

Table 2.9 - Outline of a lesson in the "Seeing inside the Body" unit (Campbell et al., 1994b).

Activity	Outline	Key Points
Teacher student discussion 1	Students are shown some radiographs. The ionizing effect of X-rays is discussed.	There are hazards associated with the use of X-rays. X-rays cause ionization of particles, including atoms in body cells.
Text related activity	Students read three brief case studies of patients and use their knowledge of the hazards associated with X-rays to answer questions relating to each of the case histories.	Safety precautions are taken when X-rays are used. These often involve the use of lead to absorb the X-rays.
Group discussion	Students discuss their ideas about the meaning of the word 'radiation'	
Oral reporting/teacher-student discussion 2	Students report back on the outcomes of their discussion. The meaning of the word 'radiation' is clarified, and the term 'ionizing radiation' is introduced.	Radiation means the spreading out of waves or rays from a center. X-rays are one form of radiation. X-rays are an ionizing radiation. When an object absorbs radiation, it does not become a source of the radiation it has absorbed.
Homework suggestion	Students could summarize the results of the discussions on radiation.	

2.9.8. Salters Horners Advanced Physics (SHAP):

Between years, 1990 and 1995 the number of A-level physics students decreased from 45,000 to 35,000 where this situation lead physics teachers to talk over their work. Most of the time potential students who can enjoy physics are choosing other subjects, after taking the physics coursed they are dropping, or who can manage to continue to the end then fail or pass with a low grade. Besides the students who take physics courses in the future they turn from physics related disciplines in higher education or in career options. Not only teachers but also academicians and industry share the same concerns. It is in this environment with the inspiration of The Salters' Advanced Chemistry Project, the Salters' Advanced Physics project was initiated in 1996. The Salters' Advanced Physics provide students have opportunity of incorporate communication skills, application of number and information technology, and the personal skills of 'improving own learning' and 'working with others' with its new-style, and changes to education (Swinbank, 1997).

Table 2.10 - Physics-based units in the Salters' GCSE Science course (Millar, 1993).

Unit title	Physics topics covered	Context
Energy Matters	energy; energy transfer; measuring energy transferred electrically; energy dissipation .	domestic fuel use; domestic energy transfers.
Moving On	Newton's first and second laws of motion; force and pressure; collisions.	cycling; traffic safety measures.
The Atmosphere	Students discuss their ideas about the meaning of the word 'radiation'.	weather and forecasting.
Communicating Information	Students report back on the outcomes of their discussion. The meaning of the word 'radiation' is clarified, and the term 'ionizing radiation' is introduced.	communication using EM waves and optical methods.
Electricity in the Home	Ohm's law; simple parallel and series circuits; electrical power; electric cells.	wiring a house; choosing batteries; choosing fuses and cable ratings; electrical safety.
Sound Reproduction	sound as waves; digital and analogue recording; resonance; electromagnetism and EM induction.	hi-fi systems; how the main sound reproduction devices work.
Seeing inside the Body	EM radiation; ultrasound; radioactivity; structure of atom.	medical uses of EM radiations, radioactive substances and ultrasound.
Earth in Space	solar system; Newton's laws; gravitational field; projectile motion; circular motion.	space travel; astronomical research.
Energy Today and Tomorrow	patterns of fuel use; energy resources; electricity generation; nuclear fission and fusion; EM induction (revised) and transformers.	national and global energy use; electricity supply.
Sports Science	work; kinetic and potential energy; levers; stability.	exercise; high jump and pole vault; operation of muscles to produce movement.

According to Bainbridge, the teachers who are using are using Salters' Advanced Chemistry stimulated the demand of physics teachers for Salters' Advanced Physics (as cited in Swinbank, 1997).

According to Parker et al. (2000) Salters Horners Advanced Physics students enjoyed the activities of testing structures on an earthquake table (simple harmonic motion and resonance), predicting the motion of a Lego bungee jumper (using graphs together with an understanding of energy conservation), exploring signal processing, crashing model trains (momentum) like eating (Parker et al., 2000).

There are some modules like ‘Transport on Track’ to teach force, momentum, electromagnetic forces and ‘Build or Bust’ to teach “simple harmonic motion” (Overton, 2007), forces “vibrations, resonance and damping in” (Overton, 2007), Salters Horners Advanced Physics where real life contexts are used (Overton, 2007). Table 2.11 summarizes some units, chapters, real life contexts used and main physics content areas.

The main aims of the Salters Honors Advanced Physics course was to help student to be occupied with science, grasp the key ideas, and also to acquire transferable skills in communication, written and oral presentation and working with others. These goals are achieved with the help of broad variety of activities field work, roleplaying, discussion and creative writing in addition to conventional laboratory (Swinbank, 1997).

Another important activity of the Salters Honors Advanced Physics course is visits. For example a group visit to National Power Engineering in Swindon in order to gain experience of scanning electron microscopy, x-ray diffraction and NDT methods, in a metallurgical context. There are also some small scale visits like a local optical lab, a manufacturer of medical electrodes, and a local engineering company where these visits all have motivated students while giving them more ideas about career options in physics and engineering (Parker et al., 2000).

Table 2.11 - SHAP course overview of four chapters (Goff, 2002; MacDonald, 2012)

Chapter/Outline	Main physics content areas
Unit PSA1: Physics at work, rest and play	
The sound of music Musical instruments and CD players introduce sound waves, wave phenomena, and properties of light.	• Travelling and standing waves. • Reflection and refraction. • Photons and atomic energy levels.
Technology in space Spacecraft power supplies are the context for DC circuit work and the photoelectric effect. Remote sensing leads to further work on waves.	• DC circuits: resistance, current, EMF, power. • Temperature and resistance. • Energy and temperature change.
Higher, faster, stronger A variety of sporting contexts introduce and develop work on kinematics, Newtonian mechanics, force and energy.	• Graphs, equations of motion and vectors. • Projectiles. • Force, mass and acceleration. • Kinetic and potential energy.
Unit PSA2: Physics for life	
Good enough to eat Issues in the food industry lead to a study of properties of solids and liquids	• Viscosity and fluid flow. • Mechanical properties of materials. • Refraction and polarization.
Digging up the past Archaeological surveying involves further work on electrical properties. Close examination of artefacts entails further work on electromagnetic radiation and waves.	• DC electric circuits; resistivity. • Diffraction and superposition. • Photoelectric effect.
Spare part surgery Further work on solids involves materials for replacement bones and joints.	• Structure and properties of materials. • Doppler effect. • Reflection, refraction, lenses.
Unit PSA3: Working with physics Assessment based on two laboratory practical activities and an out-of-school visit.	
Unit PSA4: Moving with physics	
Transport on track Issues in designing and operating a modern rail transport system lead to further work on mechanics, an exploration of electromagnetic forces and induction, and an introduction to capacitors.	• DC circuits and switching. • Force, momentum, work and energy. • Magnetic fields: electromagnetic force. • Electromagnetic induction. • Capacitors: exponential discharge. • Digital and analogue signals. • Capacitors: energy.
The medium is the message	• Fiber optics: refraction; exponential attenuation. • Uniform electric field. • Charged particles in a magnetic field. • Alpha scattering: nuclear model of atom. • Electrostatic force between point charges. • Collisions: momentum and energy.
Probing the heart of matter	• Motion in a circle. • Mass–energy inter-conversion. • Charged particles in electric and magnetic fields. • The quark–lepton model.

Table 2.12 - Categorization of visits Lubben et al (as cited in Astin, Fisher, & Taylor, 2002).

Category	Example used by the authors
Interactive museum	National Space Centre, Leicester Science Museum, London Duxford Imperial War Museum
Large structures	London Eye Alton Towers theme park Building site (the new science department!)
Fundamental research laboratories	Joint European Torus (JET) CERN Leicester University Mullard Radio Astronomy Observatory
Research and quality control laboratories	Rutherford Appleton Laboratory
Users of scientific instruments	Local hospital, local theatre Cadbury's chocolate factory Dungeness nuclear power station Superstore Aston Martin car factory

While planning a visit there are some important aspects for teachers (Astin et al., 2002):

- Should be interesting for student;
- Visit locally;
- Ensure that the physics the students encounter is not too difficult and is not obscured by complex technology;
- Not expect all facilities to cope with large numbers;
- Choose the timing carefully;
- Visit on your own before you take the students;
- Prepare your students thoroughly.

2.9.9. Physik im Kontext (Physics in Context) (piko):

Physik im Kontext (Physics in Context) one of the programs all over the world trying to find out solutions to problems of teaching and learning physics while improving science literacy. Similar to other context based learning approaches Physics in Context intents to increase students' interest, encourage "their open-mindedness and receptiveness towards science and technology" (Euler, 2004). Reinders Duit, Mikelskis-Seifert, and Wodzinski (2007) listed the basic aims of the project as follows:

- Development of new culture of learning and teaching which is constructivist;
- Students are expected not only be able to use physical knowledge in daily life contexts and also to be able to think and work like scientists;
- Students should be able to put modern physics and technologies subject together.

Physics in Context makes use of school networks and the cooperation of teachers while external experts escort and evaluate the process. The conceptions of contexts to be developed listed as follows (Euler, 2004):

- thematic contexts;
- learning environment as context;
- out of school learning contexts.

Physics in Context, beside the aim of increasing students' science literacy, "piko" has aim of the professional development of teachers. 'Active learning and inquiry processes' encouraged by the teachers, they should be engaged with new physics subjects related with their interests and committed to put into practice these subjects for creating congenial learning environments. This results in a combination of innovative physics and pedagogy (Euler, 2004).

The topics of materials and ideas developed by Reinders Duit and Mikelskis-Seifert (2010) for Physic im Kontext:

- Traffic safety – Introduction into the force concept;
- Nano – Basic ideas for lower secondary students;
- Energy in daily life;
- Feeling forces;
- Problem based physics instruction – e.g. weather and climate;
- Transition from primary science to lower secondary physics;
- Modern sensors in everyday appliances;
- Modelling – Experimenting-Arguing – Science Processes;
- Bodily experiences as basis for understanding force;

- Constructing bridges.

2.9.10. Chemie im Kontext (ChiK):

Results of TIMMS and PISA international comparisons of Germany ignited the Chemie im Kontext "ChiK" project in 1997 that is known as a cooperative project among teams of various universities including Dortmund, Oldenburg, and also involving Wuppertal and the Leibniz Institute for Science Education (IPN) in Kiel (Nentwig, Demuth, Parchmann, Ralle, & Gräsel, 2007; Pilot & Bulte, 2006a). The Salters Courses in UK used as a model for the starting ideas. Similar to other context based approaches also the ChiK aimed to implement same philosophy, using the contexts as the initiative point for the approach and at the same time for the structure of each unit (Pilot & Bulte, 2006a).

The main challenge was combining context-based learning in order to develop the basic concepts and also the key competencies. In order to overcome this issue it is planned to embed principles of 'student-oriented situated learning'. The students are required to express their 'own ideas' and their 'pre-knowledge' with the help of various activities where group learning activities appear necessary part of each unit. Similar to Salters approach, the ChiK approach also aims to develop basic concept in different units. As Germany has different curriculum and syllabi condition in each state which can be assumed to be a disadvantage, the groups of teachers from different states (14 of the 16 federal states) developed different units which is named as "symbiotic approach" turning this disadvantage to advantage. The recent studies show that the approach is effective while the learning and become more enjoyable and relevant similar to other context based approaches. This result, the positive effect in students' motivation to learn, is oriented from relevance of the content to students' lives while using the real life contexts (Pilot & Bulte, 2006a).

ChiK project development influenced by the theories of "concept of scientific literacy", "theories of motivation", and "situated learning" approaches (Nentwig et al., 2007) . The design process is summarized in the Figure 2.9.

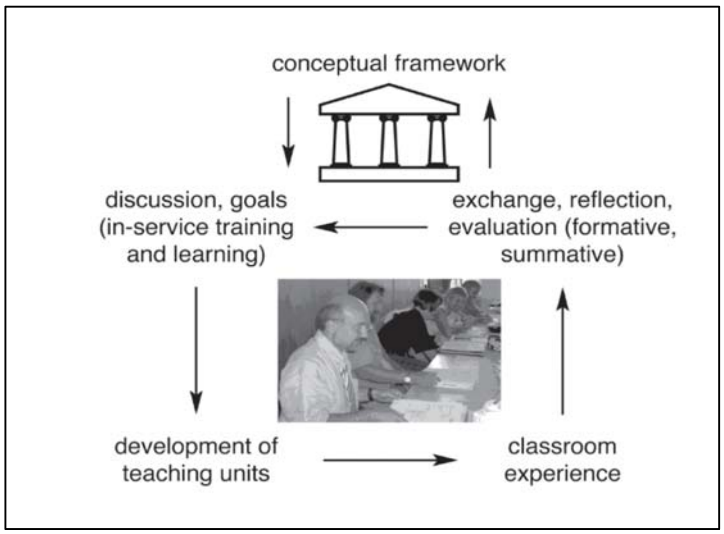


Figure 2.9- Development process of Chemie im Kontext units (Nentwig et al., 2007)

Mandl et al. summarized the design of learning environments to ensure the theoretical considerations. These are using complex situations as the starting point (Figure 2.10), using "authentic contexts", elaborating from multiple perspectives, learner expression of processes, problems and solutions, and social communication (as cited in Nentwig et al., 2007).

One of the major difference of the ChiK project is not to have “ready-to-use” materials. There are example units which forms a base for the courses where teachers and developers designing with a “symbiotic development” of the curriculum that will be applied in various states of the educational systems (Bundesländer) in Germany. This flexibility and dynamism also allows teachers to update the curriculum with the contemporary changes in society and chemistry (Pilot & Bulte, 2006a).

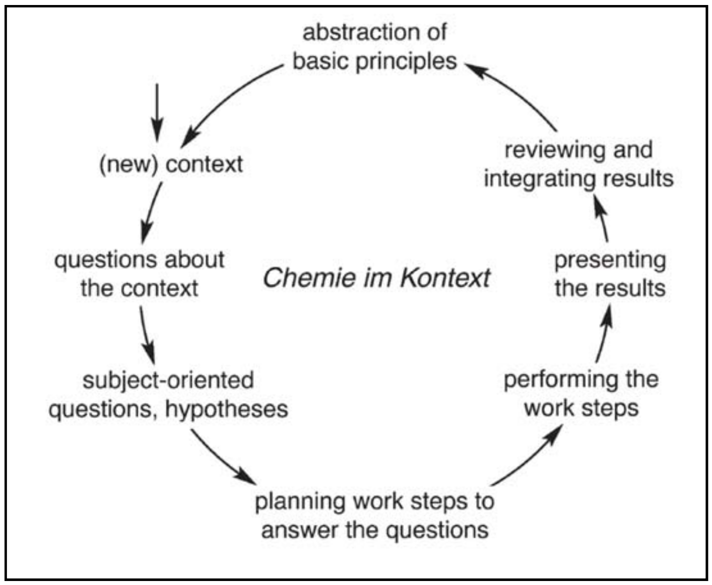


Figure 2.10 - Process cycle of Chemie im Kontext - (Nentwig et al., 2007)

The methodology of ChiK is consists of the four steps which gives a direction to application of each unit (Nentwig et al., 2007):

1. The “Contact” Phase where the context is presented and ideas/pre-knowledge of students gathered;

2. The “Curiosity and planning” phase where the students ask questions about the context and research strategies to cover the topic is planned;

3. The "Elaboration" phase where the students perform the research and findings are presented and exchanged;

4. The "Nexus and integrating" phase where the content is integrated with the other contexts.

Table 2.13 - Example Units of Chemie im Kontext Synopsizing That Unit's Context, Concepts, and Intended Grade Level (Nentwig et al., 2007)

Unit Name	Guiding Idea and Chemical Content	Basic Concepts	Grade Level
The Chemist: Today's Taster?	What can we learn about food contents? Example investigations of soda, ketchup, or other food. Chemical content: Mixtures and solutions; Methods of separation and identification; Introduction of a simple particle model.	Substances and particles (all substances consist of particles)	7–9
Clean, Neat, and Tidy: Acetic Acid Household Cleaners	Relevance of acids in life, environment, and technology. Chemical content: Characteristics of acids and bases; pH; Acid–base reactions; Methods of identification; Chemical language and symbology.	Structure properties Donor–acceptor	9–10
Alcohol: Too Precious for a Drink?	Using alcohol: Opportunities and dangers? Chemical content: Beer, wine, liquor production (fermentation; separation techniques; distillation); Ethanol amounts in drinks; Properties of ethanol (boiling point, solubility, flammability); Effects of ethanol on humans; Other alcohols and their use.	Structure properties Donor–acceptor	10
Fuels of the Future?	What makes gasoline such a useful fuel? By which criteria (caloric value, availability, price, transport, hazards, and environment) can different fuels be judged? Predicting properties of various organic molecules (alkanes, alcohols, etc.).	Structure properties relative to energy	11
Mobile Energy for Mobile Citizens	Choosing disposable or rechargeable batteries; Understanding the function of different types of batteries; Developing decision-making criteria.	Donor–acceptor reactions (redox reactions); Energy	12
Cars without Polymers?	Particular uses for particular properties; Molecular structure of various polymers; Production; Recycling.	Structure properties	12–13

2.9.11. Salters Advanced Chemistry Project:

The Salters Advanced Chemistry Project is developed for the students who wants to study chemistry in university. Salters Advanced Chemistry is pre-university course for students aged 16-18 in England and Wales (Bennett & Holman, 2003). As an example the unit "Colour by Design" (Bennett & Holman, 2003) describes the work of art restorers and dye manufacturers as an application of chemistry. This "storyline" engages the students to context to study aromatic chemistry and spectroscopy (Bennett & Holman, 2003). The main trigger of developing the project was to increase the number of students who wants to continue chemistry studies after compulsory education (post16) in order to help future need for research and industry (Barker & Millar, 2000).

After the first implementation in 1990 (Swinbank, 1997) Salters' Advanced Chemistry become popular among the teachers and students, as Bainbridge reports the rise was more than 3500 students in 1996, which also provoked development of Salters' Advanced Physics by the demand of physics teacher whose colleagues are using Salters Advanced Chemistry courses (as cited in Swinbank, 1997).

The intended outcomes of Salters Advanced Chemistry listed by Mayoh and Knutton (1997) as follows:

- to present the use of chemistry in real life and in works of chemists;
- to show the relation of chemistry with people's lives in order to increase appeal of chemistry;
- to widen the range in relation to teaching and learning activities in practice;
- to offer a demanding chemistry course to students as fundament for future studies as well as satisfying for the students who won't be studying chemistry.

The curriculum of the Salters Advanced Chemistry was developed by more than 40 authors and 100 expert advisers which "were either science educators or teachers" in order to consider the classroom teaching realities and students' interest. Later studies reported that teachers found Salters Advanced Chemistry course more motivating to teach, students are more interested in chemistry, engaged better in independent study and taken more responsibility for their own learning (Bennett & Lubben, 2007). Conversely, teaching the course was more demanding. The studies also emphasized that in-service support was essential to gain confidence to succeed the course (Bennett & Lubben, 2007).

Table 2.14 - A map of the unit, The Elements of Life (EL) (Bennett & Lubben, 2007)

Activities	Chemical Storyline	Chemical Ideas
EL1 How do we know the formula of a compound?	EL1 What are we made of?	1.1 Amount of substance
EL2.1 How much iron is in a sample of iron compound?	EL2 Take two elements	2.1 A simple model of the atom 2.2 Nuclear reactions
EL2.2 Making the most of your study of chemistry		
EL3.1 Investigating the chemistry of Group I and Group II elements	EL3 Looking for patterns in elements	1.2 Balanced equations 11.1 Periodicity 11.2 The s-block: Groups I and II
EL3.2 How do the physical properties of elements change across a row on the Periodic table?		
EL3.3 Check your notes on The Elements of Life: Part 1		
EL4.1 How do we know about atoms?	EL4 Where do the chemical elements come from?	2.1 A simple model of the atom 2.2 Nuclear reactions
EL4.2 Isotopic abundance and relative atomic mass		6.1 Light and electrons
EL4.3 Investigating a spectroscopic technique		2.3 Electronic structure: shells
EL4.4 Radon in the rocks		
EL5 Balloon molecules	EL5 The molecules of life	3.1 Chemical bonding 3.3 The shapes of molecules

Table 2.15 - Units in the Salters' Advanced Chemistry Course (Burton, Holman, Pilling, & Waddington, 1995)

Title	Storyline	Main chemical principles developed
The Elements of Life	A study of some elements in the human body, the solar system and the universe.	Atomic and nuclear structure; bonding; chemical calculations
Developing Fuels	A study of fuels and the contributions that chemists make to developing better fuels.	Homologous series; alkanes; isomerism; thermochemistry; catalysis
From Minerals to Elements	A study of the extraction and uses of three elements used to introduce major classes of chemical reactions.	Halogen chemistry; major classes of chemical reactions: acid-base. redox, complex formation, precipitation
The Atmosphere	A study of chemical processes occurring in the atmosphere which have important influence.	Interaction between radiation and matter: radicals: halogenoalkanes; equilibrium (qualitative)
The Polymer Revolution	The story of the development of polymers, from the first discoveries to the present day.	Polymerization; alkenes; intermolecular forces
What's in a Medicine?	A study of aspirin. its chemistry and synthesis, illustrating some of the features of the history of pharmaceuticals and the pharmaceutical industry	Spectroscopy: alcohols. phenols, carboxylic acids, and derivatives
Using Sunlight	An account of the ways that chemicals can trap the energy of sunlight and make it available for useful purposes.	Photochemistry, redox; electrochemistry
Engineering Proteins	The story of proteins and enzymes, the role of DNA in protein synthesis and the use of chemistry to 'engineer' proteins with particular properties.	Amino compounds: enzyme catalysis; reaction kinetics (effect of concentration); equilibrium constants
The Steel Story	Steel as a material to the processes used to made it and prevent its corrosion.	Electronic structure, d-bock elements complex formation
Colour by Design	The chemical basis of colour and the use of chemistry to provide colours to order.	Aromatic compounds; analytical techniques
Medicines by Design	An account of the way chemical principles and techniques are used to investigate the effects of chemicals on the body, and to design and make pharmaceuticals.	Carbonyl compounds; synthetic routes; molecular recognition
Aspects of Agriculture	A study of the contribution that chemistry makes to ensure a safe and sufficient food supply.	Group IV and Group V chemistry; equilibrium (effect of temperature and pressure): reaction kinetics (effect of temperature)
The Oceans	The story of the oceans: their role in regulating the climate, in forming rocks and in supporting life.	Solvation and solutions; acid-base equilibria; solubility products: entropy
Visiting the Chemical Industry	A structured industrial visit leading to study of the way that chemical principles can be applied to optimize efficiency and safety to minimize environmental damage and economic cost.	
Individual Investigation	A practical investigation of a topic chosen by the student.	

Table 2.16 - Main storylines and chemical ideas in the first five units of the course (Bennett & Lubben, 2007)

Storyline	Chemical ideas used
The Elements of Life is a study of the elements in the human body, the solar system, and the universe.	Amount of substance Atomic structure Atomic spectroscopy Periodic Table: periodicity, Group 2 Chemical bonding Shapes of molecules
Developing Fuels is a study of fuels and the contribution that chemists make to the development of better fuels.	Reacting masses and molar volumes Thermochemistry Homologous series Alkanes Structural isomerism Catalysis Entropy (qualitative)
From Minerals to Elements is a study of the extraction and uses of two elements, bromine, and copper.	Ions in solution Reacting masses and molar concentrations Electronic configuration (s, p and d orbitals) Types of reactions (redox, precipitation, acid-base) Group 7 Molecular and giant (network) covalent structures
The Atmosphere is a study of two important chemical processes, the depletion of ozone in the upper atmosphere and the greenhouse effect in the lower atmosphere.	Interaction of matter and radiation Rates of reaction (qualitative) Halogenoalkanes Reaction mechanisms: nucleophilic substitution, radical reactions Chemical equilibrium
The Polymer Revolution tells the story of the development of addition polymers, many of which were the result of 'accidental' discoveries.	Addition polymers Alkenes Reaction mechanisms: electrophilic addition Alcohols Geometric isomerism Intermolecular forces Properties of polymers in relation to structure

2.9.12. Chemistry in the Community (ChemCom)

In the United States, Chemistry in the Community (ChemCom), developed by Education Division of the American Chemical Society, a one-year program for high school students that is supported by the National Science Foundation. It is designed to be an alternative to traditional high school chemistry courses. It offers attractive, relevant, and useful chemical with a supply of traditional to provide an attractive, open access route for all high school students to the realm of relevant and useful chemical phenomena (Nelson, 1988; Sutman & Bruce, 1992; Ware, 2001). ChemCom studies started in 1980 and the first edition published in 1988 (Mason, 1996).

ChemCom introduces one topic after another without much conceptual relation between them (Nentwig et al., 2007),

Sutman and Bruce (1992) reported that ChemCom efficient instructional program for secondary level students, to learn chemistry content significantly, and may substitute traditional courses. Students have the opportunity to learn the knowledge and basic chemical facts, how to cope with personal and societal issues by using this chemical knowledge with the implementation of an understandable content. The importance of scientific information in decision making about social issues emphasized. Students become more familiar with the interactions of science, society and technology, the limitations of technology and interpreting the scientific information (Sutman & Bruce, 1992).

ChemCom uses real-life problems, students are expected to become active learners, contrary to traditional courses where students are bombarded with the scientific knowledge where they learn passively without questioning. Students learn the content from the real-life problems while they also learn chemical knowledge and its relevance with their lives. As a result knowledge that students learn can be transferable to new situations in their lives rather than being ‘inert’ (Sutman & Bruce, 1992).

ChemCom courses based on eight social issues (Nelson, 1988) they are decided on a 'need-to-know' basis (Bennett & Holman, 2003):

- Water quality and supply;
- Use and conservation of resources;
- The use of petroleum as both a fuel and chemical feedstock;
- The chemistry of food and nutrition;
- Nuclear chemistry;
- Air and climate;
- Chemistry and health;
- The role of the chemical industry in our society (Bennett & Holman, 2003).

ChemCom is becoming more popular and more than 1.5 million students attended the course. Texts are also translated in Japanese, Spanish, and Russian. As it is a well-designed chemistry course from social context it may make chemistry knowledge accessible, interesting, and intellectually exiting, and keeping students in the scientific field longer (Ware, 2001).

2.9.13. Chemistry in Contexts: Applying Chemistry to Society (CiC):

Chemistry in Context (CiC) is a similar approach to ChemCom having the same motivation, 'to improve chemical literacy' and funded by American Chemical Society (Bennett & Holman, 2003; Schwartz, 2006). CiC is a one semester course for non-science undergraduate students (Bennett & Holman, 2003) where "the beauty and utility of chemistry" can be demonstrated to "future poets, painters, philosophers, and politicians" (Schwartz, 2006). The curriculum, course, and laboratory materials developed by a team of experienced inorganic, organic, analytical, and physical chemistry and chemical education university professors. As the chief of this team Schwartz (2006) states their primary assignment as "to write an effective textbook, not to carry out research in teaching and learning" (Schwartz (2006). The contexts, concepts and the activities are increasingly sophisticated with the increase of students' age (Bennett & Holman, 2003).

CiC is the third wave of curriculum, after 1960s reform where ChemCom was the second wave curriculum (De Jong, 2007). CiC, unlike other curricula, did not aim to prepare students for further study in chemistry, which brings less pressure to cover a specified content (Pilot & Bulte, 2006a; Schwartz, 2006). In order to achieve the curricular goals following themes are aimed to be adopted (Schwartz, 2006):

- The Interaction of Science and Society;
- The Vocabulary and Concepts of Chemistry;
- The Nature and Methodology of Science;
- Analyzing Risks and Benefits;
- Evaluating Information;
- The Importance of Scale;
- Science as a Human Endeavour;

- Putting Chemistry in Perspective.

CiC units (Table 2.17) are centered on real life social problems with substantial chemical content, where content is being determined by the context. First six chapter (core) covers the fundamental chemical content almost identical to traditional content, the remaining unit(s) can be selected by teacher to complete their syllabus (Pilot & Bulte, 2006a).

Table 2.17 - Chemistry in Context (first edition) chapter topics and the major chemical concepts included (Schwartz, 2006)

Chapter title	Chief chemical concepts
The Air We Breathe	Elements, compounds, mixtures, atoms, molecules, formulas, equations
Protecting the Ozone Layer	Atomic structure, atomic mass, atomic number, molecular structure, electromagnetic spectrum, wave and photon nature of light, reaction mechanisms
The Chemistry of Global Warming	Molecular structure and vibration, infrared absorption and spectroscopy, moles, stoichiometric calculations
Energy, Chemistry, and Society	First and second laws of thermodynamics, heats of combustion, bond energies and related calculations, activation energy, entropy and calculations of thermodynamic efficiency
The Wonder of Water	Molecular structure, hydrogen bonding, solutions, solubility rules, ionic compounds and ionic structure, solutions, specific heat and related calculations
Neutralizing the Threat of Acid Rain	Acids, bases, hydrogen and hydroxide ions, molarity between bases, pH and related calculations
Onondaga Lake: a Case Study	Solubility, Solvay process, chlor-alkali process
The Fires of Nuclear Fission	Isotopes, nuclear fission, chain reactions, radioactive decay
Solar Energy: Fuel for the Future	Alternate energy sources, decomposition of water, electrochemistry, fuel cells, cells and batteries, photovoltaic cells, nuclear fusion
The World of Plastics and Polymer	Addition and condensation polymers, amino acids, fullerenes
Designing Drugs and Manipulating Molecules	Structural organic chemistry, functional groups, organic reactions, chirality and optical isomerism, binding sites, steroids
Nutrition: Food for Thought	Energy from foods, carbohydrates, fats, proteins, vitamins and minerals
The Chemistry of Tomorrow	Superconductors, catalysts, enzymes, genetics and molecular engineering

2.9.14. Chemistry in Practice (ChiP):

To redesign the Dutch chemistry curricula the ChiP programme developed to provide chemistry to all students (King, 2012). Using ‘need to know’ principle to decide which content, relation, and principles are being involved in the units practices of activities, the Chemistry in Practice research project (ChiP) takes practices of activities as contexts. Similar to the other context based learning approaches practices (contexts) are the starting points and criterion for the course to avoid curriculum overload (Pilot & Bulte, 2006a).

2.9.15. ChemConnections

The Molecular Science group, the New Traditions group and the Workshop Chemistry faculty began to develop an online delivery and assessment system, to create and to implement a new, interactive pedagogy, and to develop a training program for undergraduate leaders to run chemistry problem solving discussion sessions for chemistry classrooms respectively (Gutwill-Wise, 2001). The ModularChemistry Consortium (University of California–Berkeley) and ChemLinks Coalition (Beloit College) came together to developed topical modules, new curricular materials and methods to enhance the learning and appreciation of chemistry for considering chemistry curriculum the first two years of the college life (S. Anthony et al., 1998; Bennett & Holman, 2003; Gutwill-Wise, 2001).

The wide-ranging aim of these groups was not only enrich chemistry understanding of students but also escalade college students to a level when they graduate they would be capable of commanding scientific knowledge and skills necessary to allow lifelong learning, making their lives, and making decisions which are well-versed (Gutwill-Wise, 2001).

According to Bennett and Holman (2003) instructors can choose from a bank, and each module can be implemented independently of each other and if its required traditional modules can be used concurrently. For example, whenever car airbag system is considered, the followings are used, they are earth, fire and air in order to understand Chemistry as a whole, since it is used as an extensive range of foundation chemistry, which involve in not only the gas laws, and the kinetic theory but also chemical calculations. After that, in this chapter, both this approach and traditional approach will be compared in relation to teaching these topics (Bennett & Holman, 2003).

Modules are planned for 3 - 4 weeks each based on a single real life problem with consistent set of chemical concepts with the aim of calling attention to the importance of chemistry in real-world problems. For example designing a better automobile air-bag system, inspecting global warming, and key factors under the lessening of the ozone layer. Unlikely to traditional modules, these modules require not only more interaction between students and instructors but also require a better interaction among students' themselves while they work in groups, solve problems, classroom discussions and use multimedia (Gutwill-Wise, 2001).

The use of World Wide Web and other reference materials which are delivered through CD-ROMs and the Internet are explained by S. Anthony et al. (1998). The importance World Wide Web and various reference materials that are used by the students include due knowledge and information about greenhouse gas molecules and how they are produced and destroyed; at the same time, the students get expertized about a particular gas like that (Anthony et al., 1998). The respective students plenty of knowledge and information. Nevertheless, they sometimes can face conflicting knowledge and information, since they are pushed to handle with reliability of information they find in order to use in their problem solving situations; later on, a challenge might appear regarding translation of word statements and solving chemical formulas and also finding ways of balancing the equations (Anthony et al., 1998). Eventually, the students are in need of conducting stoichiometric calculations in relation to finding out answers of their particular greenhouse gas (Anthony et al., 1998).

Multimedia materials are developed for modules ranging from simple videos to complex animations and simulations presenting real life problems and providing an environment with the advantages of virtuality which simulates dangerous, expensive, or time-consuming experiences (S. Anthony et al., 1998).

During the implementation, instructors are free to cover all of the course with the use of modules or may choose one or two modules which are relevant to existing curriculum. This modular approach utilizes a flexible environment, which can fit different forms of learning and teaching environments. The list of the modules which are being developed and tested (S. Anthony et al., 1998):

- Earth, Fire, and Air: Can Fast, Gas-Forming Reactions Save Lives?
- Is Biomass Fuel Economically and Environmentally Feasible?

- Computer Chip Chemistry: How Can We Drive the Reactions of Integrated Circuit Design?
- How Can We Design a Therapeutic Drug?
- How Can We Control Combustion Emissions?
- Should We Build a Copper Mine?
- The Origins of Life: Where Did We Come From?
- What Should We Do About Global Warming?
- How Can We Get Energy from the Sun?
- Why Does the Antarctic Ozone Hole Form in the Spring?
- How Can You Get Blue Light from a Solid?
- Water Treatment: How Can We Make Our Water Safe To Drink?
- Why Do We Get the Flu Every Year?
- Would You Prefer Paper or Plastic?
- What Happens to Acid Rain?

2.9.16. Industrial Chemistry (IC)

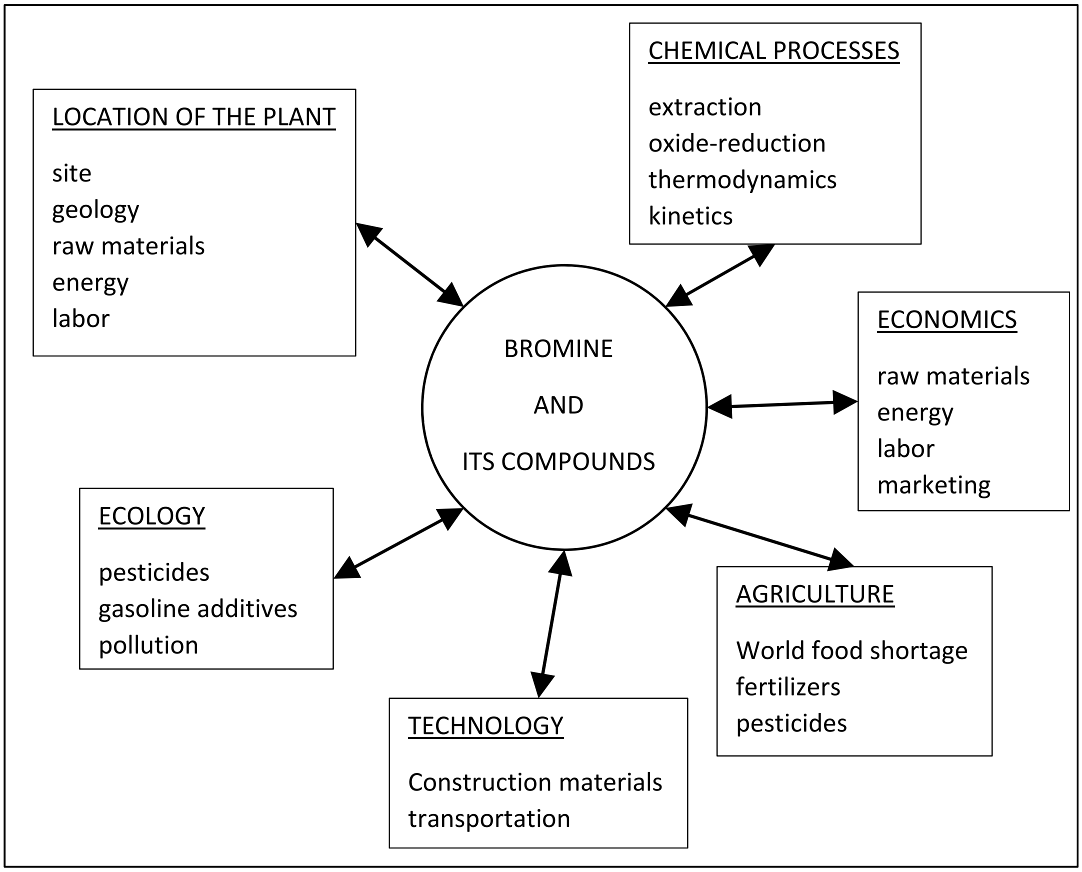
Industrial Chemistry (IC) courses developed in Israel for the year 12 students to feature the contexts of real-life matters and actual problems that are available in the chemical industry (Hofstein & Kesner, 2006).

IC courses based on the real life examples from the chemical industry in order to describe topics such as 'oxidation-reduction, heat of reaction, chemical equilibrium and rates of reaction'. The aim of IC is to demonstrate how the classroom and laboratory experiences can be transferred to real life applications as well as to point out the importance of industry to society and economy (Nae, Hofstein, & Samuel, 1980).

Nae et al. (1980) summarizes the objective of the course, and depending on these objectives during the course application of basic chemical principles to industrial production are demonstrated, importance of the chemical industry to society and to the economy pointed up, the technological, economic and environmental factors involved in chemical industry discussed and problems faced by the local chemical industry presented (Nae et al., 1980).

The important contexts are 'What happens in a chemical plant', 'Copper production at Timna', 'Life from the Dead Sea', 'The age of Plastics' and 'Methane production using wind energy'. As an example to the production of different type of chemicals from sea, context of 'Life from Dead Sea' used to illustrate production of bromine (Figure 2.11) (Nae et al., 1980).

Figure 2.11 - Life from Dead Sea (Nae et al., 1980)



2.10. Summary of Context Based Approaches and Comparison of National Curricula

The launch of the Sputnik set of science education reforms in industrial countries, especially in the USA. Educators drew attention to the quality of the science curricula. The change in science education came with three waves and this change also effected by new approaches of educational psychology (De Jong, 2007).

As it is seen in Table 2.18 after 2000s curricula changes based on social constructivism and socio-cultural perspectives with the grooving interest on use of contexts and students reasoning (De Jong, 2007). The main aim of the changes are reported to make science courses attractive, interesting, motivating and relevant to students' lives, and career plans (Acar & Yaman, 2011; Astin et al., 2002; Bennett & Holman, 2003; Bennett & Lubben, 2007; Campbell et al., 1994b; Çekiç Toroslu, 2011; Edwards, 2000; Edwards & Whitelegg, 2001; Euler, 2004; Gilbert, 2006; Glynn & Koballa Jr, 2005; Gutwill-Wise, 2001; Krapp, 2002; Lijnse et al., 1990; Lubben et al., 1996; Lye et al., 2001; Mason, 1996; Mbajiorgu & Reid, 2006; McDermott, 1991; Metz et al., 2007; Millar, 1993; Murphy & Whitelegg, 2006; Nelson, 1988; Nentwig et al., 2007; Özay Köse & Çam Tosun, 2011; Palmer, 1997; Parker et al., 2000; Peşman, 2012; Peşman & Özdemir, 2012; Pilot & Bulte, 2006a; P. Ramsden, Martin, & Bowden, 1989; Redish et al., 1998; Reiner, 2006; Schwartz, 2006; Smith & Bitner, 1993; Stinner, 1990, 1994a, 2003; Sutman & Bruce, 1992; Swinbank, 1997; Taasoobshirazi & Carr, 2008; Ulusoy & Onen, 2014; Ünal, 2008; Ware, 2001; Whitelegg & Parry, 1999; Wilkinson, 1999a, 1999c).

Table 2.18 - Science education reform and influential psychological theories (De Jong, 2007)

Wave of reform	Influential theory that shapes curricula and courses	Issue of growing interest
1960s	• Descriptive behaviorism	• Programmed instruction
	• Stages of cognitive development	• Sequence of science topics
1980s	• Guided discovery learning	• Lab work for school students
	• Information-processing perspectives	• Learning cycle
2000s	• Social constructivism	• Students' ways of reasoning
	• Socio-cultural perspectives	• Role of context and language

Based on the Comparison of National Curricula and Summary of Context Based Approaches table of Swinbank (1997) major applications of the context based approaches are listed and summarized it the Table 2.19.

Table 2.19 – Extended Version of Comparison of National Curricula and Summary of Context Based Approaches (Swinbank, 1997)

	Context-based approach	Level/age	Brief description	Researchers
1	Chemistry in Context (CiC) - USA	Tertiary Age 18–20	Began in 1989 to address the needs of undergraduate students in universities and colleges and to improve their chemical literacy. The book and other materials have been used by large numbers of students and teachers influencing other tertiary level courses in the US.	Nakhleh, Bunce, & Schwartz (1995, 2006)
	ChemConnections - USA	Tertiary	Modular course for undergraduate beginners. Modules can be used in conjunction with traditional modules.	Gutwill-Wise (2001)
	ChemCom - USA	Upper secondary	Structured around community issues related to chemistry. Uses a context-based, student-centered approach to chemistry, in which chemical principles are introduced on a 'need-to-know' basis.	Smith & Bitner (1993) Sutman & Bruce (1992)
2	Salters Advanced Chemistry - UK	17–18-year-olds; pre-university	Developed in the late-1980s and early-1990s the family of Salters courses spans the whole of the secondary and pre-university age range in England and Wales. The 'Salters Approach' became known as a prime example of a context-based approach. Emphasis on 'what chemists do.'	Barber (2000) Barker & Millar (1996, 2000) Bennett & Lubben (2005)
	Salters Horners Advanced Physics (SHAP) - UK	17–18-year-olds; pre-university	The SHAP physics course uses up-to-date contexts to teach GCE AS/A-level physics.	(Swinbank, 1997)
	Science: The Salters Approach Chemistry: The Salters Approach - UK	14–16-year-olds	Two courses: one for generalists and one for specialists where the contexts are the same but scientific concepts differ.	Ramsden (1992, 1994, 1997)
3	Chemie im Kontext (ChiK) - Germany	Year 10/11	All context-based units are based on relevant, authentic topics and questions, which are the backbone and guidelines for teaching and learning purposes. There are three relevant topics: daily life situations, issues important for society, scientific and technical issues.	Lange & Parchmann (2003) Parchmann et al. (2006)
	Physik im Kontext (piko) - Germany	Year 10/11	'piko' is a program to improve science literacy by improving the quality of physics teaching and learning.	R Duit, Euler, Friege, Komorek, and Mikelskis-Seifert (2003)

4	Chemistry in Practice (ChiP) - The Netherlands	Secondary	Project attempts to make a meaningful connection between students' learning of chemistry and their daily life and societal issues.	Bulte, Westbroek, de Jong, & Pilot (2006) Pilot & Bulte (2006)
5	Physics Curriculum Development Project (PLON) - The Netherlands	Secondary Years 8–9 and 10–12	Students' life-worlds were taken as the starting point for PLON curricula with an emphasis on technological artefacts and natural phenomena in junior secondary education. This was supplemented with an emphasis on socio-scientific issues and the nature of science in senior secondary education.	Eijkelhof & Kortland (1988) Eijelhof & Lijnse (1988) Kortland (2005) Wierstra (1984, 1990) Wierstra & Wubbels (1992, 1994)
6	Industrial Chemistry (IC) - Israel	12th grade students only	Goal of the project was to teach chemistry concepts in the context of industrial chemistry. Greater emphasis on applied chemistry and its socioeconomic and environmental consequences.	Hofstein & Kesner (2006) Hofstein, Kesner, & Ben-Zvi (2000) Key (1998)
7	Large Context Problem Approach (LCP) - Canada	Secondary	Learning capabilities and student motivation are aimed to be increased in large context problems.	Stinner (1990)
	The Applications-Led Approach - Scotland		In the late 1980s a new approach to teaching physics was developed where physics is introduced through its impact on everyday life.	Jardine (1989)
8	Event Centered Learning – UK & Brazil	Secondary	A joint project to promote common research interests in the field of secondary school science education, in teacher education and in postgraduate studies.	Zylbersztajn and Watts (1994)
9	Supported Learning in Physics Project (SLIPP) - UK	Post 16	The SLIPP is a project where real life contexts are used to motivate students to learn by increasing their interest in physics.	Whitelegg (1996)
10	The Victorian Certificate of Education (VCE) - Australia	year 11/12	A wide range of subjects and assessment strategies like research tasks, oral communication, working independently on extended problems, and traditional examinations were introduced for all of the Victorian Certificate of Education science and mathematics subjects.	Victorian Curriculum and Assessment Authority
11	Science, Technology, Environment in Modern Society (STEMS) - Israel	Years 10/11	Shows emerging evidence that the extensive involvement of teachers in the development process is resulting in change in classroom practice in the directions hoped for by those developing the materials.	(Tal, Dori, & Keiny, 2001)

Similar to Albania, Turkey educational system is also based on the traditional approach. After 2000s, commission reports of investigators and teachers taken into consideration in order to develop new curriculum for secondary schools physics programmes founded on context based approach. A group of experts, professors from universities, researchers and teachers of science education conducted a research on context based approach, analyzing context based learning approach among the world wide applications of 30 countries to develop secondary school physics curriculum for 9, 10, 11, 12th grade students. The "curriculum based on the context based learning approach" aiming to improve students' achievement and also has objectives of improving students' problem solving abilities, physics, technology, society and environment acquisitions, ITC skills, and attitude and ethical values acquisitions (Güneş et al., 2007).

After 1990s there are so many countries renewed their science education curricula like Australia, Canada, Ireland and Germany and there some major reforms ongoing like Malaysia. Some of the countries where their curricula renewed based on context based learning approach showed increase in performance in TIMMS (Trends in International Mathematics and Science Study) and PISA (Programme for International Student Assessment) like Singapore and the countries from different locations on the Globe like, Korea and USA are listed and compared with respect to certain criteria in

Table 2.20 (Güneş et al., 2007).

Turkey, New Zealand, and Australia are sharing similar curricula of physics education. Both New Zealand and Australia classified science subjects into four and named similarly rather than naming as physics, biology, chemistry, and geology (Table 2.21). In New Zealand, all students are subject to learn Science up to year 10. Students in years 11 – 13 are able to specialize in one or more science disciplines (Ministry of Education, 2007). In Australia students start Physics lessons by the years 11 and 12 (VCAA, 2008). In Turkey physics lessons starts at ninth class and all students are obliged to take it. For the years

10 – 12, only students who chosen the related area take the physics lessons (Güneş et al., 2007).

Table 2.20 - Comparison of National Curricula of Selected Countries (Güneş et al., 2007)

	when students start science courses				**when students start elective science courses**				**weekly/yearly course hours**				**Spiral approach**	**science for all/ science for some distinction**
Grade Level	9	10	11	12	9	10	11	12	9	10	11	12		
Ireland			X	X			X	X					X	X
Australia			X	X			X	X			6/ 120	6 / 120	partial	
USA	Physics content under natural sciences				Natural, earth, and life sciences		X	X	4	4	3	3	partial	
Korea			X	X			X	X			3/ 102	3/ 102	partial	
Singapore	X				X								X	
China (Hong Kong)									4/ 192	4/ 192				Basic/improved
New Zealand			X	X			X	X					X	
Malaysia	15								4	4				

Table 2.21 - Science Learning Areas (Ministry of Education, 2007; VCAA, 2008)

New Zealand	Australia*	Science Subjects
Making Sense of the Living World	Life and Living	Biology
Making Sense of the Physical World	Energy and Change	Physics
Making Sense of Planet Earth and Beyond	Earth and Beyond	Geology
Natural and Processed Materials	Making Sense of the Material World	Chemistry

* for 11th and 12th classes science learning areas are defined as Physics, Chemistry, etc.

Besides these distinct classifications, the subjects are overlapped and interrelated. However, in Turkish context science subjects are classified into three as physics, chemistry, and biology. Different commissions also prepare the curriculum designs of the subjects. Still physics curriculum gives references to other subjects when necessary (Güneş et al., 2007). Chemistry curriculum declared in vision statement: “This programme accepts that chemistry is the part of the whole science with biology, astronomy, physics, and geology, mathematics is used as a thinking tool and as a language". In addition, it is advised that there must be an integration/harmony within physics, chemistry, and biology curriculum (Yılmaz et al., 2007). Biology curriculum, however only attempted to be parallel and being unified with the other subject areas (Aydınlı et al., 2007).

As a result of third wave of educational reforms, interest on language is growing (De Jong, 2007). New Zealand Maori language is accepted as an official language in 1987 and Maori knowledge is included in the programme as contexts to enrich the curriculum for all students (Ministry of Education, 2007).

Table 2.22 - Some Contexts from Programmes (Güneş et al., 2007; Ministry of Education, 2007; VCAA, 2008)

New Zealand	Australia	Turkey
Making Sense of the Physical World	Physics Year 11 – 12	Physics Year 9
Keeping ourselves warm (Level 1)	Protection from heat and cold (Energy in Everyday Life)	Protection from heat and cold (Energy)
Electricity around us (Level 3)	Using electricity at home (Movement and Electricity)	Hair dryer/ rotary dimmer switches (Electricity/Magnetism)
Korero/communication (Level 1)	Musical instruments and reproduction (Physics in The Modern World)	Transmission of sound and image (waves)

Comparison of the context properties of these countries are given in Table 2.23.

When designing Australian programme first a wide real life situation like "Energy in Everyday Life" is chosen; second physics related contents in it described (sight and light, heating and cooling, nuclear technology). Third, contexts are defined (seeing with eyes, protection from heat, and cool, environmental radiation). Finally, student outcomes are defined.

Table 2.23 - Context properties among New Zealand, Australia and Turkey Curricula (Güneş et al., 2007; Ministry of Education, 2007; VCAA, 2008)

Context Properties / Usage	New Zealand	Australia	Turkey
real life situation/event/phenomenon/social issue	X	X	X
to be encountered now or in the future	X	X	X
significant for students	X	X	X
engaging and motivating	X	X	X
science – society – technology	X	X	X
same concepts more than one unit in different contexts	X	X	spiral

Summary of Australia Science & Physics Curriculum is given in Appendix H (VCAA, 2008).

New Zealand on the other hand, first defined achievement objectives like "students can carry out investigation…" then gave sample learning contexts from real life, like solar power, houses of the future. Summary of New Zealand is given in Appendix I (Ministry of Education, 2007).

Turkish programme for ninth classes first defined physics subjects like nature of physics, energy; second defined concepts and finally gave the real life contexts (energy and environment, protection from cold and heat. Summary of New Turkish 9th Grade Program is given in Appendix J (Güneş et al., 2007).

Unit	Energy in Everyday Life		
Area of Study	Sight and Light	Heating and Cooling	Nuclear Technology
Central Ideas	A list of central ideas is provided for each area of study. These must be studied.		
	The nature of light Refraction and refractive index, etc.	Heat as a form of energy Temperature; heat capacity; latent heat of vaporisation and fusion, etc.	The origin, nature and properties of α, β and γ radiations Stable, unstable, natural and artificial isotopes etc.
Contexts	Each central idea must be studied within, or applied to, at least one context and at least one context must be studied in detail.		
	Seeing with the eyes	Protection from heat and cold	Environmental radiation
	Or	or	or
	Extending visual capacities	People, heat and the environment	Medical diagnosis and treatment
	Or	or	or
	Photography	Food preparation and preservation	Scientific and industrial uses of radioisotopes
		or	or
		Heat and motor vehicles	Radioactivity in the nuclear fuel cycle
			or
			Nuclear power
Student outcomes	Specific student outcomes that relate to the central ideas are listed for each of the areas of study.		
	Specify that light is a form of energy Explain that a wave is a means of energy transfer etc.	Explain that heat is the flow of energy from one object to another because of a difference in temperature. Explain the difference between heat, internal energy and temperature etc.	State, in simple terms, the experimental evidence leading to the replacement of the Thomson model of the atom with the Rutherford model etc.

Figure 2.12 - A Sample Unit Plan (VCAA, 2008)

Achievement Objectives

Students can

1 carry out an extended investigation, involving a range of techniques, originating from their own interests into some aspect of, or issue related to, the Physical World;

2 clarify ideas on the applications and uses of the effects involved in the transfer and transformation of energy, *e.g., motors, compact disc players, solar panels, CT scanners, on the sports field;*

3 gather, analyze, and evaluate data of increasing complexity about physical phenomena — evaluation may include some more complex symbolic and numerical patterns, *e.g., absorption of beta particles by aluminum, data obtained for the cooling of a cup of tea, manufacturer's specifications for a light-dependent resistor;*

4 explain how physical phenomena are used in some examples of everyday technology and how such technology affects people and their environment, *e.g., a temperature alarm for a child's bedroom, a child's safety seat for a car, an electronic egg timer, a "robotic" arm to help a person with a physical disability (VCAA, 2008).*

Sample Learning Contexts

Solar power • Houses of the future • Helping people • Physics of sport • Information technology • Nuclear hazards • Scientists at work • Science award schemes • Weapons • Mìhini hou (VCAA, 2008).

Possible Learning Experiences

Students *could* be learning by:

• testing the strengths of various timbers — deciding on variables, their control, and how to test in the best way;
• determining the effectiveness and safety of a range of commercial smoke detectors;
• investigating a medical use of nuclear technology;
• designing, constructing, and testing a solar-powered device;
• using video to investigate the speed and spin of a moving ball;
• visiting a radiography department in a hospital to see how X-ray machines work and being briefed on energy changes in the body due to X-rays;
• analysing the action of a shot-putter in terms of energy transfer;
• gathering and plotting data to decide on how the bending of a beam depends on applied weight
• observing a Geiger counter response to alpha, beta, and gamma ray sources;
• designing and making a model magnetic door lock;
• evaluating the relative merits of alternative energy systems, the wise use of available energy resources;
• designing and testing a method of improving the heat retention in a house H (VCAA, 2008).

Assessment Examples

Teachers and students *could* assess the students':

• ability to plan and organise scientific investigations effectively, when the students present a project diary;
• ability to use physics principles, when explaining the results of an investigation into the relationship between the thickness of the legs of quadrupeds and the quadrupeds' weight;
• understanding of the energy changes involved in the operation of a fluorescent tube, when they provide explanatory notes to support a seminar on this topic;
• ability to reach a useful conclusion, when the students evaluate data on different windmill designs in order to recommend a particular design for use by a farmer in their local district;
• understanding of the physical principles associated with an everyday technological object or process, when the students describe the possible effects of electromagnetic radiation from household appliances H (VCAA, 2008).

Figure 2.13 - A Sample Level Contexts and Objectives (Ministry of Education, 2007)

It is expected for a curriculum utilizing context based approach to use same contexts in other learning areas. For example, eye as a context for optic concepts can be used in physics as well as biology. In Turkey there is no exact communication and unity between the commissions preparing science curriculums. All physics, chemistry and biology programme prepared by different commissions. As a result, it is not possible to employ same approaches for learning. Consequently, in our case we have to deploy most basic context based approach, where contexts are mostly related with physics concepts.

2.11. Motivation

The respective students might face problems whenever they can apply their skills and knowledge that are newly learnt in the classroom environment. At the same time, this situation might limit the authenticity of the instruction. The above-mentioned situation might occur, even though the students are willing to be more reflective and they actively get involved in learning materials. Therefore, contextualizing instruction appears an important option for the students, since it is applicable to students' everyday lives. At the same time, it offers more effective way in order to enhance motivation, performance, and understanding of the students (Glynn & Koballa Jr, 2005; Gutwill-Wise, 2001; King & Ritchie, 2013; Parchmann et al., 2006; J. M. Ramsden, 1997; Tytler, 2007).

The external outcomes appear very important for regulating human behavior, since people wish to exhibit like weathervanes, constantly shifting direction to conform to any social influence that happens momentarily. In this regard, self-reflective/reactive capabilities of people find the scope in order to control their not only thoughts and feelings but also motivation and actions. In relation to self-directedness, certain standards of behavior appear significant option for people, since they serve as guides and motivators. At the same time, they regulate their actions anticipatorily through self-reactive influence. It can be said that, human functioning occurs through two ways, they are regulated both interplay of self-generated and external sources of influence (Bandura, 1991).

In social cognitive theory, self-regulation is known as most effective for students' learning, if the respective students are aware that how they understand, how they monitor, and also how they control their motivation and behavior that lead to expected fruitful learning results. Motivation is described as an internal state through which the particular students might get aroused, directed, and sustained in tune with their goal-oriented manner. In addition to that, regarding motivation in science learning, it is also known as internal state the motivation to learn science can be defined as an internal state through which the particular students might get aroused, directed, and sustained in tune with their goal-oriented manner. (Glynn, Taasoobshirazi, & Brickman, 2009).

There are components of motivation categorized by researchers. Glynn et al. (2009) lists these components as: intrinsic motivation, self-determination, self-efficacy, career motivation, and grade motivation which may increase students' academic achievement while engaging them behaviors such as "question asking, advice seeking, studying, and participating in classes, labs, and study groups" (Glynn et al., 2009).

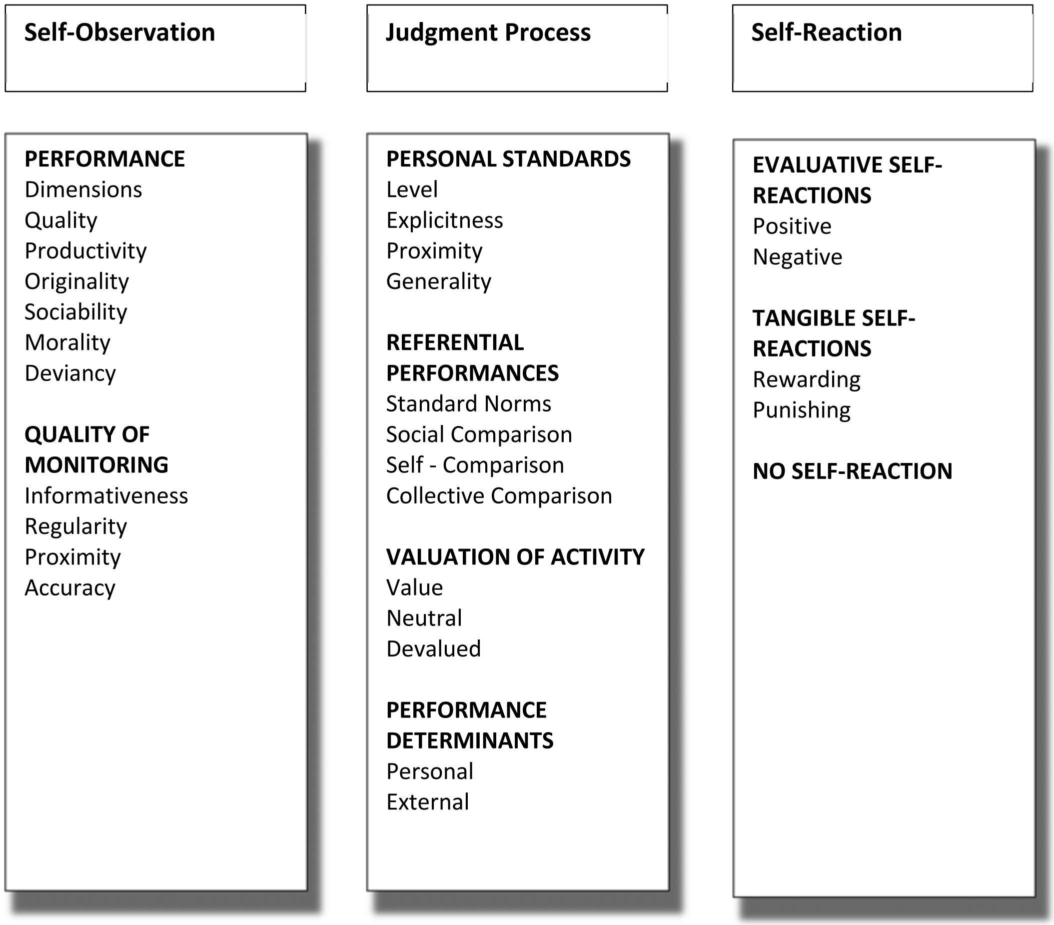


Figure 2.14 - Structure of self-regulatory systems (Bandura, 1991)

Definition of these components is as follows (Glynn et al., 2009):

- Intrinsic motivation: the inherent satisfaction in learning science for its own sake (Glynn et al., 2009).
- Self-determination: the control students believe they have over their learning of science (Glynn et al., 2009).
- Self-efficacy: which refers to students' belief that they can achieve well in science (Glynn et al., 2009).

- Extrinsic motivation: learning science as a means to a tangible end, such as a career or a grade (Glynn et al., 2009).

As cited in Abak (2003) motivation can be measured as a dimension of attitude (Aiken, 1979; Schibeci & Riley, 1986) or researchers may choose to measure it as an independent construct (Cannon & Simpson, 1985).

There are also some studies which describes motivation under two major dimensions; intrinsic motivation and extrinsic motivation while self-concept, persistence, need-achievement, and test anxiety as sub dimensions (Abak, 2003). It is also reported that

Glynn, Brickman, Armstrong, and Taasoobshirazi (2011) cited the definition of motivation with respect to social cognitive theory as defined by Bandura (1991) as "an internal state that arouses, directs, and sustains goal-oriented behavior", while extending it "as an internal state that arouses, directs, and sustains science-learning behavior".

Motivation involves in various factors, they are not only energy and direction, but also they include persistence and equifinality in order to activate and intent. Motivation is considered as primary issue in psychology. At the same time, it appears as central for regulation of biology, cognition, and society. Maybe, motivation takes a very significant place in real-life situations, since it offers fruitful outcomes as a result: As motivation gives out product, therefore in the position of teachers, parents and coaches, motivation gives ways for mobilizing to act in a certain endeavor (Ryan & Deci, 2000).

The research on the field are also emphasizing motivation as a multi – component construct which are can be listed as:

2.11.1. Intrinsic Motivation:

Intrinsic motivation represents the positive potential of human nature which is simply can be described as “the inherent tendency to seek out novelty and challenges, to extend and exercise one's capacities, to explore, and to learn”, especially children from the time of birth even in absence of rewards are active, inquisitive, curious, and playful, even in the absence of specific rewards (Ryan & Deci, 2000).

The pleasure and satisfaction derived from ones performance are the source of intrinsically motivated behaviors. Intrinsic motivation leads people to behaviors which are interesting, done freely, “with a full sense of volition”, even there are no rewards or constraints (Deci, Vallerand, Pelletier, & Ryan, 1991).

Intrinsic motivation is also postulated to have three independent types. Vallerand et al. (1992) summarizes these three types of intrinsic motivation as follows:

- Intrinsic motivation to know: It is known as an activity through which the performer can take pleasure and satisfaction. Because while experiencing new things in learning, exploring, and trying, they become more happy from what they are learning and exploring. For example, if the respective students are intrinsically motivated. It stands for that they like to read books not because of money or other thing just the sheer pleasure, since the students learn new things through which they take pleasure;

- Intrinsic motivation toward accomplishments (it is a motivation to obtain things). It is known as second type of intrinsic motivation, and it is not only in the field of developmental psychology but also it is in the field of educational research, since there is an approach of mastery motivation (Harter 1981). Moreover, the respective student gets engaged in an environment where they feel competent in order to exhibit their exclusive accomplishments (Deci, 1975; Deci and Ryan, 1985, 1991). Eventually, the students mainly focus on achievement more than the results. Because the students are likely to motivate on achievements that are under the umbrella of IM-to obtain things. The idea is that engaging in an activity for not only the pleasure and satisfaction but also attempting to obtain new things. That is known as accomplishment, which is required more than the others are and anyway satisfaction and pleasure will come with accomplishments. Therefore, the students aim to accomplish a term or final paper not because of pleasure and satisfaction but just accomplishments;

- Intrinsic motivation to experience stimulation (Intrinsic motivation to experience stimulation). Eventually, this type of motivation is considered operative, since it includes to experience stimulation on the ground. If the students would like to get involved in an activity, they aim to have experience of stimulating sensations especially for pleasure, fun, or excitement. According to research, it is aimed to find out the feelings of excitements and the stimulating experiences from the dynamic and holistic point of view in order to understand the intrinsic motivation (e.g. Csikszentmihalyi, 1975). If the students have passion of class discussion or reading books for their cognitive pleasure, it is understood that those students are motivated intrinsically, since they would like to experience stimulation in education.

2.11.2. Self – Determination

Students' motivated actions have got strong relations with their intention, and their regulatory process includes the choice. If the actions of the students are allowed by sense of self than they are considered that they are self - determined (Deci & Ryan, 1991), if the students are pushed by two forces: intrapsychic force and interpersonal, there is a compliant regulatory process in order to control the situation (Deci et al., 1991).

Actually, self-determination is known as main causal agent in an individual's life especially for decision making in relation to individual's quality of life that is considered free from both undue external influence and at the same time from interference. In this regard, the following four characteristics play important roles, they are as follows: (a) the autonomous action of individual; (b) self-regulated behaviors; (c) the person's initiation and response towards events through "psychologically empowered" fashion; and (d) the action of the person in self-realizing fashion (as cited inWehmeyer & Schwartz, 1997). In case, the students exhibit their own priorities, capabilities and interests and at the same time the whole behaviors are free from external effects. In this case, the behavior is known as autonomous. Also, if the students have authority of how make decisions in relation to their abilities, the students are considered as self-regulated, since they know how plan and examine the task and the whole process of action plan and revision accordingly. If the students are aware of their belief that they know how to use the existing capacity in order to influence the results. It stands for that the students are known as psychologically empowered, since they expect outcomes with the help of a certain behavior. If the students know that to some extend they are aware of their strong and weak points in relation to use their behaviors for attaining knowledge and information for the good of themselves, it stands for that the students are self-realized (Wehmeyer & Schwartz, 1997).

2.11.3. Self – Efficacy

Self – efficacy involves in the belief of capabilities in order to organize and implement due action in relation to managing aimed situations (Bandura, 1977). Bandura, (1982, p. 122) also describes self-efficacy as a personal judgment of "how well one can execute courses of action required to deal with prospective situations" (as cited in Stajkovic & Luthans, 1998). On the other hand, as cited in Abak (2003) one's feelings of mastery, or an ability to be successful in a given specific subject (Zimmerman, 1995; Bong & Clark, 1999).

2.11.4. Extrinsic motivation

If the students have aim to obtain some distinguishable results with the help of some activities, then they try to exhibit those behaviors which is called extrinsic motivation which differs from intrinsic motivation (Ryan & Deci, 2000). Therefore, if the students are motivated by external outcomes such as; diploma, money or career oriented study, they focus on not pleasure and enjoyment but they focus on external awards (Ryan & Deci, 2000). Both include intended behavior (Heider, 1958); nonetheless, they appear autonomously in relative fashion. Extrinsic motivation includes two main things, which are awards and punishments, since the students would like to obtain one and to avoid the other and accordingly they exhibit behaviors of avoiding punishment and receiving the rewards (Vallerand, 1997).

Early researches suggested that intrinsic motivation and extrinsic motivation having additive relationship as they were added up to result in highest level of motivation while later research on intrinsic motivation and extrinsic motivation, Deci (1971) showed that engaging in activities which had monetary reward (extrinsic motivation) intrinsic motivation in the activity dimmed as a result "intrinsic motivation was undermined by the controlling nature of the reward" as cited in (as cited in Vallerand, 1997).

2.12. Attitude

Abak (2003) stated that 50% of the variance in learning outcomes could be explained by cognitive characteristics where 50% is undefined leaded researchers to focus on affective characteristics, which may affect learning. The result of researches on these characteristics, the key affective components can be grouped under attitude and motivation (Gungor, Eryılmaz, & Fakıoglu, 2007).

Although there are many definitions of attitude, according Ajzen and Fishbein (1977) "a person's attitude represents his evaluation of the entity in question". Attitude is summation of someone's "inclinations and feelings, prejudice or bias, preconceived notions, ideas, fears, threats, and convictions about any specified topic" (L. L. Thurstone, 1928). As cited in Tanrıverdi and Demirbaş (2012) attitude as the most important affective factor which influences learning, it has positive as well as negative effect on individuals learning (Yaşar & Anagün, 2008). Attitude is formed by organization of experiences and knowledge (Tavşancıl, 2002), and according to Ekici (2002) one of the best descriptors of behavior with cognitive, affective and psychomotor dimensions (as cited in Tanrıverdi & Demirbaş, 2012).

Gagne (1985) described attitude as interaction of cognitive, affective, and behavioral domains as a mental state where learners' behaviors effected while they make their choices (as cited in Olagunju & Zongo, 2011). According to Koballa and Glynn (2007) attitude effects motivation and motivation effects learning. Attitude can also be defined as "tendency to respond positively or negatively to things, people, places, events or ideas" as cited in (Simpson, Koballa, Oliver and Crawley as cited in Tokgöz, 2007) from (Simpson, Koballa, Oliver and Crawley).

It is important to measure a construct like attitude as well to define it. It had been always assumed to be a complex process. L. L. Thurstone (1928) described this process as:

In case, a method of measuring attitude is expected to be used, the researcher is likely to try to get along with the fewest possible restrictions, since the researcher is willing to disregard so many factors that the original problem disappears. Therefore, the researchers trust that they will not be accused of throwing out the baby with its bath.

As stated by Kaya and Boyuk (2011) there are many scales developed to measure attitude. L. Thurstone and Chave (1929) developed an attitude scale. Later on Likert, Roslow, and Murphy (1934) utilized a simple and reliable method to score Thurstone Attitude Scales which is well-known and widely used even after 80 years.

One of the most challenging lessons for students from secondary school to university even for adults in graduate studies is physics (Erdemir, 2009). As cited in Erdemir (2009) learning environment and attitude towards it is also important factor though it should be also measured while measuring students' attitudes towards physics should take into account their attitudes towards the learning environment (Crawley & Black, 1992).

Basic objective of science learning should be increasing students' attitude towards physics as their attitude (feel) towards science influences their performance while research in the field showed that increase in students' science achievement could be possible with positive attitudes toward science (Cannon & Simpson, 1985; Simpson & Oliver, 1985; 1990, as cited in Tokgöz, 2007).

Researchers conducted abundant studies in order to find out the factors effecting the attitude towards science/physics based on the fact that the students do not like physics lessons as well as their physics teaches unless they have positive attitude towards physics (Erdemir, 2009).

The enjoyment and importance of physics play important role for motivation, accordingly the students exhibit interest related behavior in learning environment.

2.12.1. Enjoyment

Within the framework of the TAM, Davis et al. (1992) suggested that perceived enjoyment is similar to intrinsic motivation, which drives the performance of an activity that is not linked for any reason other than the process of performing the activity per se. As an example, when comparing two training methods (traditional training vs. game-based training) (Davis et al., 1992). Venkatesh and Speier (2000) found that the game-based training method aimed at enhancing intrinsic motivation resulted in higher enjoyment and higher perceived ease of use results than the traditional training method. In addition, Venkatesh (2000) found that the effect of enjoyment on perceived ease of use became stronger as users gained more direct experience with the system over time. These findings suggest that perceived ease of use is influenced by the extent to which users perceive using the system to be enjoyable (Venkatesh and Speier, 2000).

Davis et al. (1992) found that usefulness and enjoyment were significant determinants of behavioral intention (Davis et al., 1992) and Venkatesh (2000) showed that enjoyment influenced perceived usefulness via ease of use (Venkatesh, 2000). Perceived usefulness measures how people believe their productivity and effectiveness can be improved as a result of using technology. Perceived enjoyment has also been found to be significantly related to the intention to use computers (Igbaria, Guimaraes, & Davis 1995). Teo, Lim, and Lai (1999) investigated the impact of PU, PEU, and PEN on Internet use, found that respondents' enjoyment of the Internet was influenced by perceived usefulness, and perceived enjoyment (Teo et al., 1999). They also found that PEN had a significant effect on frequency of use (Teo et al., 1999). Further, Moon and Kim (2001) used a sample of

152 Korean graduate students to test the influence of perceived usefulness and perceived enjoyment (defined as perceived playfulness in their study) on Internet use and they had similarly found support for the mediation of PEN on intention (Teo & Noyes, 2011). Thus, it can be seen that perceived enjoyment may act to exert a significant influence on a user's intention to use, perceived usefulness, and perceived ease of use of technology. The following three hypotheses were generated (Teo & Noyes, 2011).

2.12.2. Importance of Physics

As cited in (Abak, 2003) importance of science, value of science, and usefulness of science are mentioned as dimensions of attitude (Aiken, 1979; Barrington & Hendricks, 1988; Schibeci & Riley, 1986; Yager & Penick, 1986).

2.12.3. Achievement – Motivation

Achievement motivation is one of the most important concepts for science educators. However, there are not enough studies about achievement motivation in science education. Simpson and his colleagues studied (Cannon & Simpson, 1985; Simpson & Oliver, 1985; Talton & Simpson, 1986; etc.) achievement motivation as a part of a longitudinal study. This effort enlightened the relationship of achievement motivation in science and achievement in science. It also provided more information about attitudes toward science, and science self-concept.

Simpson and his colleagues published several reports about adolescent students and their attitudes and also the major influences on attitude toward science and achievement.

Simpson and Oliver (1985) have summarized the results of the longitudinal effort. The sample was 4508 students in grades 6 through 10. The instruments were administered at the beginning, middle, and end of the 1980-1981 school year. In addition to data from self-reported student questionnaires, achievement tests, semester grades, and teacher questionnaires, the science supervisor evaluated each teacher involved in the study. During 1985- 1986 school year extensive data were collected and additional analysis were conducted to see if selection of science courses, participation in science activities, science achievement, and other high school decisions could be predicted from data collected during the 1980-1981 school year. The correlation coefficient between achievement motivation and the semester science grade is .104 and the final science grade is .101. The correlation coefficients decreased when standardized measures were taken as achievement scores. Moreover, the coefficients declined from the beginning of the year to the end. Achievement motivation had stronger relationships with attitude toward science. At the beginning of the semester the correlation coefficient was .390, decreased to .375 at the middle of the semester, and was .367 at the end. In agreement with the initial study, girls had consistently higher motivation to achieve in science in the longitudinal study.

2.12.4. Interest Related Behavior

Similar to attitude research, the origins of interest research are based upon the idea that interest plays a major role in the course and outcome of our mental activities (Hidi, 1990). However, there is a small difference: achievement in science seems more highly related to interest in science than it is to psychologically scaled attitude (Willson, 1983).

Sometimes interest is treated as a dimension of attitude and sometimes is treated independent of attitude. Feelings of enjoyment and involvement are the most typical of interest (Schiefele, 1991). Accordingly, enjoyment is sometimes seen as a dimension of attitude.

In relation to the effects of gender on science and physics, as there is a claim that boys are willing to be more interested in science and physics than girls. In a detailed research project, Häussler (1987) investigated the effects of gender on physics interest. He assessed students' interest in physics on the basis of a curricular model of physics education with three dimensions: topic, context and activity (Häussler, 1987). The sample consisted of about 4000 students between the ages of 11 and 16 attending different kinds of schools in the Federal Republic of Germany. He studied eight different topics in physics: optics, acoustics, heat, mechanics, electricity, electronics, structure of matter, radioactivity, and nuclear power (Häussler, 1987). All of the topics fell in the interval between moderate and great interest. There was no dramatic change in preference as age increases. Nevertheless, there were remarkable gender differences. Girls liked topics like light or heat or acoustics, i.e., topics that are grasped by senses almost equally well or better than did boys; but they were less attracted than boys by all other topics. The gap in radioactivity and nuclear power disappeared with age. On the other hand, the gap in electronics widened with age. These results suggested that context is by far the most dominating dimension; the interest dimension is independent of school type; the gap in interest between boys and girls might be closed if physics is treated not solely as a scientific enterprise but also in its connection to the society as a whole, including controversial issues.

Jones, Howe and Rua (2000) also investigated the gender effects on student interests in science. Their sample was 437 sixth grade U.S. students. They used the survey instrument “Science and Scientists” developed by Sjøberg (2000). Their results fit the general claim in accordance with Häussler (1987) that the boys are more interested in physical science, while girls are more interested in biological science (Häussler, 1987).

Häussler and Hoffmann (2000) took interest as a multi-dimensional construct and checked the relationship between them. They assessed the students’ interest in physics and physics as a school subject as a part of a curriculum development study (Häussler and Hoffmann, 2000).

Interest data of some 8000 students and information of the presently taught physics curriculum were sampled longitudinally as well as cross-sectionally in various German states by questionnaire (Häussler and Hoffmann, 2000). The study revealed that a student who is interested in physics and fascinated by technological objects or natural phenomena, who recognized the general importance of physics or the role that physics might play in his or her future vocation, might nevertheless not be interested in the kind of physics he or she encountered in the classroom. That is, students’ interest in physics as a school subject is only marginally related to their interest in physics, rather it is related mainly to the students’ self-esteem and their sense of academic achievement (Häussler and Hoffmann, 2000). They concluded that physics as it is taught in the majority of the physics courses does not seriously take into account students' interests.

2.13. Gender Issues

The research in education involve and try to find out the factors affecting students' achievement as well as to increase students' attitudes and motivations. As cited in Temizkan (2003) gender has significant effect on students' physics achievement (Temizkan, 2003), and (Yıldırım and Eryılmaz, 1999) in favor of boys, while students of age nine have similar scores, with the age of 13 gap increases and it narrows at age 17 (Yıldırım and Eryılmaz, 1999).

It is also reported that girls are less represented in science related professions (Reid & Skryabina, 2003). Boys have higher attitude towards science, especially in physics, than girls but this shouldn't be understood as a problem of girls in physics (Reid & Skryabina, 2003) or different brain structures and functions of females (Temizkan, 2003). Girls are distracted by parents, peers, teachers from science because of the consideration of this field to be unfeminine (Temizkan, 2003). According to Murphy (1990) Girls experiences during childhood such "as the environment at home or in the local community, and exposure to the media and advertising" (Murphy, 1990), influence their interest as well as toys they are given to play, hobbies advised to them, household jobs even stereotypes in books, films and televisions may keep girls away from science (Kelly, 1981; as cited in Reid & Skryabina, 2003). According to Stables (1990) broader curriculum also effects students' attitude.

Boys and girls may have different levels of attitudes toward physics where boys, with respect to girls, were observed to have higher attitude (Peşman, 2012).

Tindall and Hamil (2004) listed and summarized solutions in order to reduce gender disparity in science education as follows:

- Connect Science Concepts to Life Experiences;
- Promote an Environment of Self-Confidence and Success;
- Create a Sense of Community;
- Provide Students with Positive Female Role Models;
- Advocate Gender-Fair Materials.

Among the above mentioned solutions, connecting science concepts to life experiences is one of the major starting points of contextual approach. As boys are involved more physical sciences connected with their out of school activities with respect girls they tend to develop more interest with respect to girls. Career plans of girls are basically concentrated on supporting careers (helping and caring) on the contrary physical sciences are not anticipated among these careers causing girls to have less interest (Tindall & Hamil, 2004). Science interest and participation can be achieved with connecting everyday life experiences with scientific processes such as stimulating girls (also boys) with "encouraging discussions and reflections on the importance of physics in the real world, connecting physics with applications, showing physics in relation to the human body" (Tindall & Hamil, 2004) may reduce the gender gap (Tindall & Hamil, 2004). However many teachers are not concerned about encouraging participation of girls (Temizkan, 2003).

In order to increase interest of girls, self concept and physics achievement following strategies can be followed according to the research results of Häussler and Hoffmann (2002) as cited in Temizkan (2003):

- Adapting the curriculum in a way that comes to the interest of girls (and likewise of boys);
- Teaching girls and boys separately, which enhances the effect of an interest-guided curriculum;
- Recognizing that separating girls and boys in physics classes is probably ineffective when not supported by a girl-friendly curriculum and a gender-fair teacher;
- Ignoring girls' feelings towards monoeducation, which are, on average, ambivalent at first. Once they have experienced it, they like the separation and would like to continue it. Boys are indifferent in this respect;
- Measuring achievement several weeks after the instruction has ended, which may reveal interesting developments;

- Being patient when it comes to changing teacher behavior. This is much more difficult and takes more time.

According to Peşman (2012) there is a gap in between boys and girls in physics instruction in favor of boys and cited the problems and solutions which may help to reduce this gap as follows:

- During the physics instruction girls and boys have the largest gender difference in achievement (Taasoobshirazi & Carr, 2008) and girls benefit from context-based physics instruction more, because some hands-on activities might help the girls for fostering their understanding of physics concepts;

- Students, especially girls think that physics is irrelevant for their future goals, as context based physics instruction makes use of daily life in order to make physics relevant to them. In other words context based physics instruction may reduce the gap in physics in favor of girls while making physics more relevant to their lives (Murphy & Whitelegg, 2006);

- It is also reported that the gap is not only present in achievement but also in motivation (Taasoobshirazi, 2007). As context based physics instruction is expected to make physics more relevant to students' lives gender related this gap may be closed.

According to Stables (1990) and Reid and Skryabina (2003) type of schools (mixed/single gender) also a factor in students' subject preferences. Pupils are effected from each other.

For example, girls in mixed schools prefer physics more than the girls in single gender schools. Boys are much more effected from the presence of girls in terms of science interest. The following Table 2.24 and Table 2.25 summarizes subject preferences of boys and girls with respect to school types.

In certain areas of the curriculum this divergence of feelings is observed towards subjects and when it occurs the tendency is strongly for example in physics the results are really remarkable (Stables, 1990).

Table 2.24 - Boys' subject preferences (Stables, 1990)

Boys in mixed schools		**Boys in single - gender schools**	
Subject	Mean	Subject	Mean
Physics	5,4	English	5
Games/PE	5,6	Games/PE	5,6
Geography	5,8	Chemistry	6
English	6	History	6
Mathematics	6	Mathematics	6,2
Craft	6,2	Art	6,4
Art	6,4	Biology	6,4
Chemistry	6,6	Geography	6,6
History	6,6	Physics	6,8
Physical Science	7	Craft	7
Biology	7,8	General Science	7
General Science	8,4	French	8,2

Vockell and Lobonc (1981:217) mentioned that physics is considered to be ‘more masculine’ by the girls from coeducational schools than the girls from non-coeducational schools. As interaction with boys is expected to increase stereotyping rather than decreasing, girls may develop positive attitude towards physics if they are taught separately from boys. It was suggested that girls will develop more positive attitudes towards physics if they are taught separately from boys, because interaction with boys (as cited in Reid & Skryabina, 2003).

Another important aspect is the “attitudes of teachers towards girls’ abilities in physics” (Reid & Skryabina, 2003). According to Harding (1982) “the individual behaviour and teaching style of a teacher may be more effective in influencing girls in their enjoyment and choice of physical science than their sex as such” (as cited in Reid & Skryabina, 2003).

Girls in mixed schools		**Girls in single - gender schools**	
Subject	Mean	Subject	Mean
Mathematics	1,8	Mathematics	1,8
English	2,2	English	2,2
Biology	5,6	General Science	5,0
Chemistry	6,0	Chemistry	5,4
Geography	6,2	Physics	5,4
Physics	6,2	Biology	5,8
French	7,0	Geography	6,6
History	7,0	French	6,8
Physical Science	8,0	History	7,4
German	8,4	Home Economics	8,0
Home Economics	8,8	German	8,6
Art	10,2	Craft	9,6

CHAPTER III:

3. METHODOLOGY

This chapter presents information on the target population, the accessible population to which the results are generalized, the sample drawn from the accessible population, variables in the study, the instruments used for measurement, the materials used in treatments, the methodology of research, the researched procedure followed, research design, implementation, treatment verification, treatment fidelity, procedure followed in statistical analysis of data, power analysis for estimating the required sample size, unit of analysis, and the assumptions and limitations related to the study.

3.1. Population and Sample

The target population consists of all 10th grade students from private schools in Albania. The accessible population is 10th grade students from Turkish private schools in Albania. The random sampling was not possible because the design requires to be working on intact groups. It is not also possible to randomly assign students to the groups. The schools in the study was chosen with respect to their availability.

The sample of the study was chosen from the accessible population by using convenience sampling. There were six Turkish private schools in the accessible population and only five of them were convenient to be included in the present study. The instructor of the sixth school was not available to participate in the study. From five schools eight classes out of 18 classes were assigned randomly as experimental group of the study. As a result, a total of eighteen classes, ten of them are control group and remaining eight of them are experimental group, from five high schools, 326 10th grade students formed the sample of the study. The sample size is obtained from schools' registrar records, it is different from the sample size included in statistical analyses, and it will be discussed in Chapter 4. Detailed information for sample size is given in **Error! Reference source not found.**.

Table 3.1 - Number of students regarding to each class and school for control and experimental groups.

School	Control Group		Experimental Group		Total	
	class size	attended	class size	attended	class size	attended
A	15	14	20	19	35	33
B	30	28	21	20	51	48
C	47	46	24	23	71	69
D	13	13	8	8	21	21
E	73	69	75	72	148	141
Total	178	170	148	142	326	312

There are one experimental and one control group in the study, Traditional Method with Contextual Approach (TMCA) and Traditional Method with Non-Contextual Approach (TMNCA) respectively. Distribution of genders with respect to schools are given in **Error! Reference source not found.**.

Physics course end of term grades of students among control and experimental groups are given with respect to schools in **Error! Reference source not found.**.

Table 3.2 - Gender distribution of control and experimental groups among the schools

	Control Group (TMNCA)		Experimental Group (TMCA)		Total		
School	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Grand Total**
A	6	8	14	5	14	19	33
B	-	28	-	20	-	48	48
C	46	-	23	-	69	-	69
D	8	5	6	2	14	7	21
E	30	39	35	37	65	76	141
Total	90	80	78	64	166	144	312

Physics achievement of students participated in the study is quite high as it was seen from **Error! Reference source not found.**. The frequency distribution of students' physics course grades are given in **Error! Reference source not found.**. It is seen that more than 40% of students get 10 from physics course.

Table 3.3 - Physics course grade averages of control and experimental groups.

	Control Group (TMNCA)		Experimental Group (TMCA)		Total		
School	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Grand Total**
A	7.75	6.90	8.71	9.24	8.42	7.80	8.18
B	-	8.65	-	8.49	-	8.59	8.59
C	8.42	-	9.02	-	8.61	-	8.61
D	7.76	6.20	8.58	7.5	8.13	6.44	7.55
E	9.11	9.07	9.27	8.82	9.19	8.96	9.06
Total	8.56	8.52	9.04	8.70	8.78	8.60	8.70

There were five schools involved in the study. Three of them are coeducational schools and two of them are non – coeducational school, boys and girls schools respectively. One of the coeducational school is an international school, and all five schools have science courses in English.

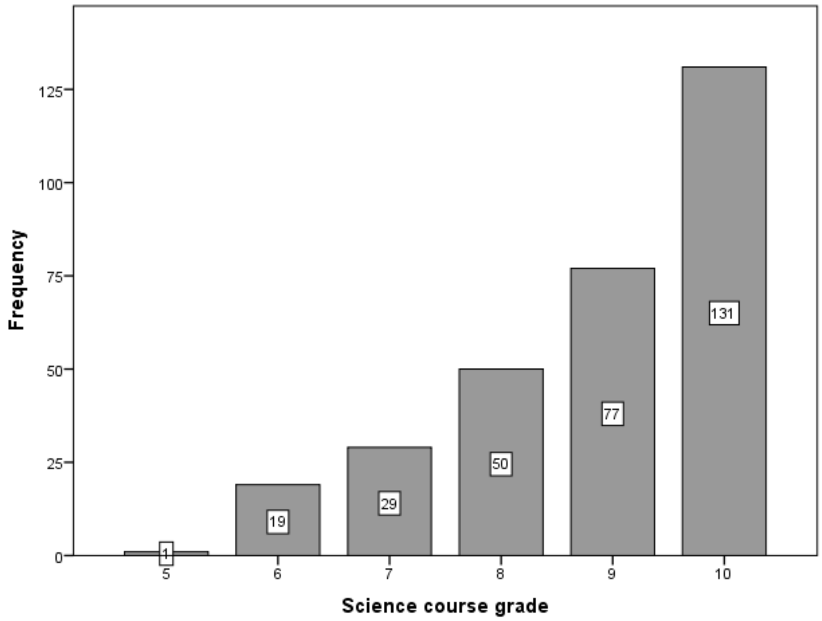


Figure 3.1 - Frequency distribution of students' physics course grades

From five schools seven teachers are involved in the study. Three of them were female and four of them were male teachers of similar age and experience.

3.2. Variables

There are six independent (group membership and covariates) and three dependent variables used in this study.

As cited in Sönmez (2015), Fraenkel and Wallen (2006) stated that the most powerful method to analyze the relations among the variables is to use experimental research designs. In experimental studies, at least one variable (independent variable) is manipulated to analyze the effect of this manipulation on other variables (dependent variables). The manipulation on dependent variables is not possible where they only change with the changes in independent variables (Sönmez, 2015).

Independent variable (IV) of the study is teaching approach (approach). “Approach'” shows group membership which has two levels: Traditional Method with Contextual Approach (TMCA) and Traditional Method with Non-Contextual Approach (TMNCA).

Dependent variables (DV) of the study are students’ posttest scores on Newton’s Laws of Motion achievement test (POSTNLMAT), students’ posttest scores on attitude toward Newton’s Laws of Motion course test (POSTATT), students’ posttest scores of physics motivation test (POSTMOT).

Extraneous variables (EV) of the study are students’ pretest scores on Newton’s Laws of Motion achievement test (PRENLMAT), students’ pretest scores on attitude toward Newton’s Laws of Motion course test (PREATT), and students’ pretest scores of physics motivation test (PREMOT). These variables PRENLMAT, PREATT, and PREMOT are possible variables to be used as covariate for adjusting the dependent variables, in other words these variables can be used to ensure equality between groups (statistical matching) with respect to these variables.

Some characteristics of the independent variables dependent variables and extraneous variables are given in **Error! Reference source not found.**.

Table 3.4 - List of Independent and Dependent Variables

Variable	Dependent (DV) / Independent (IV)	Continuous / Categorical	Scale	Measured by
approach	IV	Categorical	Nominal	NA
gender	IV	Categorical	Nominal	Questions in ATT
PRENLMAT	EV	Continuous	Interval	Pre-test cores of NLMAT
PREATT	EV	Continuous	Interval	Pre-test cores of ATT
PREMOT	EV	Continuous	Interval	Pre-test cores of MOT
grade	IV	Continuous	Interval	Registrar's records
POSTNLMAT	DV	Continuous	Interval	Post-test cores of NLMAT
POSTATT	DV	Continuous	Interval	Post-test cores of ATT
POSTMOT	DV	Continuous	Interval	Post-test cores of MOT

3.3. Instruments

There are four instruments in the study. Newton's Laws of Motion Achievement Test (NLMAT) was developed by the researcher. Attitude toward Newton's Laws of Motion Course Test (ATT) is the adapted version of the AT, which was originally developed by (Taşlıdere, 2002). Physics motivation test (MOT) is the adapted version of the Science Motivation Questionnaire (SMQ) developed by Glynn et al. (2011). Observation Checklist (OCL) adopted from the works of Gökalp (2011) and Peşman (2012). These instruments are discussed comprehensively in the succeeding sections.

A classroom inventory form adopted from The School Inventory Form of Gökalp (2011) to check availability of multimedia options in physics classrooms and if they are being used during physics lessons. The Classroom Inventory Form consist of questions which are asked to check availability of video projector, interactive board and other available technologies in the classroom and how often they are utilized. The

CLASSROOM INVENTORY FORM

Physical Properties of Classroom	**Yes**	**Partial**	**NO**
1. Is lighting enough?			
2. Is the ambient temperature appropriate?			
3. Is there enough desks?			
4. Is there any video projector?			
5. Is there any interactive board?			
Question 4 and 5 if yes: How frequently they were used to present course materials?			

is given in Appendix B.

3.3.1. Newton's Laws of Motion Achievement Test (NLMAT)

Newton's Laws of Motion Achievement Test (NLMAT) was developed by the researcher. The purpose of NLMAT is to measure students' academic achievement in the Newton's Laws of Motion topic. As the first step of test construction process, instructional objectives of the topic were defined. The textbooks and unit plans of the respective schools are analyzed to form the list of the instructional objectives:

- Regarding the force cause of motion: Students should be able to;
    - Describe the force with examples based on the effects of it on objects.
    - Describe the force as a vector quantity with examples.

- Calculate the resultant force from different ways.

- When the net force is zero: Students should be able to;
    - Explain the motion of the objects with examples.
- Regarding the object in motion with the influence of a net force: Students should be able to;
    - Solve problems using the relation of net force with acceleration and mass of an object.
    - Explain the motion in one dimension with constant acceleration.
- Regarding the action reaction forces; Students should be able to
    - Explains action-reaction pairs with examples.
    - Calculate the acceleration of the systems with more than one body.
    - Construct free-body diagrams.
- Regarding the inertia of an object: Students should be able to;
    - Explain inertia by relating motion of the object when it is at rest, moving with constant velocity and constant acceleration.
    - Explain inertia as a measure of its mass with examples.

The level of these objectives are ranging from knowledge to application with respect to cognitive domain of Bloom's Taxonomy.

The lecturing hours of the schools were 40 minutes. With the intention of measuring each instructional objective as well as to have the test conducted during one lecturing hour, it was decided to develop at least two items per instructional objective. Multiple choice and true/false types of items are decided to be developed to have more objective test results.

As the second step, achievement tests which are previously developed on the content of Newton's Laws of Motion were reviewed from textbooks, these studies, test books, Internet, Higher School Certificate Examination, and School Certificate Test of New South Wales, Australia. Some of the test items are selected from the above mentioned sources which are coincide with instructional objectives of the topic and other are developed by the researcher. In order to measure all 11 instructional objectives of the topic 25 test items are used in NLMAT. Table of test specification for the NLMAT is given in **Error! Reference source not found.**. The questions are categorized as traditional and context-based questions and they are almost equal in number so that the test would not be in favor of any groups.

An English teacher and a physics teacher who gives physics courses in English have edited the test for grammar and spelling errors. Five education researchers' opinions taken to confirm content and face validity. EXPERT OPINION FORM FOR THE NEWTON'S LAWS OF MOTION ACHIEVEMENT TEST (NLMAT) (See Appendix A) is an adopted version of Expert Opinion Form for Force and Motion Achievement Test (FMAT) (Gökalp, 2011).

The reviewers compared the cognitive level of the objectives and questions with respect to Bloom's Taxonomy. Most of the reviewers approved that questions were compatible with their objectives and they are represented by enough number of items. The items were correct in grammar and there were no ambiguity.

The students of tenth grade has not covered Newton's Laws of Motion unit yet. Consequently, it was decided to conduct the pilot study with 11th graders which are already been taught Newton's Laws of Motion unit before administering the test. Pilot study with 354 11th grade students was done with this version of the NLMAT from three of the schools participated in the current study.

Table 3.5 – Table of Specifications for Newton's Law of Motion Achievement Test (NLMAT)

	Level in Bloom's Taxonomy				
Objective	Item	Knowledge	Comprehension	Application	Total
Regarding the force cause of motion: Students should be able to;					
Describe the force with examples based on the effects of it on objects.	1	●			3
	2	●			
	3	●			
Describe the force as a vector quantity with examples.	4	●			4
	5	●			
	6	●			
	7	●			
Calculate the resultant force from different ways.	10			●	2
	11			●	
When the net force is zero: Students should be able to;					
Explain the motion of the objects with examples.	12		●		2
	13		●		
Regarding the object in motion with the influence of a net force: Students should be able to;					
Solve problems using the relation of net force with acceleration and mass of an object.	14			●	2
	15			●	
Explain the motion in one dimension with constant acceleration.	8		●		2
	9		●		
Regarding the action reaction forces; Students should be able to;					
Explains action-reaction pairs with examples.	16		●		2
	24		●		
Calculate the acceleration of the systems with more than one body.	17			●	2
	25			●	
Construct free-body diagrams.	18			●	2
	19			●	
Regarding the inertia of an object: Students Should be able to;					
Explain inertia by relating motion of the object when it is at rest, moving with constant velocity and constant acceleration.	20		●		2
	21		●		
Explain inertia as a measure of its mass with examples.	22		●		2
	23		●		

ITEMAN 3.00 has been used to carry out item analysis. The output is given in Appendix C. The internal reliability coefficient for the test was found to be 0.77. Descriptive statistics regarding the pilot data is listed at the end of the output. There were 25 items analyzed. Mean was 14.04 where maximum possible score was 25. Mean item difficulty

was 0.56, this indicates medium difficulty level. Skewness and kurtosis values indicates a normal distribution of pilot data. Mean biserial was .52. It indicates the correlation between item score and total score defining most of the high achievers responded correctly and low achieves responded wrong. There were no item with negative discrimination index. All of the indices are above .20 except item 24. As there were no serious problems regarding the items all of them decided to be held in the test. Final version of the test is given in Appendix R.

3.3.2. Attitude towards Newton's Laws of Motion Test (ATT)

Taşlıdere (2002) has developed an attitude test to measure attitude of students towards "simple electric circuits" content and Küçüker (2004) used the same test on the same topic while making some modifications such as writing items in negative form (five of the test items), 23rd and 24th of the test items written in new form (as cited in Serin, 2009).

Serin (2009) used modified version of the attitude test. The previous versions were measuring attitude of the students towards "simple electric circuits". In order to adopt this test to pressure unit the terms "simple electric circuits" had been replaced with "pressure" (Serin, 2009). The test was successful to measure attitude of students towards physics contents, later on numerous researchers adopted the test in their respective content of interests. For example, Temizkan (2003) and Gökalp (2011) modified the test for force and motion content and similarly Eryılmaz (2004) modified the test for the content of Newton's Laws of Motion unit. The attitude test not only used in physics contents but also used in other fields such as biology. Koksal and Berberoglu (2014) used the attitude test for “growth in living things” unit.

Albanian version of the Attitude towards Newton’s Laws of Motion Test (ATT) was derived form of the AT which had been already modified to measure attitude of students towards pressure unit (Serin, 2009). The revision of the test made by changing and replacing the term “pressure” with “Newton’s Laws of Motion” terms. This replacement had been made to measure attitude of 10^{th} grade students toward Newton's Laws of Motion.

The Newton’s Laws of Motion unit includes the following content:

- Law of inertia (First Law of Newton)
- Force, Mass & Acceleration (Second Law of Newton)
- Constant force and change in velocity
- Magnitude of force and acceleration relation.
- Action and Reaction (Third Law of Newton)

ATT is rated on 5-point Likert scale and consist of 24 test items. The final version of the test is given in Appendix E. The students are expected to make choice among “strongly disagree” to “strongly agree” where their choices are rated with numbers staring from one to five respectively. Thus, the lowest score of the test is 24 and the highest score of the test is 120. Between the ranges of scores, the attitude of the student towards Newton's

Laws of Motion content is being measured where a low score shows lower and high score shows higher attitude towards the content. The test composed of five components which are self-efficacy, enjoyment, achievement-motivation, importance of physics, and interest related behavior. The test items and the components of the Taşlıdere's study (as cited in Serin, 2009) correspondingly given in **Error! Reference source not found.**.

The AT, as reported, has high reliability coefficient. Taşlıdere, Küçüker (as cited in Serin, 2009) and Serin (2009) stated the Cronbach's alpha reliability coefficient of the test as 0.94, 0.83, and 0.91 respectively. The Albanian adopted version of AT (ATT) has Cronbach's alpha reliability coefficient of 0.75. Here this coefficient states that minimum 75% of the total score variance is with respect to true score variance.

During the adaptation process, three separate polyglot researchers translated the AT from Turkish to Albanian independently. Then inconsistencies among the translations compared to assure validity. Afterward, two independent researchers translated Albanian version back to original language to compare with the original test to assure consistency. Subsequently, the Albanian version of AT given to 17 students to verify face and content validity. During the pilot study from five different high schools, 387 students involved where number of boys and girls were 189 and 198 respectively. The duration of the test was 15 minutes and administration of test made during physics lectures.

Table 3.6 – The components and the respective items of the AT provided in Taşlıdere's study (as cited in Serin, 2009)

Components	Items
Enjoyment	1 - I like the "Newton's Laws of Motion" chapter. 2 - I have positive feelings about the NLoM chapter. 16 - The NLoM chapter is entertaining for me. 17 - I don't like studying on the NLoM chapter at school. 23 - The NLoM chapter is effective in improving my manual skills.
Self-efficacy	9 - I am sure that I can learn the NLoM chapter. 10 - I am sure that I can succeed in the NLoM chapter. 11 - I am sure that I can solve the hard problems of the NLoM chapter. 18 - I believe I can cope with harder problems of the NLoM chapter. 21 - I believe I can solve the hardest problems of NLoM chapter if I have enough time.
Importance of physics	3 - I believe that what I've learned from the NLoM chapter will make my life easier. 4 - I don't believe that the NLoM chapter will gain more importance in the future. 5 - I believe that the NLoM chapter will be beneficial for my further studies. 13 - I don't think that the NLoM chapter will have any importance in my prospective vocational life. 14 - I believe that what I've learned in the NLoM chapter will be useful in my daily life.
Achievement-motivation	6 - I will do my best to be successful at the NLoM chapter. 7 - I will try my best for the NLoM chapter. 8 - I will not try harder if I do not succeed in the NLoM chapter. 12 - I will try my best to solve the problems related to the NLoM chapter no matter how difficult they are.
Interest related behavior	15 - I like reading books about the NLoM chapter and its applications in technology. 19 - Talking with my friends about the NLoM after school is enjoyable. 20 - I would like to be given books and tools related with the NLoM chapter as gifts. 22 - I like talking about the NLoM chapter or its applications in technology. 24 - I don't want to have more lesson hours for the NLoM chapter.

Statistical Package for the Social Sciences (IBM SPSS 21.0 for Windows) software was used to analyze the data gathered from the pilot study. The expected responses to the test were strongly disagree, disagree, neutral, agree, strongly agree and these responses were coded from one to five respectively. As there are 24 test items the minimum score and the maximum score of the test expected to be 24 and 120 respectively. The Cronbach's alpha coefficient is a measure to evaluate reliability of test scores. In other words, it is a measure of internal consistency and may take values from zero to one. Fraenkel and Wallen (2003, p. 168) recommend that the value of Cronbach's alpha should be equal to .70 and higher values are preferred for the educational studies. It was reported that the

Cronbach's alpha reliability coefficient was in between .65 and .98 when the research studies regarding attitude of students towards science were analyzed (Kaya & Boyuk, 2011).

According to Field (2000) the Kaiser-Meyer-Olkin value should be more than .6 for the data set in order to conduct factor analysis. The data of the pilot study yielded Kaiser-Meyer-Olkin as .879 which confirmed that the data was suitable for factor analysis (as cited in Çetin-Dindar & Geban, 2010). Moreover, a statistically significant Barlett's Test of Sphericity (χ^2=2499.184, df = 276, .000) indicates correlation matrix factorability. The Eigen – values of eight components were greater than 1.000 at the first run of the factor analysis. The number of components were restricted to five for the second run. The Eigen – values of five components were 4.579, 4.273, 2.996, 2.343, and 1.742 respectively. **Error! Reference source not found.** summarizes the Eigenvalues and explained variance for the components of ATT and in **Error! Reference source not found.** results of factor analysis of the PATT are summarized.

The Cronbach's alpha of the test was .75 which is suitable for the reliability of the test results and it is estimates the internal consistency. Another reliability indicator is to calculate Guttman split-half coefficient (=.66) that was also satisfactory. Cumulatively, 66.388% of the variance was explained by these five components. The components interest related behavior, self-efficacy, achievement-motivation, importance of physics and enjoyment were explaining 19.081%, 17.803%, 12.482%, 9.764%, and 7.258% respectively (see **Error! Reference source not found.**).

When it is compared with the original test, the item loadings of the components interest related behavior, achievement motivation, and self-efficacy were nearly matching except the 24th item which was loaded to achievement motivation component. The items loaded to other components are also similar. The components importance of physics, achievement-motivation and self-efficacy have one item loaded from the components enjoyment, interest related and enjoyment respectively. The component interest related behavior has two items loaded from the component importance of physics. Items and the respective components where they are loaded are presented in **Error! Reference source not found.**.

Table 3.7 - Eigenvalues and explained variance for the components

Components		Eigen Values	% Variance explained
1	interest related	4.579	19.081
2	self-efficacy	4.273	17.803
3	achievement-motivation	2.996	12.482
4	importance of physics	2.343	9.764
5	enjoyment	1.742	7.258
Total variance			66.388
Cronbach's alpha			.75

Table 3.8 - Factor analysis of the PATT

Components		Item numbers
5	Enjoyment	**16*, 17, 23***
2	Self-efficacy	**9, 10, 11, 18, 21,** 1
4	Importance of physics	**3, 4, 14*,**2
3	Achievement-motivation	**6, 7, 8, 12,** 24
1	Interest related behavior	**15*, 19, 20, 22,** 5, 13

The items which are bold formatted are loaded to same components as Taşlıdere's (2002) AT (as cited in Serin, 2009). There are three items (14, 16, 23) and one item (15) which are stared are loaded to interest related behavior and enjoyment components respectively.

Latent variables are cannot be observed directly but can be measured/modelled in terms of other observable variables. According to this definition of latent variables attitude can be defined as one of those. According to Çetin-Dindar and Geban (2010) latent variables are infrequently involved in research studies because of their nature which makes them hard to interpret and measure.

Regarding the above mentioned findings of the study the adopted version of Taşlıdere's (2002) AT can be stated as reliable and valid tool to measure attitudes of students towards Newton's Laws of Motion content in Albanian context. ATT includes the following components which are self-efficacy, interest related behavior, achievement-motivation, enjoyment, and importance of physics.

Sustainability of effective learning depends on measurement of attitudes of the students towards respective courses regarding the similar scientific studies mentioned in the literature. This Albanian adaptation of the AT can be used by instructors and researchers who want to measure attitude of students towards "Newton's Laws of Motion" content and also other contents. ATT can be used for other contents just replacing the term "Newton's Laws of Motion" with the respective terms that instructors and researchers who are interested in measuring attitudes of the students including the components mentioned.

The pilot study supplied enough evidence for the reliability and validity of the Albanian adaptation of the ATT. Regarding that the proper reliability and validity measures are taken into consideration, ATT can be translated to other languages as AT translation into

Albanian is reliable and valid. It is also encouraged to develop similar forms of ATT in other content settings like biology, mathematics, and chemistry. Moreover, the ATT might be also suitable for other data collection settings like case studies, interviews, essays, and other quantitative approaches to acquire new data.

Table 3.9 - Loading of items to the components

Items	**Components**				
	1	**2**	**3**	**4**	**5**
I would like to be given books and tools related with the NLoM chapter	.828				
Talking with my friends about the NLoM after school is enjoyable	**.780**				
I like talking about the NLoM chapter or its applications in technology	**.697**				
I don't think that the NLoM chapter will have any importance in my	.680				
I believe that what I've learned in the NLoM chapter will be useful in my	.633*			**.410***	
The NLoM chapter is effective in improving my manual skills	.614*				**.422***
I believe that the NLoM chapter will be beneficial for my further studies	.577				
The NLoM chapter is entertaining for me	.410*				**.314***
I am sure that I can succeed in the NLoM chapter		**.855**			
I am sure that I can solve the hard problems of the NLoM chapter		**.785**			
I believe I can cope with harder problems of the NLoM chapter		**.761**			
I am sure that I can learn the NLoM chapter		**.705**			
I believe I can solve the hardest problems of NLoM chapter if I have		**.687**			
I like the "Newton's Laws of Motion" chapter		.476			
I will do my best to be successful at the NLoM chapter			**.762**		
I will try my best for the NLoM chapter			**.716**		
I will not try harder if I do not succeed in the NLoM chapter			**.653**		
I will try my best to solve the problems related to the NLoM chapter no			**.629**		
I don't want to have more lesson hours for the NLoM chapter			.557		
I don't believe that the NLoM chapter will gain more importance in the				**.793**	
I have positive feelings about the NLoM chapter				**.626**	
I believe that what I've learned from the NLoM chapter will make my life				**.617**	
I don't like studying on the NLoM chapter at school					**.762**
I like reading books about the NLoM chapter and its applications in	**.518***				.532*

Bold items are same as AT in Taşlıdere's study (as cited in Serin, 2009). Stared items are also loaded to other components.

3.3.3. Motivation for Learning Physics Test (MOTT)

3.3.3.1. First version of Motivation for Learning Physics Test (MOTT - I)

First version of Motivation for Learning Physics Test (MOTT - I) (the original and adopted test is given in Appendix F) consist of 30 items. The scale is five point Likert – type. The students are expected to choose a response among always, usually, sometimes, rarely and never. There are six components of the motivation for learning test which are intrinsically motivated physics learning (labeled as intrinsic), extrinsically motivated physics learning (extrinsic), relevance of learning physics to personal goals (relevance), responsibility (self-determination) for learning physics (responsibility), confidence (self-efficacy) in learning physics (confidence), and anxiety about physics assessment (anxiety). The minimum total score variance with respect to true score variance is explained with Cronbach's alpha reliability coefficient. The data of the study yielded this coefficient to be equal to .93. Here this result states that minimum 93% of the total score variance is with respect to true score variance.

During the adaptation process three separate polyglot researchers translated the AT from Turkish to Albanian independently. Then inconsistencies among the translations compared to assure validity. Afterward, two independent researchers translated Albanian version back to original language to compare with the original test to assure consistency. Purpose of this back translation was to point out possible uncertainty regarding the terms in the questions as well as to assure conceptual and cultural equivalence. Subsequently, the Albanian version of the test was given to 14 students to verify face and content validity. During the pilot study from five different high schools, 387 students involved where number of boys and girls were 189 and 198 respectively. The duration of the test was 15 minutes and administration of test made during physics lectures. Taking the responses of the students into account, the questionnaire was revised with minor changes which were made with consensus; and a last version of the translated MOTT - I was developed. After all, the last version of the test, MOTT – I was administered. The sample of the pilot study was selected form four schools in Albania. The number of girls and boys attended to the pilot study was 55 and 54 respectively where one of them didn't state his or her gender. The questionnaire was administered during their physics courses and lasted approximately fifteen minutes.

Statistical Package for the Social Sciences (IBM SPSS 21.0 for Windows) software was used to analyze the data gathered from the pilot study. The expected responses to the test were changing from newer to always and these responses were coded from 1 to 5 respectively. The anxiety about physics assessment items were reverse coded items; therefore, the items consisting the anxiety about physics assessment component were recoded (for example; if a student's response is one, it is tallied as five.). As there were 30 test items the minimum score and the maximum score of the test expected to be 30 and 150 respectively.

The Cronbach's alpha coefficient is a measure to evaluate reliability of test scores. In other words, it is a measure of internal consistency and may take values from zero to one. Fraenkel and Wallen (2003, p. 168) recommend that the value of Cronbach's alpha should be equal to .70 and higher values are preferred for the educational studies. The Albanian adopted version of Science Motivation Questionnaire (MOTT – I) has Cronbach's alpha reliability coefficient of .81. Here this coefficient states that minimum 81% of the total score variance is with respect to true score variance.

The MOTT - I items were subjected to principal component analysis (PCA) the Kaiser-Meyer-Olkin value was .783, expressing the suitability of data for factor analysis, exceed the recommended value of 0.6 (Field, 2000, p. 455). Additionally, Barlett's Test of Sphericity reach statistical significance supporting the factorability of the correlation matrix (χ^2= 1344.755, df = 435, 0,000). The PCA revealed six components exceeding eigen-values 1, which were 7.955, 3.004, 2.422, 1.792, 1.489, and 1.234 respectively.

According to Field (2000) the Kaiser-Meyer-Olkin value should be more than .6 for the data set in order to conduct factor analysis. The data of the pilot study yielded Kaiser-Meyer-Olkin as .783 which confirmed that the data was suitable for factor analysis (as cited in Çetin-Dindar & Geban, 2010). Moreover, a statistically significant Barlett's Test of Sphericity (χ^2= 1344.755, df = 435, .000) indicates correlation matrix factorability. The Eigen – values of six components were greater than 1.000 at the first run of the factor analysis. The Eigen – values of five components were 7.955, 3.004, 2.422, 1.792, 1.489, and 1.234 respectively.

Considering meaning of the items, components were labeled as intrinsically motivated physics learning (6 items), anxiety about physics assessment (4 items), confidence in physics learning (6 items), relevance for learning physics to personal goal (5 items), extrinsically motivated physics learning (6 items), and responsibility for learning physics

(3 items), respectively. The test items and their loadings to components are given in the **Error! Reference source not found.**.

Table 3.10 – Items and components with factor loadings

Items	Component					
	1	2	3	4	5	6
I enjoy learning the physics	**,808**					
Understanding the physics gives me a sense of accomplishment	**,790**		-,300			-,370
The physics I learn is more important to me than the grade I	**,789**				,378	
The physics I learn relates to my personal goals	**,722**			,370		
I find learning the physics interesting	**,649**	-,315		,346		
I like to do better than the other students on the physics tests		**,607**	-,473	,375		
I expect to do as well as or better than other students in the		**,510**				
Earning a good physics grade is important to me		**,761**				
I think about how learning the physics can help my career		**,711**				
I am concerned that the other students are better in physics		**,646**		-,473		
I think about how my physics grade will affect my overall grade	-,331	**,635**				
I believe I can earn a grade of 10 in the physics course			**,755**			
I believe I can master the knowledge and skills in the physics			**,749**		,320	
I am confident I will do well on the physics labs and projects			**,719**			
I prepare well for the physics tests and labs			**,660**			-,323
I am confident I will do well on the physics tests		-,419	**,622**	,433	,337	
I think about how I will use the physics I learn			**,578**	,461	,340	,337
I become anxious when it is time to take a physics test	,522			**,790**		
I hate taking the physics tests	,411		-,304	**,764**		
I worry about failing the physics tests				**,746**	,317	
I am nervous about how I will do on the physics tests	,307	,345		**,380**		
The physics I learn is relevant to my life		,377			**,719**	
I think about how learning the physics can help me get a good		-,502	-,413	,304	**,652**	
I think about how the physics I learn will be helpful to me	,355			,499	**,504**	-,309
I like physics that challenges me					**,422**	-,352
The physics I learn has practical value for me					**,763**	
It is my fault, if I do not understand the physics			-,310			**,737**
If I am having trouble learning the physics, I try to figure out why	-,411			,409		**,687**
I put enough effort into learning the physics			-,366	,425		**-,605**
I use strategies that ensure I learn the physics well	,405			,374		**-,478**

Only loadings above .3 are displayed.

A total of 59.653% of the variance was explained by these six factors. The components intrinsic, anxiety, confidence, relevance, extrinsic and responsibility are contributing 26.517%, 4.962%, 8.073%, 5.975%, 10.013%, and 4.112% respectively (**Error! Reference source not found.**).

Table 3.11 - Factor analysis scores for each component.

		Eigen Values	Variance explained
Components	Intrinsic (brendshem)	7.955	26.517%
	Extrinsic (jashtem)	3.004	10.013%
	Confidence (besueshmeria)	2.422	8.073%
	Relevance (relevancës)	1.792	5.975%
	Anxiety (ankthit)	1.489	4.962%
	Responsibility (përgjegjësisë)	1.234	4.112%
Total variance explained			59.653%
Cronbach's alpha			0.805

The researches previously conveyed on the SQM which has six components were also yielded similar results with the MOTT – I which are theoretically and statistically justified (Glynn et al., 2009). These components are intrinsically motivated physics learning, anxiety about physics assessment, confidence in learning physics, relevance of learning physics to personal goals, extrinsically motivated physics learning, and responsibility for learning physics. The SQM (English version) had internal consistency coefficient .93 which is slightly higher than the internal consistency coefficient (α=.81) of the Albanian adaptation, MOTT – I.

According to above-mentioned findings MOTT – I has enough evidence and can be concluded that it can be used as a reliable and valid tool to measure motivation of students to learn physics in the Albanian context.

3.3.3.2. Final Version of Motivation for Learning Physics Test (MOTT - II)

Social-Cognitive theory of Bandura (1991) explains learning by student characteristics, behaviors and interaction with environment. This theoretical frame implies that the learning becomes more meaningful when it is self - regulated (İlhan, Yıldırım, & Sadi

Yılmaz, 2012). First version of Science Motivation questionnaire described self - regulated learning composed of six components; intrinsic motivation, extrinsic motivation, goal orientation, self-determination, self-efficacy and assessment anxiety (Glynn et al., 2009). Later on Glynn et al. (2011) developed second version of SMQ. In this second version of SMQ it is stated that the students conceptualized some components of motivation differently where intrinsic motivation involved personal relevance, self - efficacy involved assessment anxiety and extrinsic motivation differentiated as grade motivation and career motivation (Glynn et al., 2011). The revised version, SMQ II has five components:

1. Intrinsic motivation (involves personal relevance)
2. Career motivation (differentiated from extrinsic motivation)
3. Self - determination
4. Self - efficacy (involves assessment anxiety)
5. Grade motivation (differentiated from extrinsic motivation)

Original SMQ-II was developed to measure students' motivation to learn science. Previously first version of SMQ and SMQ-II were translated and validated not only other languages (Çetin-Dindar & Geban, 2010; Reinfried, 2010) and also adopted to other disciplines like chemistry, biology and etc. (Dindar Çetin & Geban, 2015; Ekici, 2009). Adaptation of the test was made while physics word substituted for the word science. Each component is measured by five items. There are 25 items where 16 items from the first version and nine new items on a 5-point Likert-type scale. The response categories were “never”, “rarely”, “sometimes”, “usually”, and “always” (see Appendix G). The Cronbach’s alpha reliability coefficient is .89, which means that at least 89% of the total score variance is due to true score variance.

In terms of validity, three independent bilingual researchers made Albanian translation individually then the inconsistencies were compared. Later on, back translation into English was made by other two researchers to check consistency. Before the final revision was administered to 273 high school students, the translated version is reviewed to check the face and content validity while administering to 17 high school students.

The sample of this study was 273 high school students from four different high school in Albania. The test was administered during physics courses to 139 female students, 132 male students, two students did not report gender, and it has taken around fifteen minutes.

The data collected from high school students analyzed via SPSS 21.0 for Windows. Students’ response were coded according to their response never (1), rarely (2), sometimes (3), often (4), or always (5). The score range between maximum 125 to minimum 25.

The reliability of the MOTT - II was analyzed by internal consistency, which is assessed via Cronbach’s alpha. For educational studies, the suggested alpha value is at least .70 and preferably higher (Fraenkel & Wallen, 2003, p. 168).

The MOTT-II items were subjected to principal component analysis (PCA) the Kaiser-Meyer-Olkin value was .837, expressing the suitability of data for factor analysis, exceed the recommended value of 0.6 (Field, 2000, p. 455). Additionally, Barlett's Test of Sphericity reach statistical significance supporting the factorability of the correlation matrix (χ^2=2955.401, df = 300, 0.000). The PCA revealed five components (factors) exceeding eigen-values 1, which were 7.593, 2.809, 2.199, 1.340, and 1.118 respectively.

The components were categorized with respect to the meanings of the items loaded as intrinsic motivation (6 items), self-determination (5 items), grade motivation (4 items), self-efficacy (6 items), and career motivation (4 items), respectively. Factor loadings for each of the components are given in **Error! Reference source not found.**.

The reliability coefficient for the full questionnaire estimated by Cronbach's alpha was .894, indicating high internal consistency. The five factors explained a total of 60.232% of the variance, with component intrinsic explaining 30.372%, component self-determination explaining 11.234%, component grade motivation explaining 8.795%, component self-efficacy explaining 5.361%, and component career motivation explaining 4.471% (Table 3.13).

The previous study SMQ-II (Glynn et al., 2011) with five components that was theoretically and statistically justified is consistent with the Motivation for Learning Physics Test (MOTT - II).

The five components of MOTT - II are intrinsic motivation, self-determination, grade motivation, self-efficacy and career. According to DeVellis (2003) (as cited in Glynn et al., 2011), a coefficient above 0.80 is ‘‘very good,’’. The Cronbach’s alpha of 25 items (α=.894) for the MOTT - II was very good. The Albanian adopted version of the MOTT - II’s internal consistency (α=.894) is just a bit smaller than the English version of SMQ - II’s internal consistency (α=.92).

Table 3.12 - Exploratory factor analysis: Factor loadings of items

	Factors				
	1	2	3	4	5
Factor 1. Intrinsic motivation					
01. The physics I learn is relevant to my life.	**.828**				
03. Learning physics is interesting.	**.821**				
12. Learning physics makes my life more meaningful.	**.820**				
17. I am curious about discoveries in physics.	**.804**			.315	
19. I enjoy learning physics.	**.769**				
Factor 2. Self-determination					
22. I study hard to learn physics.		**.849**			
05. I put enough effort into learning physics.		**.833**			
16. I prepare well for physics tests and labs.		**.705**			
06. I use strategies to learn physics well.		**.690**			
11. I spend a lot of time learning physics.	**.544**	.308			
Factor 3. Grade motivation					
24. Scoring high on physics tests and labs matters to me.			**.814**		
20. I think about the grade I will get in physics.			**.757**		
04. Getting a good physics grade is important to me.			**.726**		
02. I like to do better than other students on physics tests.			**.704**		
08. It is important that I get a "10" in physics.			.434	**.569**	-.285
Factor 4. Self-efficacy					
09. I am confident I will do well on physics tests.				**.700**	
14. I am confident I will do well on physics labs and projects.	.278			**.626**	.279
21. I am sure I can understand physics.	.446			**.626**	
18. I believe I can earn a grade of “10” in physics.	.304		.251	**.545**	
15. I believe I can master physics knowledge and skills.	.258	**.626**		.321	
Factor 5. Career motivation					
07. Learning physics will help me get a good job.	.386	.365		**.395**	.284
25. I will use physics problem-solving skills in my career.			.288		**.713**
23. My career will involve physics.					**.704**
10. Knowing physics will give me a career advantage.					**.540**
13. Understanding physics will benefit me in my career.		.307			**.406**

Only loadings above .25 are displayed.

Based on these findings, it can be interpreted that the adaptation of this questionnaire is successful because of showing satisfactory reliability and validity results and is appropriate to use MOTT - II in the Albanian culture to assess students' motivation to learn physics.

Table 3.13 - Factor analysis scores for each component

		Eigen Values	% Variance explained	% Cumulative Variance Explained
Components	Intrinsic motivation	7.592	30.372	30.372
	Self-determination	2.809	11.234	41.606
	Grade motivation	2.199	8.795	50.401
	Self-efficacy	1.340	5.361	55.762
	Career motivation	1.118	4.471	60.232
Total variance explained				60.232
Cronbach's alpha				.894

3.3.4. Classroom Observation Checklist

There are two treatments are used in the study. Observation check lists are developed from a similar in the field (Peşman, 2012). They are used for verifying if the plans of the treatments and their implementations are consistent. There are two types of treatments implemented. Classroom observation checklists adopted for these two treatments.

3.4. Materials Used in Instruction and Treatments

The materials used in instruction are given in the Appendix K. The educational context used in the study is summarized in this section and treatment for each group is described.

3.4.1. The Educational Context

Large context problem developed by Stinner (1990) used in the study. He defines the large context problem as “learning could be well motivated by a context with one unifying central idea capable of capturing the imagination of the student” while it is placed to the center of learning, surrounded and linked distinctly to the other contexts. Guidelines for designing contextual settings and large context problems are given in Table 3.14.

Table 3.14 - Guidelines for Designing Contextual Settings, Science Stories and Large Context Problems (Stinner, 1995)

1	**Map out a context with one unifying central idea that is deemed important in science and is likely to capture the imagination of the student.**
2	Provide the student with experiences that can be related to his/her everyday world as well as being simply and effectively explained by scientists’ science but at a level that “makes sense” to the student.
3	Invent a “story line” that will dramatize and highlight the main idea. Identify an important event associated with a person and find binary opposites, or conflicting characters or events (Egan, 1987) may be appropriate to include in the story.
4	Ensure that the major ideas, concepts and problems of the topic are generated by the context naturally; that it will include those the student would learn piecemeal in a conventional textbook approach.
5	Secure the path from romance to precision to generalization (Whitehead, 1985). This is best accomplished by showing the student that: Problem situations come out of the context and are intrinsically interesting. That concepts are diversely connected, within the setting of the story as well as with That concepts are diversely connected, within the setting of the story as well as with
6	Map out and design the context, in cooperation with students, where you as the teacher assumes the role of the research leader and the student becomes part of an ongoing research program.

3.4.2. Treatments

The study involves two treatment types regarding the experimental design. Both treatments are based on traditional teaching methods. The first treatment is non-contextual approached and the second is contextual approach where they are implemented using traditional teaching method.

3.4.2.1. Non-Contextual Approach Given via Traditional Method

As a widely implemented method, the traditional method is teacher centered where teachers introduce the physics content, solve some exemplary problems, and have the students solve some additional problems. The teachers directly instructs the equations regarding the content and the definitions of the respective concepts are given. For example, the equations regarding Newton's Laws of Motion are given and the related concepts like inertia, force, mass, acceleration, etc. are explained.

In order to avoid John henry effect (Hake, 1998) among the students of different classes, teachers are advised to use similar activities in the classes. (Hake, 1998). This effect may demoralize students and they performance may change positively or negatively if they recognized that other students are being taught by a new method and this may affect the results of study.

Context based approach makes use of real life examples. The teachers may also make use of real life examples in traditional method non contextual approach. However using some real life examples at the end of the presentation of physics content does not change the nature of approach and it does not necessarily mean that context based approach is being used during the instruction.

3.4.2.2. Contextual Approach Given via Traditional Method

The implementation of this treatment in terms of the method used is similar to the other treatment described already. The difference comes from the way of the integration of the educational context. The instruction starts with the context associated with the content. Questions focused on the context is being asked to students. By doing so it is intended to gain students' interest and introducing context through a debate. Throughout the lesson feedback from students are considered and all of the concerns are discussed as detailed as possible for the good of lesson.

After a while, the respective exhibited an inclination towards a shift to physics subject matter from contextual debate. The traditional teaching treatment appeared similarly as described in the previous. After the demonstration of the context related to the respective content, both groups posed the relevant problems. At the same time, during the discussion, everything were addressed again regarding the content of physics and, at this point in time, the students are expected to give answer while making use of the respective physics subjects.

Thorough considering number of questions, everyday situations, and including conventional questions of textbooks, solutions to all were attempted in this experimental group. After all, the questions solved in experimental group with respect to control group were less in number due to the fact that more time spent to cover the context and convey debate on the context.

3.5. Research Design

The effect of an instructional method was investigated in the study that requires an experimental design. When the subjects are not possible to be assigned to control and experimental groups randomly, quasi-experimental design (Non-Equivalent Control

Group design) is used (Fraenkel & Wallen, 2003, p. 278). The design of the study is matching – only pretest – posttest control group design. This is similar to pretest-posttest control group design except the random sampling. The subjects in each class will be statistically matched on students' pre-test scores of Newton's Laws of Motion Achievement Test (PRENLMAT), pre-test scores of Newton's Laws of Motion Attitude Test (PREATT), pre test scores of Motivation to Learn Physics Test (PREMOT). The groups used in the study and its design are summarized in Table 3.15.

Table 3.15 – Groups and Studies' Research Design

Groups	**Pre Test**	**Treatment**	**Post Test**
Experimental Group	NLMAT, ATT, MOT	TMCA	NLMAT, ATT, MOT
Control Group	NLMAT, ATT, MOT	TMNCA	NLMAT, ATT, MOT

The selected design, matching – only pretest – posttest control group design, has certain weaknesses regarding internal validity threats controlling, which are data collector characteristics, location, data collector bias, implementation and attitudinal (Fraenkel & Wallen, 2003).

After selecting the schools, the instructional approaches (non contextual approach and contextual approach) are be assigned to classes randomly. The class, which will be taught by non contextual approach, will be control group; whereas the class, which will be taught by contextual approach, will be experimental group. There were no chance to assign subjects randomly to the groups involved in the study since the classes are intact groups formed in the school system. Therefore, there may be some differences between these intact groups. Statistical matching procedure will be applied to overcome this context. The students' pre test scores of physics achievement scores, attitude towards physics content, motivation to learn physics and prior physics grades was included in the statistical matching procedure.

3.6. Internal Validity of the Study

Internal validity is a measure for the independent variables which are the only responsible for the observed differences on the dependent variables, where the differences are not caused by the extraneous variables (Fraenkel & Wallen, 2003, p. 278). In other words, the possible effect of other independent variables which may affect dependent variables should be controlled.

The design of the study should control the threats to internal validity. The best way to control these threats is random assignment. As the sample was not chosen randomly, the design should be named as quasi experimental and non-equivalent pretest-posttest control group design was used in the study. In this design, the groups are formed from classrooms where the treatments are implemented to groups randomly. This design is similar to pretest-posttest control group design except random assignment (Gravetter, 2006; as cited in Sönmez, 2015). As listed by Fraenkel and Wallen (2003, p. 283), possible threats to internal validity are mortality, subject characteristics, attitude of subjects (Hawthorne, novelty, and John Henry effect), instrumentation (instrument decay, data collector characteristics, and data collector bias), location, testing, history, implementation, and maturation are potential threats to internal validity of this research while design of the study may control some of the listed variables such as subject characteristics, instrument decay, mortality, history, testing, regression, and maturation.

3.6.1. Subject characteristics

In order to control subject characteristics statistical matching is used. The covariates (pre test scores Newton's Laws of Motion Achievement Test, Attitude towards Newton's Laws of Motion Test, Motivation to Learn Physics Test and students' prior physics grades) are used in the analysis of data to adjust post test scores. Moreover, the treatments (approaches) were randomly assigned to the intact classes.

3.6.2. Mortality

Mortality occurs when there are loss of subjects during the study. It can affect the results especially when the mortality rate is different between the groups. To control the mortality thread the percentage of the students who did not entered post-tests treated as loss of subjects. The students who did not entered post tests were removed from data as their percentages were less than 12 percent and this will not cause serious problem.

3.6.3. Location

The location where the data collected may affect the results of the study. The best way to control location thread to internal validity is to keep the location same for all students. There were at least one pair of treatment and control group in each of the schools. As the treatment and control group pairs were at same school and the location threat is supposed to be controlled as the schools had similar environments.

3.6.4. Instrumentation

3.6.4.1. Instrument Decay

If the nature of the instrument is changing over time this is called instrument decay. In order to control this issue objective test items were administered. The students informed about the research study and the results of the test shall be limited only for this research and they will not be shared by the third parties. The data collection procedure is described to teachers.

3.6.4.2. Data Collectors' Characteristics

Data collection procedure may constitute an internal validity threat for the research. According to Fraenkel & Wallen (2003), the characteristics of the data collectors can affect results. Gender, age, ethnicity, language patterns, or other characteristics of the individuals who collect the data in a study may have an effect on the nature of the data they obtain (Fraenkel & Wallen, 2003). With the aim of controlling this threat, using the same data collector throughout the study is advised. There is also the possibility of distortion of the data caused by the collector unconsciously; the data in such a way as to make certain outcomes more likely (Fraenkel & Wallen, 2003). In order to prevent this context, all procedure regarding the data collection was standardized, which will require some sort of training of the data collector.

Teachers who collects the data can affect the results of the study unintentionally. During the study, it was not possible to collect all data by a data collector (teacher in this case).

In this study, the teacher who has administered the pretest for a class has also administered the posttest.

3.6.4.3. Data Collector Bias

Another important threat to internal validity is data collector bias. One data collector may differ in terms of data collection. This is situation is named as implementer effect or called data collector bias. When data collectors are teachers of students, they may favor one group to another. As a result, one group during the study may benefit from the conscious actions of the data collectors. Data collectors should be informed about the purpose of the testing and how the results will be used in order to avoid such biases. Data collectors should also be notified about students' cheating behaviors. The directions about tests should be prepared and described to data collector to guarantee standardized administration of the test. Subsequently, this threat was controlled by the application of above described procedures.

3.6.5. Testing

During the pretest, students may become alerted. The difference between pretest and posttest may be caused by this alertness. For example, students may remember answers of the tests. In the intervention studies, this threat to internal validity is inevitable. As the testing threat is valid for all of the groups, its effect will be minimum. Besides of all, there were eight weeks between the pretests and posttests also minimize the effect of testing threat.

3.6.6. History

Unplanned or unintended events may affect the results of the study. This threat to internal validity is called as history. It was not reported or observed any event, which may affect the study, by the teachers. This threat also assumed to be controlled.

3.6.7. Maturation

The students may improve their performance if the intervention takes so long time regardless of the treatment. The students who are involved in the study were almost at the same age and intervention was lasted in eight weeks. The maturation threat was not a serious problem for the research.

3.6.8. Attitudinal effect

During intervention studies, students may become aware about the treatment conditions and they may become moralized and perform better or demoralized and perform poor than the experimental group. This is known to be "Hawthorne Effect". Novelty effect can be sourced from the nature of the treatment may cause students to think they are part of a special treatment. Both experimental and control groups has the same method. It was advised to teachers to discuss same examples. Similar contexts are used in application problems of the control group.

3.6.9. Regression

The students who has extreme scores, very high achievers, or very low achievers may deceive the results. It is mostly common for one group research designs. The students in the study were not selected with respect to their extreme specifications and there were control groups. As a result, it can be concluded that regression threat to internal validity is controlled.

3.6.10. Implementation

In order to monitor "implementer bias", the respective teachers knew how/why to use the treatments. Therefore, they accepted the treatments for using in the classrooms and accordingly they were very helpful for the researcher. At the same time, in order to "implementer bias" to be controlled the treatments were implemented with respect to the lesson plan descriptions. The classroom observation checklist is used. Another teacher observed several class hours in order to have each treatment group was observed.

3.7. External Validity

This research was performed in five schools in Albania four of them were in Tirana and one of them was in Scutari (Shkoder). Five high schools were selected purposively for the research. The participation of the students exceeded 10 percent of the accessible population. Moreover, the students of these schools were medium or high achievers. Hence, the research results may be generalized to the accessible population.

The students participated in the study supposed to be at medium or high socio-economic status. While it was already mentioned, the students were mainly particularly medium or high achievers so the results of the study can be generalized to the other populations, which have similar characteristics as well as the Turkish Private High Schools in Albania.

The treatments were carried out schools where there were 15 – 24 students in each of the classes. Most of the classes were equipped with computers and video projectors. The number of desks were enough for the students. Thus, it is necessary to define ecological conditions of the research while generalizing the results of the research.

3.8. Procedure

Before the study starts, the research problem was defined and the keywords which will be used in database researches decided. The databases of Social Science Citation Index (SSCI), Educational Resources Information Center (ERIC), Dissertation Abstracts International (DAI), Wiley-Interscience, Taylor&Francois, Kluwer Online and Google Scholar were used with the keywords of "context based learning and science", "context based instruction and science", "context led and science and "contextual approach and science". Later on the search was extended my search by replacing the term "science" with "physics", "student achievement", "motivation", "attitude", "gender" and "traditional instruction". The related online articles and books are used in the study.

The researcher defined the location of the study conveniently. Later on achievement test developed. The course books of schools, New South Wales (Australia) certificate tests of schools were reviewed to find related questions and few questions were taken from them.

Some of the questions are translated from Turkish course books into English. The researcher developed the rest of the questions and views of experts were taken. During expert opinions are taken table of specification (**Error! Reference source not found.**) and expert opinion forms (Appendix A) are used. Necessary revisions are made. The test piloted to make final revisions and final version of the achievement test was developed. The tests are photocopied regarding the amount of participating students who are planned to be involved in the study.

Attitude (Serin, 2009) and motivation (Glynn et al., 2009) scales are found from the literature. Both of the test are adopted and piloted for the Albanian context. After the second version of the motivation scale published (Glynn et al., 2011) it had been also adopted and piloted for Albanian context. The last adaptation of the motivation scale (MOTT-II) is administered in the research. The tests are photocopied in number of students.

The teachers trained for the research study. Before the treatments, pretests are administered. After the treatment ended, the posttests are administered. At last, all of the responses from the administered tests were entered to SPSS with respect to codes and later on, they were scored. Using these data, statistical reports are prepared where descriptive and inferential statistics were involved.

3.8.1. Teacher Training

Teachers who will be participated in the study are trained. The training is helpful to standardize the administration procedures and the implementation of the treatments. A workshop had been arranged for the participating teachers. A manual prepared and distributed during the workshop for the teachers. In this workshop, some seminars were given and teachers' role in the class was explained. Teachers conducted their teaching process by traditional method with non-contextual approach in the control groups, which includes lecturing, demonstration, demo experiments and asking questions. In the experimental groups, teachers used contextual approach.

Physics achievement test administered to all groups as a pretest by a data collector before the treatment. Treatment experienced by control and experimental group of students for about four weeks. Throughout the treatment, researcher observed the control and experimental groups to ensure that all teachers follow the guidelines and procedures. Finally, after the treatment, the same data collector will administer the instruments as a posttest.

3.8.2. Statistical Control

With the purpose of grasping the net treatment effect, other factors besides the treatment that might influence the outcome of the study should be controlled. The literature states that age, gender, socioeconomic status, prior knowledge, attitude, and motivation have an effect on achievement of students. For this reason, the students' prior knowledge, attitude, and motivation were controlled.

3.8.3. Treatment Fidelity and Verification of Independent Variable

Verification of the independent variable is critical to the valid interpretation of effects and estimation of generalizability (Shaver, 1983). Leonard and Lowery (as cited in Shaver, 1983) advice that teaching methods researchers must attend to two verification concerns: (1) were the instructional methods executed as defined? (2) were the treatments different from one another?

To give answer to these questions, it is necessary to observe control and experimental groups. The use of systematic observation for verifying that the teachers executed instructional methods exactly as defined. An observation checklist was prepared and it was used to collect data.

The experts and teachers reviewed the materials used at the study. Implementation period was planned to ensure all the steps of instruction to function as planned. Observation check lists were used throughout the treatment sessions of the TMNCA and TMCA groups. Observation checklist consists of characteristics of the approaches so the researcher may assure that instructors implemented instructions as planned.

The treatment concentered on teaching approach. Related literature had been analyzed to follow an instruction, which fits contextual approach. Sample implementations and explanations are followed. As Peşman (2012) also mentioned there were differences in definitions and examples of context based approach. Among different definitions Large Context Problem of Stinner (2006) was used as primary sources. As secondary sources Gilbert (2006) and Peşman (2012) was used because the definitions good examples of educational context. Turkish Ministry of Education developed and encouraged the use of context based instruction. While developing contexts and lessons the Turkish context and experiences were used.

The researcher observed the groups during the application of the treatments in one of the schools. Minimum 30% of the implementations were observed to ensure the treatment verification. In the remaining schools, it was asked helped from other instructors to observe lessons in the other four schools. As almost all of the observations recorded by researcher and observers were in concurrence it was concluded that administration of the treatments and the planned treatments were coherent.

3.8.4. Ethical Issues

The whole students will be assured that any data collected from them with the help of the research will be held in confidence. Their names will never be used in any publications that involves in the research. All participants may leave the study at any time if they want or they may request that data collected about them not be used. The design of the study will not require the deception of subjects.

3.9. Analysis of Data

The research involves, one variable describing group memberships (approach) and four covariates, which are pre test scores of Newton's Laws of Motion Attitude Test (PRENLMAT), Attitude towards Newton's Laws of Motion Test (PREATT), Motivation to Learn Physics Test (PREMOT), and student's previous years physics grade (grade).

Furthermore, the dependent variables are defined as posttest scores of Newton’s Laws of Motion Attitude Test (POSTNLMAT), Attitude towards Newton’s Laws of Motion Test (POSTATT), and Motivation to Learn Physics Test (POSTMOT). As cited in Peşman (2012) recently made research describes the science learning not only in terms of cognitive domain gains of the students but also their gain in affective domain (Duit & Treagust, 2003). Taking this fact in to account POSTNLMAT, POSTATT, and POSTMOT scores (post test scores regarding the achievement, attitude and motivation test) of the students were considered as the dependent variables.

After the administration of the tests NLMAT, ATT and MOTT as pre-tests and post-tests the data obtained were submitted to a new SPSS data file. The scores of students from each of the tests were computed as variables PRENLMAT, PREATT, PREMOT, POSTNLMAT, POSTATT, and POSTMOT. The other variables like gender, group membership (approach), previous years’ physics grade, teacher, school of students were also inserted to the SPSS file. Variables and subjects were analyzed for missing values in order to accomplish missing data analysis. Missing data analysis and the methods used to treat missing data summarized at Chapter Four. Afterward, descriptive statistics were performed regarding the variables defined and the treatment groups involved in the study.

After obtaining information regarding the variable, descriptive and inferential statistics are performed. Descriptive statistics were performed to check related assumptions to be assured. Inferential statistics are used to make inferences about the population where the data was collected. Because of that, Multivariate Analysis of Covariance (MANCOVA) was performed (Fraenkel et al., 2012, p. 236; Tabachnick & Fidell, 2007, p. 21). After assuring the assumptions of MANCOVA, the test used to evaluate effects of independent variable on the collective dependent variables. Later on, in order to evaluate effects of the independent variable follow up Analysis of Variances (ANOVA) were executed one by one on respective dependent variables after MANCOVA tests.

As treatment groups are intact groups some variables are needed to be controlled. This was the one other reason to use MANCOVA in the study (Bonate, 2000, p. 93; Fraenkel et al., 2012, p. 236; Tabachnick & Fidell, 2007, p. 21). If one group is superior to the other group, it should be controlled. Covariate analysis is required with minimum on one independent variable to equate the groups (Fraenkel et al., 2012, p. 236).

3.9.1. Unit of Analysis

In an experimental study to assure independence of observation; it is needed to have unit of analysis and experimental unit should be the same. The unit of analysis is each one of the participants and each one of the whole groups is the experimental unit in the study. As they are not the same, independence of observation cannot be assured. The participants will be interacting during class hours and situation is inevitable. In order to assure independence of observation at least for the measurement processes the teachers warned to keep the students not interacting during the data collection procedures, in other words during administering of pre and post tests.

3.9.2. Analysis of the Missing Data

During the time of data collecting procedure missing subjects were determined. If it is possible, it will be tried to reach these subjects as soon as possible in order to gather data from them. In the statistical procedure, if the missing values in categorical data, additional level for that variable should be created and the missing values will be replaced with a different number. If the missing data are from continuous data the mean score of all other subjects for that variable should be replaced with missing values if the variable has less than 5% missing data. If a certain variable exceeds 5% for missing data, list wise method should be used.

3.9.3. Descriptive Statistics

Descriptive statistics, the mean, range, standard deviation, kurtosis, and skewness values of the variables were computed for control and experimental groups. The data is summarized with the use and calculation of descriptive statistics and it is necessary for the verification of inferential statistics assumptions. When necessary bar graphs, pie charts, and crossbreak tables for summarizing categorical data are used. In order to see the distribution of quantitative data, histograms with normal curve were presented for continuous variables. The central tendency of the data mean, median, trimmed mean and mode of the data were presented. The variability in the scores were obtained by standard deviation. To determine whether relationships exist in data scatterplots were plotted and the correlation coefficients calculated when necessary.

3.9.4. Inferential Statistics

In order to generalize results from a sample to population inferential statistics were used. There is only one independent variable in the study, which is the teaching approach; three dependent variables, which are post test for Newton's Laws of Motion content (POSTNLMAT), post test for attitude towards Newton's Laws of Motion content (POSTATT) , and post test for motivation to learn physics (POSTMOT); and four covariates, which pre test for Newton's Laws of Motion content (PRENLMAT), pre test for attitude towards Newton's Laws of Motion content (PREATT) , and pre test for motivation to learn physics (PREMOT).

All hypotheses will be analyzed by multivariate analysis of covariance (MANCOVA). It is used when there exists more than one dependent variables in an experiment. It is superior to ANCOVA in terms of which is useful in finding the important factor and better protection for Type I errors with respect to having successive independent ANCOVAs. Moreover, MANCOVA may expose differences which cannot be determined by ANCOVA analysis (French & Poulsen, 2001; as cited in Serin, 2009). As the study groups are intact groups, there is possibility of having difference between the control groups and experimental groups so it is required to control this difference with the use of covariate analysis.

As MANCOVA is a parametric test, prior to analysis all assumptions of MANCOVA, normality, sample size, linearity, outliers, multicollinearity and singularity, homogeneity of variance – covariance matrices (Pallant, 2003, pp. 219-225), and independency of observations are needed to be satisfied.

When it is needed to guarantee validity of test results also non-parametric test can also be put into practice for each of the dependent variables. Non-parametric test do not have assumptions about population parameters. They can be also used were assumptions of parametric test are not satisfied.

After analyzing the first hypothesis of the research by conducting MANCOVA, follow up ANCOVAs used to test the rest of the hypotheses.

3.9.5. Power Analysis and Determining Sample Size

In order to guarantee the desired power for the study sample size is needed to be decided. Before starting the study to calculate the sample size for some values are needed to be fixed. First of all effect size was determined. Effect sizes are classified as small, medium and large and equal to 0.02, 0.15 and 0.35 respectively according to Cohen and Cohen (1983, p. 161). The effect size is chosen as medium based on the similar studies from the related literature.

Significance level alpha (α), the probability of making Type I-error (the probability of rejecting the true null hypothesis), of the study was selected to be equal to 0.05 as most of the educational studies accepting and using this value.

Beta (β) value, the probability of making Type II-error (probability of failing to reject a false null hypothesis) was selected to be equal to 0.20. The probability of accepting true alternative hypothesis is the power of the study. In other words, probability of rejecting a false null hypothesis is equal to 1- β. As beta is 0.20 than power is equal to 0.80. This power value is also advised by Cohen and Cohen (1983, p. 162).

From the *L* table for α = 0.05 given in Cohen and Cohen (1983, p. 527) *L* value is determined. This table requires the fixed factor numbers used in the research (Cohen and Cohen, 1983:527). This values are used in MRC analysis. As the current study involves covariate analysis the number of fixed factor were converted to MRC format. The number of levels in the fixed factor (*n*) gives k_b value where is equal k_b = n-1. In order to determine *L* values and calculate sample size f^2 (effect size), k_b (group membership variable / number of groups - 1), and k_a (number of covariates) are set 0.15, 1 and 4 respectively.

The *L* value is found to be *L* = 7.85 where f^2=0.15, k_b = 1, k_a = 4.

$$n = \frac{L}{f^2} + k_a + k_b + 1$$

Equation 3.1 - Determining Sample Size for an *F* Test (Cohen & Cohen, 1983, p. 155)
Using Equation 3.1 sample size is calculated and it is *n* = 59 for each group.

In the study the sample size was 308 (~ 150 for each group). Using this sample size, and Equation 3.2 *L* value is found to be equal to 21.6 for medium effect size f^2=0.15, k_b = 1, k_a = 4.

$$L = f^2 \, (n - k_a - k_b - 1)$$

Equation 3.2 - Determining *L* from Sample Size for an *F* Test (Cohen & Cohen, 1983, p. 163)

From the *L* values table, calculated *L* represents power greater than 0.99 so calculated power of the study is more than 0.99. With respect to calculated power of the study, it can be concluded that probability of failing to reject a false null hypothesis is less than 0.01.

3.10. Limitations and Assumptions

3.10.1. Assumptions

Below it is listed the assumptions of the research.

1. The students in all of the groups responded all the questions in the instruments used in measurement decently.
2. There were no interaction between the students of the control and experimental groups.

3.10.2. Limitations

Below it is listed the limitations of the research.

1. The sample of the research was limited to 312 10th level students.
2. The research was limited to 10th level students of the high schools.
3. The length of the research was limited to four weeks.

4. The research was limited to the Newton's Laws motion content.

CHAPTER IV:

4. ANALYSIS AND RESULTS

The present chapter involves in the following sections: missing data analysis, descriptive statistics, inferential statistics, analysis of the classroom observation checklist, and summary of the findings.

4.1. Missing Data Analysis

Missing data analysis completed before undertake to carry out descriptive and inferential statistics. There were a total of 326 students in designated classes. The pre tests of NLMAT, ATT, and MOT were conducted to 312 students. 311 students were attended post-tested for the NLMAT, ATT, and MOT. The number of students who were attended to the post tests was 15. For that reason, the missing value for the dependent variables (POSTNLMAT, PASTATT, and POSTMOT) was 15, which was 5% of the sample, of the present research. The subjects which have dependent variables with missing values should be excluded from all of the analyses (Cohen, Cohen, West, & Aiken, 2013, p. 275). One of the students from the School 3 and two of the students from the School 5 TMNC group attended the posttests but did not answered POSTATT, POSTMOT and POSTNLMAT respectively. Thus, these students with the missing values in dependent variables were omitted from the calculations. The data from the remaining 308 students included in the calculations.

Detailed missing values of variables in respective groups are listed in the Table 4.1. The overall missing values are given in the brackets. With respect to group sizes the missing value percentages of the groups did not exceed 8%, and the sample overall missing value was 5%. If representativeness of the sample will not be compromised missing values are acceptable in each group (Fraenkel & Wallen, 1996, p. 105). The student who were being tested were not aware that they will be tested. As a result, we may assume that the loss of subject was not systematic and random. The results don't be affected seriously if missing data is random (Cohen et al., 2013, p. 276).

Table 4.1 - Missing values of the PRENLMAT, PREATT, PREMOT, POSTNLMAT, POSTATT, and POSTMOT in regard to each group and school

Variable		PRENLMAT		PREATT		PREMOT		POSTNLMAT		POSTATT		POSTMOT	
		n (mis.)	%	n (mis.)	%	n (mis.)	%	n (mis.)	%	n (mis.)	%	n (mis.)	%
Attended*		312 (14)	4	312 (14)	4	312 (14)	4	311 (15)	5	311 (15)	5	311 (15)	5
School A**	TMNC	14 (1)	7	14 (1)	7	14 (1)	7	14 (1)	7	14 (1)	7	14 (1)	7
	TMC	19 (1)	5	19 (1)	5	19 (1)	5	19 (1)	5	19 (1)	5	19 (1)	5
	Total	33 (2)	6	33 (2)	6	33 (2)	6	33 (2)	6	33 (2)	6	33 (2)	6
School B**	TMNC	28 (2)	7	28 (2)	7	28 (2)	7	28 (2)	7	28 (2)	7	28 (2)	7
	TMC	20 (1)	5	20 (1)	5	20 (1)	5	20 (1)	5	20 (1)	5	20 (1)	5
	Total	48 (3)	6	48 (3)	6	48 (3)	6	48 (4)	8	48 (4)	8	48 (4)	8
School C**	TMNC	46 (1)	2	46 (1)	2	46 (1)	2	46 (1)	2	46 (1)	2	46 (1)	2
	TMC	23 (1)	4	23 (1)	4	23 (1)	4	23 (1)	4	23 (1)	4	23 (1)	4
	Total	69 (2)	3	69 (2)	3	69 (2)	3	69 (2)	3	69 (2)	3	69 (2)	3
School D**	TMNC	13 (0)	8	13 (0)	0	13 (0)	0	13 (0)	0	13 (0)	0	13 (0)	0
	TMC	8 (0)	0	8 (0)	0	8 (0)	0	8 (0)	0	8 (0)	0	8 (0)	0
	Total	21 (0)	0	21 (0)	0	21 (0)	0	21 (0)	0	21 (0)	0	21 (0)	0
School E**	TMNC	69 (4)	5	69 (4)	5	69 (4)	5	69 (4)	5	69 (4)	5	69 4)	5
	TMC	72 (3)	4	72 (3)	4	72 (3)	4	71 (4)	5	71 (4)	5	71 (4)	5
	Total	141 (7)	5	141 (7)	5	141 (7)	5	140 (8)	5	140 (8)	5	140 (8)	5

*Percentages were computed for n=326
** Percentages were computed in regard to size of groups

If a few data points are missing randomly in pattern from a large data set (i.e. 5% or less), any method to manage missing data will lead to similar results causing less serious problems (Tabachnick & Fidell, 2007, p. 63). As there was only one student in the School 4 TMNC group who has accomplished the post-tests and did not accomplish the PRENLMAT test, that is much more less than 5%. Consequently, to prevent probable loss in variance, it had been decided to replace missing values with the group mean (Tabachnick & Fidell, 2007, p. 67). So, the students PRENLMAT score replaced with the respective groups mean of PRENLMAT score.

Subsequently, the test results of the students who has taken all posttests were distinguished and kept for the analysis. After replacing the missing pretest score with group mean, 308 cases involved in MANCOVA and final version of the data is listed in Appendix K.

4.2. Descriptive Statistics

The descriptive statistics for covariates are calculated as well as dependent variables. The calculations carried out for all levels of the independent variables and for all levels of the interactions among the independent variables. Since it is needed execute inferential statistics to check "if the population means of the dependent variables (POSTNLMAT, POSTATT, and POSTMOT) are equal for all groups (TMNCA and TMCA), the population means for any linear combination of these dependent variables are also equal for all groups" (Salkind & Green, 2008, p. 223). Descriptive statistics in relation to the main effects are shown not only for the dependent variables but also for the overall descriptive statistics. Only the overall descriptive statistics is exhibited for covariates.

The distribution of gender among 312 students analyzed in the study can be accepted as equal. The male and female contributions to the sample were 46% and 54% respectively. Gender distribution among the schools and approaches are given in Table 4.2.

Students' gender and physics course grades are given in Table 4.3 to represent students' achievement. With respect to this distribution of students' grades, they are mostly high achievers.

Table 4.2 – Gender distribution among approaches and schools

			SCHOOL					**Total**
			School 1	School 2	School 3	School 4	School 5	
APPROACH	Non Contextual Approach	MALE	8	28	0	5	39	80
		FEMALE	6	0	46	8	30	90
		Total	14	28	46	13	69	170
	Contextual Approach	MALE	5	20	0	2	37	64
		FEMALE	14	0	23	6	35	78
		Total	19	20	23	8	72	142
Grand Total			33	48	69	21	141	312

Table 4.3 Distribution of students' physics course grades between males and females

Physics Grades	**Males**		**Females**		**Total**	
	f	%	f	%	f	%
5.0 - 5.9	8	6	3	2	11	4
6.0 - 6.9	15	10	16	10	31	10
7.0 - 7.9	15	10	18	11	33	11
8.0 - 8.9	35	24	40	24	75	24
9.0 - 9.9	60	42	75	46	135	44
10.0	11	8	12	7	23	7
Total	144	100	164	100	308	100

4.2.1. Descriptive Statistics for the POSTNLMAT Scores

The descriptive statistics for the post – test scores for Newton's Laws of Motion Achievement Test (POSTNLMAT) is given in Table 4.4. The table also summarizes and compares the POSTNLMAT scores of males, females with respect to group memberships, traditional method with non-contextual approach and traditional method with contextual approach.

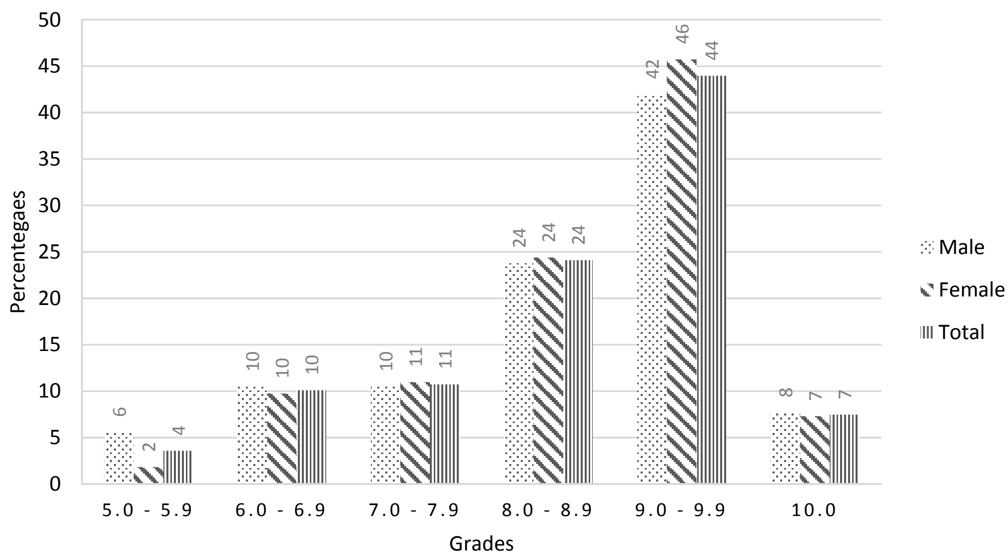


Figure 4.1 Distribution of students' physics course grades between males and females

The overall descriptive statistics for POSTNLMAT scores is given in Table 4.5.

The maximum possible score for a student can take through the POSTNLMAT was 25. The overall mean of the scores is 16.1 for 308 students. The minimum score is 1 and maximum score is 23. The scores has a range of 22, which is large. The standard deviation is 4.261, which is also large, and it also support this conclusion. In order to assure normality assumption it is need to have sample size for each cell more than 20 (Tabachnick & Fidell, 2007, p. 279). As it is seen in the Table 4.4 contextual approach has the minimum sample size, which is 141. The skewness and kurtosis are considered to be excellent if they fall in between -1.0 and +1.0 (George & Mallery, 2016, p. 115). The samples can be accepted as normally distributed if the kurtosis and skewness values are range in between -2 and +2 (George & Mallery, 2016, p. 115; Serin, 2009). The skewness and kurtosis of POSTNLMAT scores are -0.928 and -0.117 respectively. Non contextual approach has skewness and kurtosis values of -0.74 and 0.03 and contextual approach has skewness and kurtosis values of -1.3 and 1.72 respectively. Thus, it can be concluded that the distributions of the cells are normal.

Table 4.4 - Descriptive Statistics for POSTNLMAT Scores

		N	Minimum	Maximum	Mean	Std. Deviation	Skewness	Kurtosis
Non Contextual Approach	Male	80	3	22	15.8	4.45	-0.75	0.02
	Female	88	5	22	15.26	3.83	-0.8	0.08
	Total	168	3	22	15.52	4.13	-0.74	0.03
Contextual Approach	Male	63	1	21	16.41	3.93	-1.57	3.57
	Female	78	2	23	17.19	4.62	-1.26	1.06
	Total	141	1	23	16.84	4.33	-1.3	1.72
TOTAL	Male	142	1	22	16.03	4.214	-1.06	1.082
	Female	166	2	23	16.17	4.313	-0.882	0.274
	Total	308	1	23	16.1	4.261	-0.955	0.602

The TMNCA and TMCA groups almost have same mean scores combined with the main effects, which are 15.52 and 16.84, respectively. Both genders, boys and girls have similar mean scores, which are 16.03 and 16.17, respectively. Accordingly, when inferential statistics calculated it is not supposed to have any significant difference between physics achievements of students.

Mean scores of girls is higher than mean scores of boys in the TMCA groups which are 17.19 and 16.41, respectively. On the contrary mean scores of boys is higher than mean scores of girls when TMNCA groups are compared (15.8 and 15.26, respectively). Still the differences are too small to expect significant effects.

Table 4.5 - Overall Descriptive Statistics for POSTNLMAT Scores

	Descriptives		Statistic	Std. Error
POSTNLMAT	Mean		16.10	.243
	95% Confidence Interval for Mean	Lower Bound	15.63	
		Upper Bound	16.58	
	5% Trimmed Mean		16.36	
	Median		17.00	
	Variance		18.159	
	Std. Deviation		4.261	
	Minimum		1	
	Maximum		23	
	Range		22	
	Interquartile Range		5	
	Skewness		-.955	.139
	Kurtosis		.602	.277

4.2.2. Descriptive Statistics for the POSTATT Scores

The descriptive statistics for Attitude towards Newton's Laws of Motion Test (POSTATT) are given in Table 4.6. The table also summarizes and compares the POSTATT scores of boys, girls with respect to group memberships, TMNCA and TMCA.

Table 4.6 - Descriptive Statistics for POSTATT Scores

		N	Minimum	Maximum	Mean	Std. Deviation	Skewness	Kurtosis
Non Contextual Approach	Male	79	51	109	80.80	10.295	-.323	1.013
	Female	88	30	96	75.18	11.188	-.651	2.281
	Total	167	30	109	77.84	11.104	-.522	1.717
Contextual Approach	Male	63	48	120	80.97	11.112	.039	2.609
	Female	78	50	99	79.59	9.334	-.425	.606
	Total	141	48	120	80.21	10.153	-.121	1.898
TOTAL	Male	142	48	120	80.87	10.627	-.139	1.754
	Female	166	30	99	77.25	10.560	-.645	1.882
	Total	308	30	120	78.92	10.727	-.387	1.836

The overall descriptive statistics for POSTATT scores is given in Table 4.7.

The minimum score that students can take on the POSTATT was 24 and the maximum score that students tan take on the POSTATT is 120. The overall mean of the POSTATT scores for 308 students is 78.92. The minimum score taken in POSTATT is 30 and maximum score taken in POSTATT is 120, and the range is 90. The standard deviations for all of the cells are can be accepted as large when compared with the mean scores. The samples can be accepted as normally distributed if the kurtosis and skewness values are range in between -2 and +2 (George & Mallery, 2016, p. 115; Serin, 2009). The kurtosis and skewness of POSTATT scores are -0.387 and 1.836 respectively. Non contextual approach has skewness and kurtosis values of -0.522 and 1.717 and contextual approach has skewness and kurtosis values of -0.121 and 1.898 respectively. As the sampling distributions fall within the desired skewness and kurtosis values so they can be accepted as normal.

Table 4.7 - Overall Descriptive Statistics for POSTATT Scores

	Descriptives		Statistic	Std. Error
POSTATT	Mean		78.92	.611
	95% Confidence Interval for Mean	Lower Bound	77.72	
		Upper Bound	80.12	
	5% Trimmed Mean		79.21	
	Median		79.00	
	Variance		115.075	
	Std. Deviation		10.727	
	Minimum		30	
	Maximum		120	
	Range		90	
	Interquartile Range		13	
	Skewness		-.387	.139
	Kurtosis		1.836	.277

The TMCA group has slightly higher mean score with respect to TMNCA group which are 80.21 and 77.84, respectively. Taking this difference in to consideration it can be concluded that there might be a statistically significant difference between these groups. Boys seem to have more positive attitude towards Newton's Laws of Motion content than girls (80.87 and 77.25, respectively). Similarly, the mean difference between male and female may be significant.

When it is compared the mean score of girls with respect to TMCA and TMNCA groups, the girls in the TMCA group scored higher than the girls in the TMNCA group (79.59 and 75.18, respectively). The difference in attitude scores of girls between TMCA and

TMNCA groups appears to be less so it is not expected to be significant. As well as girls, the boys in the TMCA group scored higher than the girls did in the TMNCA group (80.97 and 80.80, respectively) while this difference is too less to be significant.

4.2.3. Descriptive Statistics for the POSTMOT Scores

Table 4.8 summarizes the descriptive statistics of the posttest scores for Motivation to Learn Physics Test (POSTMOT). The table also summarizes and compares the POSTMOT scores of males, females with respect to group memberships, TMNCA and TMCA.

The overall descriptive statistics for POSTMOT scores is summarized in Table 4.9.

Table 4.8 - Descriptive Statistics for POSTMOT Scores

		N	Minimum	Maximum	Mean	Std. Deviation	Skewness	Kurtosis
Non Contextual Approach	Male	79	53	120	96.41	14.925	-.928	.990
	Female	88	39	123	88.11	16.368	-.519	.728
	Total	167	39	123	92.04	16.196	-.679	.594
Contextual Approach	Male	63	33	125	93.73	17.233	-.821	1.438
	Female	78	56	124	93.09	15.626	-.305	-.346
	Total	141	33	125	93.38	16.307	-.562	.554
TOTAL	Male	142	33	125	95.22	15.987	-.893	1.272
	Female	166	39	124	90.45	16.168	-.429	.309
	Total	308	33	125	92.65	16.234	-.620	.554

The minimum score that students can take on the POSTATT was 25 and the maximum score that students tan take on the POSTATT is 125. The overall mean of the POSTATT scores for 308 students is 92.65. The minimum score taken in POSTATT is 33 and maximum score taken in POSTATT is 125, and the range is 92. The standard deviations for all of the cells are can be accepted as large when compared with the mean scores. The skewness and kurtosis of POSTMOT scores are -.620 and .554 respectively. Non contextual approach has skewness and kurtosis values of -.679 and .594 and contextual approach has kurtosis skewness and values of -.562 and .554 respectively. As the skewness and kurtosis values falls in between -2 and +2 (George & Mallery, 2016, p. 115; Serin, 2009), the assumption of normality is not likely to be violated.

The TMCA group has slightly higher mean score the mean score of the TMNCA group (92.04 and 93.38, respectively). Meanwhile the difference between the mean scores is not expected to be statistically significant. The motivation scores of boys to learn physics seems to be more than motivation scores of girls (95.22 and 90.45, respectively). Similarly, the mean difference between male and female may not be significant.

The girls in TMCA group scored higher than the girls in TMNCA group with respect to post test scores of motivation to learn physics (93.09 and 88.11, respectively). The difference in motivation scores of girls between contextual and non contextual approach groups may not to be less so it might be expected to be significant. On the contrary, the boys in TMCA group scored lower than the boys in TMNCA group if the mean of post test scores of motivation to learn physics are compared (93.73 and 96.41, respectively) while this difference may be trivial to be significant.

Table 4.9 - Overall Descriptive Statistics for POSTMOT Scores

	Descriptives		Statistic	Std. Error
POSTMOT	Mean		92.65	.925
	95% Confidence Interval for Mean	Lower Bound	90.83	
		Upper Bound	94.47	
	5% Trimmed Mean		93.31	
	Median		94.00	
	Variance		263.551	
	Std. Deviation		16.234	
	Minimum		33	
	Maximum		125	
	Range		92	
	Interquartile Range		21	
	Skewness		-.620	.139
	Kurtosis		.554	.277

4.2.4. Descriptive Statistics for the PRENLMAT Scores

The descriptive statistics for the pretest scores for Newton's Laws of Motion Achievement Test (PRENLMAT) are given in Table 4.10. The table also summarizes and compares the PRENLMAT scores of boys, girls with respect to group memberships, TMNCA and TMCA.

The overall descriptive statistics for PRENLMAT scores is summarized in Table 4.11.

Table 4.10 - Descriptive Statistics for the PRENLMAT Scores

		N	Minimum	Maximum	Mean	Std. Deviation	Skewness	Kurtosis
Non Contextual Approach	Male	79	0	20	13.46	4.239	-.868	1.230
	Female	88	5	20	13.61	3.409	-.423	.095
	Total	167	0	20	13.54	3.813	-.723	1.018
Contextual Approach	Male	63	6	21	13.32	3.822	-.121	-.680
	Female	78	3	21	13.88	4.042	-.299	-.297
	Total	141	3	21	13.63	3.941	-.211	-.489
TOTAL	Male	142	0	21	13.39	4.046	-.585	.527
	Female	166	3	21	13.74	3.711	-.330	-.108
	Total	308	0	21	13.58	3.866	-.473	.271

Table 4.11 - Overall Descriptive Statistics for PRENLMAT Scores

	Descriptives		Statistic	Std. Error
PRENLMAT	Mean		13.58	.220
	95% Confidence Interval for Mean	Lower Bound	13.15	
		Upper Bound	14.01	
	5% Trimmed Mean		13.71	
	Median		14.00	
	Variance		14.948	
	Std. Deviation		3.866	
	Minimum		0	
	Maximum		21	
	Range		21	
	Interquartile Range		5	
	Skewness		-.473	.139
	Kurtosis		.271	.277

The minimum score the students can achieve on the PRENLMAT was 0 and the maximum score the students can achieve on the PRENLMAT was 24. The number of students was 308 who has attended to the PRENLMAT where the overall mean of the scores was 13.58. The median is 14.0. The students had lowest score of 0 and highest score of 21, so the range is 21. The skewness and kurtosis of PRENLMAT scores are -.473 and .271, respectively. Non contextual approach has skewness and kurtosis values of -,723 and 1,018 and contextual approach has kurtosis and skewness values of -,211 and -,489, respectively. As the skewness and kurtosis takes values from -2 to +2 (George & Mallery, 2016, p. 115; Serin, 2009), the distribution can be accepted as normal. The mean and the median are close to each other as the distribution is normal. If the standard deviations and the means of the distributions are compared with respect to mean scores, they can all be stated as high which may provide reliability evidence for the scorers of each cell (Peşman, 2012).

The mean score of boys is 13.39 and the mean scores of girls is 13.74. The mean scores of students for non-contextual approach group and contextual approach group are 13.54 and 13.63, respectively. Thus, taking PRENLMAT scores as the prior knowledge of the students on Newton's Laws of Motion unit, it seems that students' prior knowledge are equal if PRENLMAT scores of boys and girls as well as non-contextual approach group and contextual approach group are compared.

4.2.5. Descriptive Statistics for the PREATT Scores

The descriptive statistics of the pretest scores for Attitude towards Newton's Laws of Motion Content Test (PREATT) are summarized in the Table 4.12. The table also summarizes and compares the PREATT scores of males, females with respect to group memberships, TMNCA and TMCA.

The overall descriptive statistics for PREATT scores is summarized in Table 4.13.

Table 4.12 - Descriptive Statistics for the PREATT Scores

		N	Minimum	Maximum	Mean	Std. Deviation	Skewness	Kurtosis
Non Contextual Approach	Male	79	32	95	79.15	8.715	-1.768	9.928
	Female	88	39	96	76.18	10.414	-.492	1.154
	Total	167	32	96	77.59	9.733	-.979	3.495
Contextual Approach	Male	63	50	101	78.17	10.506	-.228	.284
	Female	78	18	99	77.37	11.091	-1.940	9.809
	Total	141	18	101	77.73	10.803	-1.239	6.002
TOTAL	Male	142	32	101	78.72	9.528	-.901	3.840
	Female	166	18	99	76.74	10.721	-1.213	5.340
	Total	308	18	101	77.65	10.220	-1.115	4.871

The lowest score that students could take on the PREATT was 24 and the highest score that students can achieve on the PREATT is 120. The pretest scores has overall mean of 77.65 on the PREATT for 308 students. The median is 78. The minimum and maximum scores range from 18 to 101, and the range is 83. The kurtosis and skewness of PREATT scores are 4.871 and -1.115, respectively. Non contextual approach has kurtosis and skewness values of 3.495 and -.979, and contextual approach has kurtosis skewness and values of 6.002 and -1.239, respectively. The kurtosis and skewness values should fall in between -2 and +2 (George & Mallery, 2016, p. 115; Serin, 2009), in order to accept distributions to be normal. Kurtosis values are out of the range for normal distributions. The mean and the median are close to each other. However, the cases in each cell is more than 30. The standard deviations for all of the cells are can be accepted as large when compared with the mean scores, which may provide reliability evidence for the scorers of each cell (Peşman, 2012).

Boys and girls have mean scores of 78.72 and 76.74, respectively. The students' mean scores in non contextual approach group and contextual approach group are 77.59 and 77.73, respectively. Thus, taking PREATT scores as the prior attitude of the students towards Newton's Laws of Motion content, it seems that students' prior attitudes are equal if it is compared between boys and girls in addition to non contextual approach group and contextual approach group.

Table 4.13 - Overall Descriptive Statistics for PREATT Scores

	Descriptives		Statistic	Std. Error
PREATT	Mean		77.65	.582
	95% Confidence Interval for Mean	Lower Bound	76.51	
		Upper Bound	78.80	
	5% Trimmed Mean		78.09	
	Median		78.00	
	Variance		104.449	
	Std. Deviation		10.220	
	Minimum		18	
	Maximum		101	
	Range		83	
	Interquartile Range		11	
	Skewness		-1.115	.139
	Kurtosis		4.871	.277

4.2.6. Descriptive Statistics for the PREMOT Scores

The descriptive statistics of the pretest scores for Motivation to Learn Physics Test (PREMOT) are given in Table 4.14. The table also summarizes and compares the PREMOT scores of males, females with respect to group memberships, traditional method with non-contextual approach and traditional method with contextual approach.

Table 4.14 - Descriptive Statistics for the PREMOT Scores

		N	Minimum	Maximum	Mean	Std. Deviation	Skewness	Kurtosis
Non Contextual Approach	Male	79	31	125	96.10	16.790	-1.410	3.056
	Female	88	25	125	90.57	15.891	-.697	2.207
	Total	167	25	125	93.19	16.507	-.982	2.124
Contextual Approach	Male	63	40	124	92.68	17.561	-.716	.385
	Female	78	45	125	93.88	17.187	-.487	1.247
	Total	141	40	125	93.35	17.303	-.587	.792
TOTAL	Male	142	31	125	94.58	17.160	-1.067	1.525
	Female	166	25	125	92.13	16.546	-.550	1.606
	Total	308	25	125	93.26	16.849	-.784	1.422

The overall descriptive statistics for PREMOT scores is summarized in Table 4.15.

The lowest score the students can take on the PREMOT was 25 and the maximum score the students can take on the PREMOT is 125. The pretest scores on the PREMOT has an overall mean of 93.26 for 308 students. The median is 95. The lowest and highest scores change from 25 to 125, and the range is 100. The skewness and kurtosis of PREMOT scores are -.784 and 1.422, respectively. Non contextual approach has skewness and kurtosis values of -.982 and 2.124, and contextual approach has skewness and kurtosis values of -.587 and .792, respectively. The kurtosis and skewness values should be changing from -2 to +2 (George & Mallery, 2016, p. 115; Serin, 2009), in order to accept distributions to be normal. As the skewness and kurtosis values are between the expected ranges, the distribution can be accepted as normal (one of kurtosis values which is very close to 2.0 accepted as normal). As the mean and the median are close to each this is also another evidence of being normally distributed. The standard deviations for all of the cells are can be accepted as high when compared with the mean scores, which may provide reliability evidence for the scorers of each cell (Peşman, 2012).

Table 4.15 - Overall Descriptive Statistics for PREMOT Scores

	Descriptives		Statistic	Std. Error
PREMOT	Mean		93.10	.945
	95% Confidence Interval for Mean	Lower Bound	91.24	
		Upper Bound	94.96	
	5% Trimmed Mean		94.07	
	Median		95.00	
	Variance		275.144	
	Std. Deviation		16.587	
	Minimum		25	
	Maximum		125	
	Range		100	
	Interquartile Range		22	
	Skewness		-.891	.139
	Kurtosis		1.359	.277

The mean score of boys is 92.13 and the mean score of girls is 94.58. The students' mean scores in non-contextual approach group and contextual approach group are 93.19 and 93.35, respectively. Thus, taking PREMOT scores as the prior motivation of the students to learn physics, it seems that students' prior motivations are equal if it is compared between boys and girls in addition to non-contextual approach group and contextual approach group.

4.2.7. Descriptive Statistics for Physics Grades

Table 4.16 presents the descriptive statistics of the students' physics grades. The table also summarizes and compares the physics grades scores of males, females with respect to group memberships, traditional method with non-contextual approach and traditional method with contextual approach.

Table 4.16 - Descriptive Statistics for Physics Grades

		N	Minimum	Maximum	Mean	Std. Deviation	Skewness	Kurtosis
Non Contextual Approach	Male	79	5.2	10.0	8.5	1.342	-0.826	-0.366
	Female	88	5.6	10.0	8.6	1.150	-0.632	-0.667
	Total	167	5.2	10.0	8.5	1.241	-0.755	-0.419
Contextual Approach	Male	63	5.5	10.0	8.7	1.267	-0.921	-0.182
	Female	78	5.6	10.0	9.0	1.102	-1.485	1.646
	Total	141	5.5	10.0	8.9	1.187	-1.194	0.543
TOTAL	Male	142	5.2	10.0	8.6	1.307	-0.862	-0.307
	Female	166	5.6	10.0	8.8	1.149	-0.959	-0.025
	Total	308	5.2	10.0	8.7	1.227	-0.928	-0.117

The overall descriptive statistics for grade scores is presented in Table 4.17.

The minimum score the students can get from the physics grades was 0 and the maximum score the students can get from the physics grades was 10. The physics grades has overall mean of 8.7 for 308 students is. The median is 9.0. The lowest and highest scores change from 5.2 to 10, and the range is 4.8. The kurtosis and skewness of physics grades scores are -.117and -.928, respectively. Non contextual approach has kurtosis and skewness values of -0.419and -0.755, and contextual approach has kurtosis and skewness values of -0.307 and -0.862, respectively. The kurtosis and skewness values should change from -2 to +2 (George & Mallery, 2016, p. 115; Serin, 2009) , in order to accept distributions to be normal. As the skewness and kurtosis values are between the expected ranges, the distribution can be accepted as normal. As the mean and the median are close to each this is also another evidence of being normally distributed. The standard deviations for all of the cells are can be accepted as high when compared with the mean scores, which may provide reliability evidence for the scorers of each cell (Peşman, 2012).

Table 4.17 - Overall Descriptive Statistics for Physics Grades

	Descriptives		Statistic	Std. Error
GRADE	Mean		8.696	.0699
	95% Confidence Interval for Mean	Lower Bound	8.559	
		Upper Bound	8.834	
	5% Trimmed Mean		8.786	
	Median		9.000	
	Variance		1.505	
	Std. Deviation		1.2266	
	Minimum		5.2	
	Maximum		10.0	
	Range		4.8	
	Interquartile Range		1.7	
	Skewness		-.928	.139
	Kurtosis		-.117	.277

Boys and girls have mean scores of 8.7 and 8.8, respectively. The students' mean scores in non contextual approach group and contextual approach group are 8.5 and 8.9, respectively. Thus, taking physics grades scores as the prior physics knowledge, it seems that students' prior knowledges are equal if it is compared between boys and girls in addition to non contextual approach group and contextual approach group.

4.2.8. Gain scores and effect sizes

The summary of the gain scores are given in Table 4.18 gives for both the traditional method non contextual approach (TMNCA) and the traditional method contextual approach (TMCA) groups for the NLMAT, ATT, and MOT. Both TMNCA and TMCA groups both have large effect sizes. While there is large effect size, only for TMCA on ATT scores but no effect for TMNCA group. However, there is negative effect of TMNCA on MOT scores where there was no effect of TMCA on MOT scores.

Additionally, the average normalized gain "<g>" was computed for NLMAT, ATT and MOT scores (Table 4.18). The average normalized gain was defined Hake (1998) by as "the ratio of the actual average gain (%<posttest> – %<pretest>) to the maximum possible average gain (100 – %<pretest>)" and it has been assumed to be medium for the values between 0.3 and 0.7 and assumed to be low for the values below 0.3 (as cited in Gökalp, 2011).

Table 4.18 - Gain scores and effect sizes for both groups on the NLMAT, ATT and MOT

Test	Group	Gain Score (posttest - pretest)	Effect Size (Gain Score/SD_{pre})	<g>
NLMAT	Non Contextual	16.17	4.34	0.19
	Contextual	27.63	7.06	0.32
ATT	Non Contextual	0.51	0.05	0.02
	Contextual	5.65	10.79	0.25
MOT	Non Contextual	-4.44	-0.24	-0.65
	Contextual	0.21	0.01	0.03

Average normalized gain of NLMAT for the TMNCA is calculated as 0.19 and it is calculated to be 0.32 for TMCA group. Taking this values in to consideration, the effect of TMCA can be concluded to be medium and the effect of TMNCA can be concluded to be low on the NLMAT scores of students.

Average normalized gain of ATT was calculated to be equal to 0.02 and 0.25 for the TMNCA and TMCA groups, respectively. With these values, it can be concluded that the TMCA had a low effect (very close to medium effect) and the TMNCA had a no effect on the ATT scores of students.

Average normalized gain of MOT for the TMNCA is calculated as -0.65 and it is calculated to be 0.03 for TMCA group. Taking this values in to consideration, the effect of TMCA can be concluded to have no effect and the effect of TMNCA can be concluded to have negative effect on the MOT scores of students.

In Table 4.19, the effect size values can be seen for posttest scores of NLMAT, ATT, and MOT between TMNCA and TMCA groups.

Table 4.19 - Mean differences between the TMNCA and TMCA groups and effect sizes on posttest scores of NLMAT, ATT and MOT

Test	Mean difference ($mean_{TMNCA} - mean_{TMCA}$)	Effect size (Mean difference/SD_{TMNCA})
NLMAT	1.30	0.31
ATT	2.40	0.21
MOT	2.23	0.12

4.2.9. Comparisons of Item Based Score Means of Pre and Post Tests

It may give a better understanding if students' performance on each item in the posttest of NLMAT, ATT and MOT are examined. Table 4.20 shows item based mean scores for both the TMNCA and TMCA groups.

Table 4.20 - Item Based Score Means for the posttest of NLMAT, ATT and MOT

Item	NCA	CA	Dif.	Item	NCA	CA	Dif.	Item	NCA	CA	Dif.
ATT01	4	4	0.21	MOT01	4	4	0.2	NLMAT01	1	1	0.04
ATT02	4	4	0.01	MOT02	4	4	0.33	NLMAT02	1	1	0.06
ATT03	3	4	0.12	MOT03	4	4	-0.21	NLMAT03	1	1	0.04
ATT04	3	3	0.14	MOT04	4	4	0.21	NLMAT04	0	1	0.41
ATT05	3	4	0.14	MOT05	3	3	-0.39	NLMAT05	1	1	0.09
ATT06	4	4	0.2	MOT06	3	3	0.03	NLMAT06	0	1	0.21
ATT07	4	4	0.21	MOT07	5	5	-0.02	NLMAT07	1	1	0.18
ATT08	2	2	-0.01	MOT08	4	4	-0.4	NLMAT08	0	1	0.37
ATT09	4	4	0.31	MOT09	4	3	-0.23	NLMAT09	1	1	0.21
ATT10	4	4	0.42	MOT10	4	4	-0.08	NLMAT10	0	0	-0.02
ATT11	3	4	0.38	MOT11	4	4	-0.35	NLMAT11	1	1	0.22
ATT12	4	4	-0.01	MOT12	4	4	0.2	NLMAT12	0	0	-0.04
ATT13	3	3	0.04	MOT13	4	3	-0.44	NLMAT13	0	1	0.37
ATT14	3	3	-0.07	MOT14	3	3	0.2	NLMAT14	1	1	0.23
ATT15	3	3	0.02	MOT15	4	4	0.11	NLMAT15	1	1	0.07
ATT16	3	3	0.12	MOT16	3	3	-0.04	NLMAT16	0	1	0.15
ATT17	2	2	0.04	MOT17	3	3	0.26	NLMAT17	1	1	0.28
ATT18	3	3	0.24	MOT18	4	4	0.19	NLMAT18	0	0	0.1
ATT19	3	3	0.03	MOT19	4	4	0.38	NLMAT19	1	0	-0.15
ATT20	3	3	0.08	MOT20	4	4	-0.22	NLMAT20	1	1	0.21
ATT21	3	4	0.24	MOT21	3	3	0.04	NLMAT21	0	0	0.06
ATT22	3	3	-0.02	MOT22	4	4	0.23	NLMAT22	0	0	0.22
ATT23	4	4	0.01	MOT23	3	3	0.16	NLMAT23	1	1	0.08
ATT24	3	3	-0.01	MOT24	4	4	0.17	NLMAT24	0	0	-0.03
				MOT25	4	4	0.15	NLMAT25	1	1	0.27

Histograms with normal curves are given in Figure 4.3, Figure 4.3, Figure 4.6, Figure 4.6, Figure 4.6 and Figure 4.7 for the PREMOT, PRENLNMAT, PREATT, POSTNLMAT, POSTATT, and POSTMOT for both the TMNCA and TMCA groups. These histograms summarizes the distributions of the scores noticeably and these can be used as an evidence for normal distribution.

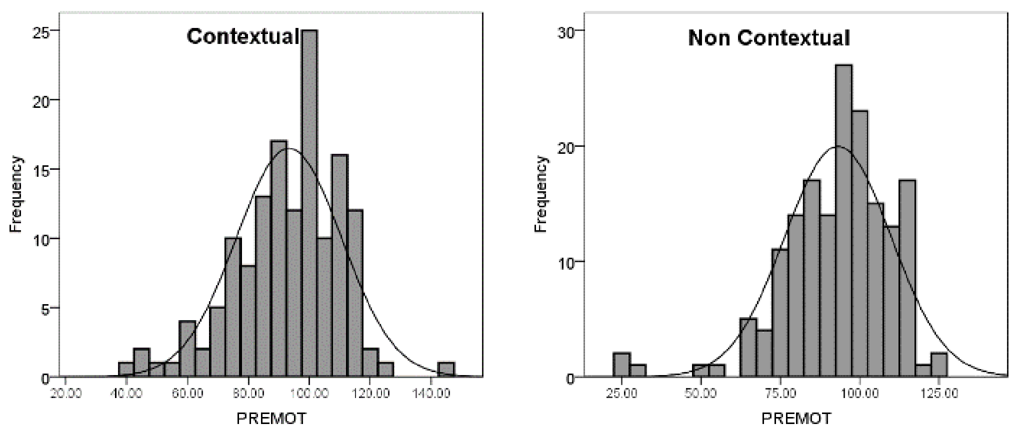


Figure 4.3 - Histograms with normal curves for the PREMOT scores for each group

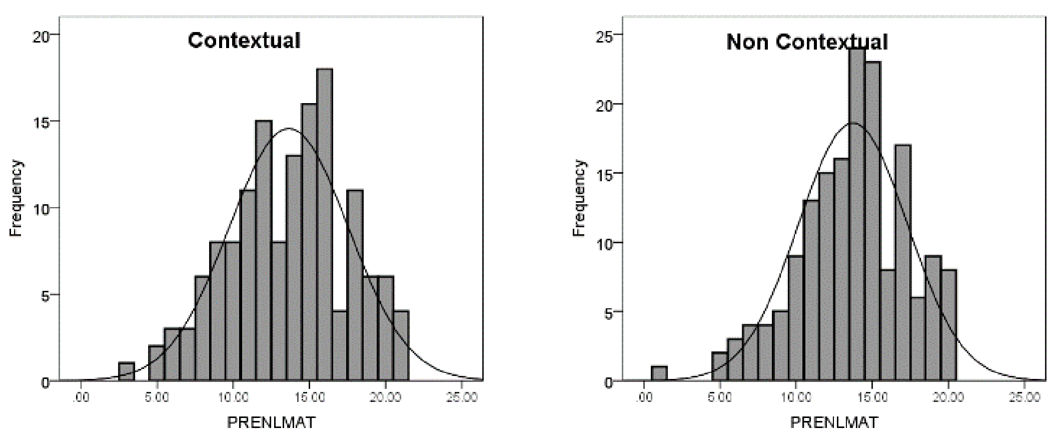


Figure 4.3 - Histograms with normal curves for the PRENLNMAT scores for each group

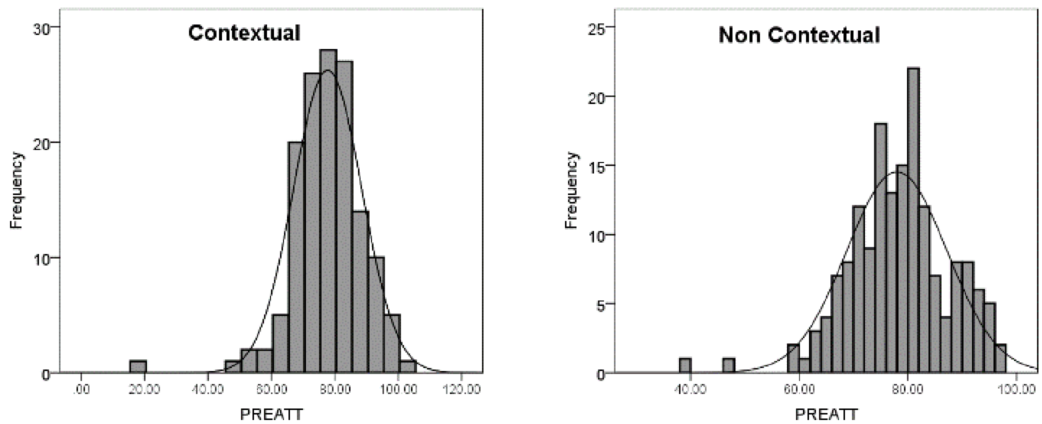


Figure 4.6 - Histograms with normal curves for the PREATT scores for each group

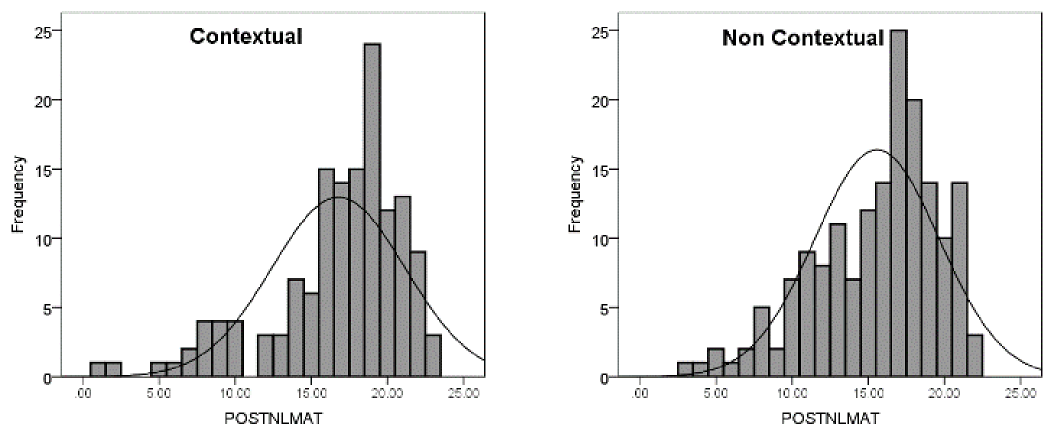


Figure 4.6 - Histograms with normal curves for the POSTNLMAT scores for each group

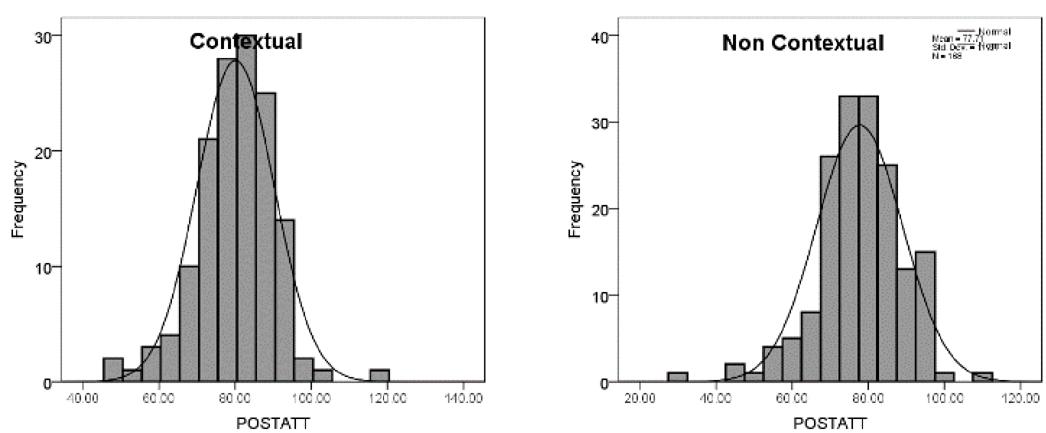


Figure 4.6 - Histograms with normal curves for the POSTATT scores for each group

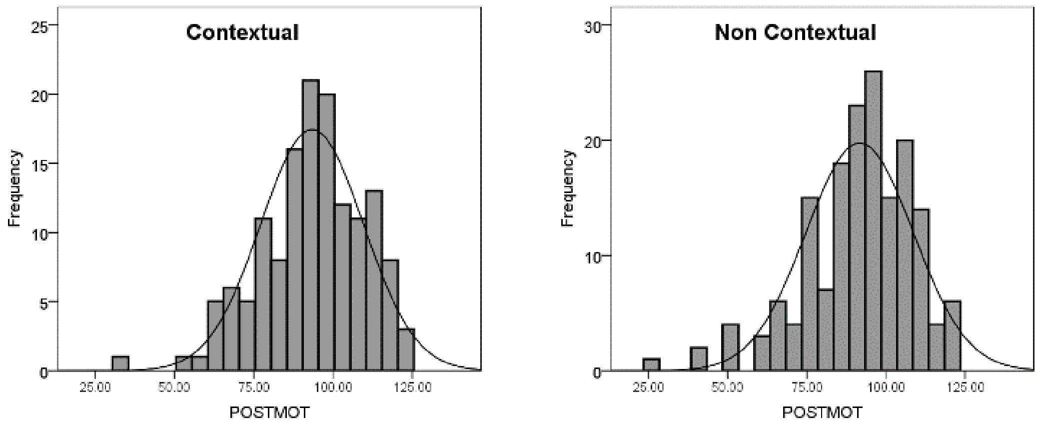


Figure 4.7 - Histograms with normal curves for the POSTMOT scores for each group

Table 4.21 - Descriptive statistics of IV and DV with respect to Approach

		N	Min	Max	Mean	SD	Skewness		Kurtosis	
		Stat.	Stat.	Stat.	Stat.	Stat.	Stat.	SE	Stat.	SE
Non Contextual	PREATT	168	39.00	96.00	77.9583	9.22659	-.520	.187	1.529	.373
	PREMOT	168	25.00	125.00	93.1488	16.79522	-1.157	.187	2.919	.373
	PRENLMAT	167	1.00	20.00	13.7246	3.58152	-.474	.188	.348	.374
	POSTATT	168	30.00	109.00	77.7143	11.31008	-.588	.187	1.709	.373
	POSTMOT	168	26.00	123.00	91.7024	16.96194	-.883	.187	1.315	.373
	POSTNLNMAT	168	3.00	22.00	15.5714	4.09260	-.760	.187	.123	.373
Contextual	PREATT	142	18.00	101.00	77.7254	10.78753	-1.236	.203	5.986	.404
	PREMOT	143	40.00	145.00	93.3217	17.30733	-.578	.203	.745	.403
	PRENLMAT	143	3.00	21.00	13.6434	3.91531	-.222	.203	-.455	.403
	POSTATT	142	48.00	120.00	80.1127	10.17722	-.108	.203	1.831	.404
	POSTMOT	142	33.00	125.00	93.3873	16.24932	-.566	.203	.580	.404
	POSTNLNMAT	142	1.00	23.00	16.7817	4.37614	-1.269	.203	1.528	.404

4.3. Determination of Covariates

According to Tabachnick & Fidell (2007), Table 4.22 summarizes the correlations among the dependent variables and possible covariates, which can be used to decide the intended extraneous variables as covariates if they assure the necessities required for them to be utilized as covariates. With the purpose of using an extraneous variable as a covariate at least one of the dependent variables should be significantly correlated with the extraneous variables that are selected to be assigned as covariates, and correlations among the selected covariates are expected to be less than .80 (Tabachnick & Fidell, 2007, p. 211). The Table 4.22 summarizes the values for GRADE, PREATT, PREMOT and PRENLMAT are satisfying the requirements to be used as covariates. Therefore, these variables are assigned to be used as covariates during the analysis of the study to control their effects on dependent variables.

Table 4.22 - Correlations among the dependent variables and possible covariates

		PREATT	PREMOT	PRENLMAT	POSTATT	POSTMOT	POSTNLMAT
	Corr.	,273**	,300**	,392**	,195**	,335**	,446**
GRADE	Sig.	0	0	0	0,001	0	0
	N	308	308	308	308	308	308
	Corr.		,650**	,307**	,386**	,424**	,293**
PREATT	Sig.		0	0	0	0	0
	N		308	308	308	308	308
	Corr.			,315**	,358**	,511**	,296**
PREMOT	Sig.			0	0	0	0
	N			308	308	308	308
	Corr.				,237**	,209**	,436**
PRENLMAT	Sig.				0	0	0
	N				308	308	308
	Corr.					,699**	,342**
POSTATT	Sig.					0	0
	N					308	308
	Corr.						,328**
POSTMOT	Sig.						0
	N						308
	Corr.						
POSTNLMAT	Sig.						
	N						

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

4.4. Evaluation of the Assumptions in MANCOVA

The Multivariate Analysis of Covariance (MANCOVA) has following assumptions:

4.4.1. Sample Size

According to Pallant (2003, p. 219) the minimum instances in any cell should at least equal to the number dependent variables in the analysis. The number of dependent variable in this study is three. Therefore, this assumption is satisfied.

4.4.2. Normality

Significance of MANOVA depends on the multivariate distribution, if the violations are not based on outliers, violations of normality is not expected. (Pallant, 2003, p. 219).

4.4.2.1. Univariate Normality

Skewness and kurtosis values are checked for each cell to assure univariate normality (Tabachnick & Fidell, 2007, pp. 79-83). The sampling distributions are normal, if skewness and kurtosis values are around zero. The kurtosis and skewness are considered to be excellent if they fall in between -1.0 and +1.0 (George & Mallery, 2016, p. 115). The samples can be accepted as normally distributed if the skewness and kurtosis values are range in between -2 and +2 (George & Mallery, 2016, p. 115; Serin, 2009). All values show normal sampling distributions for each of the covariates and dependent variables in each cell except two variables, in this research.

4.4.2.2. Multivariate Normality

Multivariate normality is assumed to be satisfied, if each cell has more than 20 cases, according to (Pallant, 2003, p. 219; Tabachnick & Fidell, 2007, p. 279), despite the fact the factorial design has unequal sample sizes for any of the cells. As there are cases more than 20 for the each cell of the factorial experiment, assumption for the multivariate normality can be accepted as not violated. Additionally, multivariate normality can be checked with the use of calculations of Mahalanobis distances (Pallant, 2003, pp. 220-221). There were tree outliers and they are kept in the analysis not to reduce sample size.

Additionally, Box's test of equality of covariance matrices can be used to validate multivariate normality. Table 4.23 summarizes the Box's test of equality of covariance matrices. Multivariate normality is not violated as the test result is not significant.

Table 4.23 - Box's M Test of Equality of Covariance Matrices

Box's M	4.564
F	.753
df1	6
df2	629149.892
Sig.	.607

4.4.3. Outliers

The boxplots as explained in Pallant (2003, pp. 59-62) are used to check univariate outliers. Univariate outliers for each observed variable was a few in number. Mahalanobis distances are used to check multivariate outliers, as described in above section (Pallant, 2003, pp. 220-221). The critical distance exceeded by only the tree cases. Removing those cases from data would be decreasing the sample size, though they were kept in the data.

4.4.4. Linearity

This assumption is based on relation of each pairs of dependent variables and it is supposed to be straight line relationship (Pallant, 2003, p. 223). Then the dependent variables and the covariates are skewed, the relations among them are linear if they are skewed in the same direction (Tabachnick & Fidell, 2007, p. 224). As the direction of skewness are in the same way, the linearity assumption is not violated.

4.4.5. Multicollinearity and Singularity

The other assumption of MANCOVA is multicollinearity which is validated if dependent variables are moderately correlated, if correlation coefficients are less than 0.80 there is no reason for concern (Pallant, 2003, p. 225). The correlation among covariates expected to be low or medium not high. The correlations among the dependent variables are summarized in the correlation matrix given in Table 4.22. Regarding these results multicollinearity and singularity are not present because all of the correlations are not more than 0.80. Consequently, multicollinearity and singularity assumption is validated.

4.4.6. Homogeneity of Variance – Covariance Matrices

The ratio of largest group size and smallest group size should not be higher than 1.5 in order to assure robustness of the F-test for the assumption (Stewens, 2009, p. 227; as cited in Peşman, 2012). The groups in the analysis are almost equal to each other. The groups in the study (TMNCA and TMCA) are expected to be equal in number, when they are compared (n_1=167, n_2=141) it can be assumed to be equal as they are too near to each other. The violation of the assumption will have more effect when the difference between them gets higher.

Test of Levene's can be used to check equality of variances. The results of the Levene's test is given in the Table 4.24 and they are not significant. The dependent variables POSTNLMAT, POSTATT, and POSTMOT have equal error variances through groups as the results are analyzed. Regarding to this results equality of variances assumptions were met.

Table 4.24 – Levene's Test of Equality of Error Variances

	F	df1	df2	Sig.
POSTATT	.349	1	306	.555
POSTMOT	.551	1	306	.458
POSTNLMAT	.708	1	306	.401

To assess homogeneity of covariance matrices Box's Test of Equality of Covariance Matrices is used (Pallant, 2003, p. 225). As the test, yields a non-significant result, this assumption is satisfied (Table 4.23).

4.4.7. Independency of Observations

The other assumption is independency of observations. In order to warrant that all of the students covered the test by themselves all of the test sessions are observed. As a result, of this observation it had been decided that the individuals completed the test by themselves only. Consequently, independency of observations assumption of was satisfied.

4.5. Result of MANCOVA

4.5.1. Null Hypothesis 1

$H_{0\ (1,2,3)}: \mu_{CA} - \mu_{NCA} = 0$

The first null hypothesis states that "There is no statistically significant difference between the posttest mean scores of 10th grade students taught by the contextual approach, and those taught by non - contextual approach on the population means of the collective dependent variables of physics achievement posttest scores, attitude towards physics course posttest scores, and motivation for learning physics posttest scores when the effects of students' physics achievement pre-test scores, attitude towards physics course pre-test scores, motivation for learning physics pretest scores and physics grades are controlled".

In order to conclude that if there was statistically significant effect of the teaching approaches on the POSTNLMAT, POSTATT and POSTMOT, MANCOVA test was computed. Table 4.25 summarizes the results of the analysis. The first null hypothesis was rejected (Wilks' $\lambda = .968$, $F(3,300) = 3.310$, $p = .020$). Which indicates that there is a significant difference between the students instructed with the contextual and non-contextual approaches on the collective dependent variables POSTNLMAT, POSTATT and POSTMOT. The observed power of the study found to be equal to .752. At the beginning of the study, the calculated power of the study stated as 0.80. When there exists difference between the observed and the calculated effect sizes a difference between observed and calculated power can be observed. Medium effect size was set during the calculated power determination. Nevertheless, small effect size obtained with the observed power at the end. MANCOVA analyses yielded 0.032 as the effect size of the research.

Table 4.25 - Results of MANCOVA analysis

Effect	Wilks' Lambda	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power
Intercept	.777	28.658	3.000	300.000	.000	.223	85.974	1.000
GRADE	.871	14.763	3.000	300.000	.000	.129	44.290	1.000
PREATT	.959	4.278	3.000	300.000	.006	.041	12.833	.861
PREMOT	.891	12.218	3.000	300.000	.000	.109	36.654	1.000
PRENLMAT	.905	10.544	3.000	300.000	.000	.095	31.632	.999
APPROACH	.968	3.310	3.000	300.000	.020	.032	9.930	.752

4.5.2. Null Hypothesis 2

After MANCOVA analysis, as follow-up test Analysis of covariance (ANCOVA) test were performed. The results of ANCOVA should give teaching methods and their effects on each dependent variable. The results of the follow-up ANCOVAs are given in .

$H_{0\,(1)}$: μ_{CA}-$\mu_{NCA} = 0$

The second null hypothesis was "There is no significant difference between the posttest mean scores of 10th grade students taught by contextual approach and those taught by non - contextual approach on the population means of the physics achievement posttest scores, when the effects of students' physics achievement pre-test scores, attitude towards physics course pre-test scores, motivation for learning physics pretest scores, and physics grades are controlled".

Table 4.26 - Follow-up ANCOVA results

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Sqr.	Obs. Power
Corrected Model	POSTATT	6768.807	5	1353.761	14.315	.000	.192	1.000
	POSTMOT	24939.484	5	4987.897	26.913	.000	.308	1.000
	POSTNLMAT	1721.372	5	344.274	26.982	.000	.309	1.000
Intercept	POSTATT	6780.664	1	6780.664	71.702	.000	.192	1.000
	POSTMOT	1620.982	1	1620.982	8.746	.003	.028	.838
	POSTNLMAT	2.224	1	2.224	.174	.677	.001	.070
GRADE	POSTATT	20.743	1	20.743	.219	.640	.001	.075
	POSTMOT	2424.360	1	2424.360	13.081	.000	.042	.950
	POSTNLMAT	337.809	1	337.809	26.476	.000	.081	.999
PREATT	POSTATT	1178.170	1	1178.170	12.459	.000	.040	.940
	POSTMOT	862.261	1	862.261	4.652	.032	.015	.575
	POSTNLMAT	23.694	1	23.694	1.857	.174	.006	.274
PREMOT	POSTATT	502.152	1	502.152	5.310	.022	.017	.632
	POSTMOT	6178.777	1	6178.777	33.339	.000	.099	1.000
	POSTNLMAT	14.336	1	14.336	1.124	.290	.004	.184
PRENLMAT	POSTATT	276.606	1	276.606	2.925	.088	.010	.399
	POSTMOT	45.916	1	45.916	.248	.619	.001	.079
	POSTNLMAT	339.690	1	339.690	26.623	.000	.081	.999
APPROACH	POSTATT	364.248	1	364.248	3.852	.051	.013	.499
	POSTMOT	10.951	1	10.951	.059	.808	.000	.057
	POSTNLMAT	74.883	1	74.883	5.869	.016	.019	.675
Total	POSTATT	1953766.000	308					
	POSTMOT	2724752.000	308					
	POSTNLMAT	85450.000	308					
Corrected Total	POSTATT	35328.130	307					
	POSTMOT	80910.130	307					
	POSTNLMAT	5574.675	307					

The second null hypothesis was rejected with respect to the ANCOVA results given in , (F (1,308) = 5.869, p = 0.016). Consequently, the population mean difference was significant between the students instructed with the contextual and non-contextual approaches on the POSTNLMAT scores. Analyzing the results given in Table 4.4 the mean scores of each group indicates that the contextual approach instruction resulted in students to achieve higher POSTNLMAT scores than the non-contextual approach instruction. Additionally, small effect size was observed as the eta square value shows, 0.016. In addition, the calculated power was 0.80 which is slightly higher than the observed power, that is 0.675. The Table 4.27 summarized the dependent variables and respective estimated means.

The effects covariates are used to adjust the estimated means. The estimated mean differences between the TMNCA and TMCA groups is 1.160 for the POSTNLMAT (Table 4.27). Before making the adjustments with respect to the covariate effects, the difference was 1.320 as it was given in the Table 4.4.

Table 4.27 - Estimated means for the POSTATT, POSTMOT and POSTNLMAT at each group

Dependent Variable		**Mean**	**Std. Error**	**95% Confidence Interval**	
				Lower Bound	Upper Bound
POSTATT	Non Contextual Approach	78.206	,805	76,621	79,790
	Contextual Approach	80.300	,889	78,551	82,049
POSTMOT	Non Contextual Approach	92.463	1,121	90,258	94,669
	Contextual Approach	92.575	1,237	90,141	95,010
POSTNLMAT	Non Contextual Approach	15.682	,293	15,106	16,258
	Contextual Approach	16.842	,323	16,205	17,478

4.5.3. Null Hypothesis 3

$H_{0\,(2)}$: μ_{CA}-μ_{NCA} = 0

The third null hypothesis was "There is no statistically significant difference between the posttest mean scores of 10th grade students taught by contextual approach and those taught by non - contextual approach on the population means of the attitude towards physics course posttest scores, when the effects of students' physics achievement pre-test scores, attitude towards physics course pre-test scores, motivation for learning physics pretest scores, and physics grades are controlled".

With respect to the results summarized in the , the third null hypothesis was failed to be rejected (F (1,308) = 3.852, p = .051). Thus, the difference between the population means was not significant when the POSTATT scores of the students taught with the contextual and non-contextual approaches are compared. However as p = .051 results can be accepted as significant.

The mean scores of each group are summarized in Table 4.27. The mean scores of the students who are taught with contextual approach achieved more on the POSTATT scores than the students who are taught with non-contextual approach. Additionally, the effect size had been found to be small which is indicated by the eta square value, .013. Furthermore, pre-calculated power (.80) was higher than the observed power, which was .499. The dependent variables and the respective estimated means for them are summarized in Table 4.27.

The effects covariates are used to adjust the estimated means. The estimated mean difference between the TMNCA and TMCA groups is 2.094 for the POSTATT (Table 4.27). Before making the adjustments with respect to the covariate effects, the difference was 2.370 as it was given in the Table 4.4.

4.5.4. Null Hypothesis 4

$H_{0\,(3)}$: μ_{CA}-$\mu_{NCA} = 0$

The third null hypothesis was "there is no statistically significant difference between the posttest mean scores of 10th grade students taught by contextual approach and those taught by non - contextual approach on the population means of the motivation for learning physics posttest scores, when the effects of students' physics achievement pre-test scores, attitude towards physics course pre-test scores, motivation for learning physics pretest scores, and physics grades are controlled".

With respect to the results summarized in the , the forth null hypothesis was failed to be rejected (F = (1,308) = .059, p = .808). Thus, the difference between the population means was not significant when the POSTMOT scores of the students taught with the contextual and non-contextual approaches are compared.

4.6. Non-parametric Analysis

Non – parametric test are assumed to be more radical, less sensitive to outliers and advised to be used to support the findings of parametric tests. Mann-Whitney U Test results are given in the Table 4.28. The population mean difference (p=0.001) between students taught with the contextual and students taught with the non-contextual approaches was significant with respect to POSTNLMAT scores.

The population mean difference (p=0.043) between students taught with the contextual and students taught with the non-contextual approaches was also significant with respect to POSTNLATT scores.

However, the students taught with the contextual approach and non-contextual approach didn’t yield a significant mean difference (p = 0.557) on the POSTMOT scores.

Table 4.28 - Results of non-parametric analysis for POSTNLMAT, POSTATT and POSTMOT

	POSTATT	POSTMOT	POSTNLMAT
Mann-Whitney U	9863.500	10952.000	8829.500
Wilcoxon W	23393.500	24482.000	22359.500
Z	-2.020	-.587	-3.394
Asymp. Sig. (2-tailed)	.043	.557	.001

4.7. Summary of the Results

In this part of the study, the results are summarized.

- The percentages of missing data for each of the variables were within the acceptable ranges. The validity of the results are not seriously affected, as missing data values are acceptable.

- The distribution of the data for the variables can be accepted as normal with respect the results of the descriptive statistics.

- Pretest scores of the NLMAT, pretest scores of the ATT and pretest scores the MOT, students’ physics grades, which are the extraneous variables of the research study, and minimum one dependent variable had significant correlation. As a result, MANCOVA analysis had been used and covariates are as these extraneous variables.

- The assumptions of MANCOVA were absence of outliers, normality, homogeneity of regression, multicollinearity, equality of variances, and independency of observations were inspected and none of them were violated.

- There were significant difference had been found when the population means of the students instructed with the contextual and non-contextual approaches compared on the collective dependent variables POSTNLMAT, POSTATT and POSTMOT according to the MANCOVA results. This indicates that the students taught with the contextual approach achieved significantly more than the students taught with the non-contextual approach.

- There were significant difference had been found when the population means of the students instructed with the contextual and non-contextual approaches compared on the POSTNLMAT scores according to the MANCOVA results. That means the contextual approach has significant effect on increasing students' achievement on Newton's Laws of Motion concepts.

- There were no significant difference had been found when the population means of the students instructed with the contextual and non-contextual approaches compared on the POSTATT scores according to the MANCOVA results. However as $p = .051$ results can be accepted as significant. If mean scores of each group are compared, it can be concluded that the students taught with contextual approach achieved more on POSTATT scores than the students taught with non-contextual approach.

- There were no significant difference had been found when the population means of the students instructed with the contextual and non-contextual approaches compared on the POSTMOT scores according to the MANCOVA results.

- A non-parametric test, Mann-Whitney Test, had been used. The results of the test indicated that there was a significant effect of the contextual approach on the students' POSTNLMAT scores when it is compared with non-contextual approach.

- A non-parametric test, Mann-Whitney Test, had been used. The results of the test indicated that there was a significant effect of the contextual approach on the students' POSTATT scores when it is compared with non-contextual approach.

- A non-parametric test, Mann-Whitney Test, had been used. The results of the test indicated that there was no significant effect of the contextual approach on the students' POSTMOT scores when it is compared with non-contextual approach.

CHAPTER V

5. DISCUSSION AND CONCLUSIONS

The Chapter Five consist of two sections, which involves the discussion of the results, and conclusions.

5.1. Discussion of the Results

The purpose of this research was to sort out the effectiveness of the contextual approach regarding achievement in, attitude towards and motivation to learn Newton's Laws of Motion unit of 10^{th} grade students. Contextual approach had significant effect on the population means of the collective dependent variables, which are Newton's Laws of Motion Achievement Test post - test scores, Attitude towards Newton's Laws of Motion content post-test scores and motivation to learn physics post-test scores of tenth grade students with respect to the results of MANCOVA analysis.

Moreover, the effect of the contextual approach on the Newton's Laws of Motion Achievement Test post - test scores of students was significant according to follow-up ANCOVA analysis. That stands for that the students taught with the contextual approach taken achieved higher scores on Newton's Laws of Motion Achievement Test post – test when compared with the students taught with the non – contextual approach.

The follow-up ANCOVAs also revealed a non significant effect of the contextual approach on the POSTATT scores of the students. As p value (0.51) was too close to critical value it can be concluded that the students taught with the contextual approach achieved more attitude scores on Newton's Laws of Motion topic than the students taught with the non – contextual approach. Meanwhile, non – parametric analysis of data shown that there was a significant population mean difference ($p=0.043$) between students taught with the contextual and non-contextual approaches on the POSTATT. Additionally, it was seen from the ANCOVA as well as non – parametric test results shown that the contextual approach had no significant effect on students' motivation to learn physics.

The main characteristics of this study is its focus on teaching approach rather than teaching method. Some of the recent studies shown that contextual approach with traditional method may be more effective (Peşman, 2012). The researcher investigated the factors contributing students' science achievement analyzing the Third International Mathematics and Science Study – Repeat (TIMSS-R) data found that teacher centered activities were more effective than student centered activities, this may be the reason why contextual approach with traditional method is more effective (as cited in Peşman, 2012). The researcher recognized that it was not easy to change teachers' teaching habits. It would be a wise decision not to change their habits but encourage them to have different approach.

Peşman (2012) stated that "teaching approach is consisted of correlated assumptions while teaching method is an overall plan of the course". Within the scope of this research as contextual approach includes correlated assumptions it is treated as a teaching approach. Content becomes more interesting and relevant for students if a context is being involved in study of a content (Bennett & Lubben, 2007; Gilbert, 2006; Peşman, 2012; Pilot & Bulte, 2006a; Taasoobshirazi & Carr, 2008; Whitelegg & Parry, 1999). As a result of recent researches it had been concluded that context based approach increases students' achievements (Çekiç Toroslu, 2011; Değermenci, 2009; Ekinci, 2010; Gilbert, 2006; King, 2009; Özay Köse & Çam Tosun, 2011; Özgen, 2012; Peşman, 2012; Tekbiyik, 2010; Yayla, 2010; Yilmaz, Othan, & Cantimur, 2014).

The recent researches also determined that contextual approach has positively affected students' attitudes and motivations (Acar & Yaman, 2011; Bennett et al., 2003; Campbell et al., 1994b; Demircioglu et al., 2009; Ekinci, 2010; İlhan et al., 2012; King, 2009; Özgen, 2012; Peşman, 2012; J. M. Ramsden, 1997; Stinner, 1994a; Tekbiyik, 2010; Wilkinson, 1999a; Yayla, 2010). However, results of this study shown that there were no significant effect of the contextual approach on motivation of students. Similar to this result (Özgen, 2012) stated that this result may due to several factors such as students' high motivation prior to implementation, short implementation period and motivation test was measuring motivation to learn chemistry not the energy content.

5.2. Conclusions

Up to now, the internal and external validity of the research were discussed. The generalizability of the conclusions, which are being covered here, is limited to the comparable situations explained in the earlier sections. As a result, of the conducted study first conclusion is that the contextual approach seems to assist students to develop better understanding of physics concepts. The contextual approach also helps students to develop better attitude towards physics.

- It is clearly supported by the data where the contextual approach is increasing achievement of students effectively in Newton's Laws of Motion topic and there is statistically ($p < 0.05$) and practically ($\eta^2 = .032$) significant mean difference between the contextual approach and non – contextual approach where contextual approach is effective. According to this result, it can be concluded that students will achieve better scores when they are taught by the contextual approach rather than the non – contextual approach.

- The contextual approach can be accepted as an effective method to increase students' attitude towards Newton's Laws of Motion topic as the p value was too close to significant value ($p = 0.051$) and practically ($\eta^2 = .013$) mean difference between the contextual approach and non – contextual approach where contextual approach is effective. According to this result, it can be concluded that students will achieve better scores when they are taught by the contextual approach rather than the non – contextual approach.

- The contextual approach is not an effectively increasing students' motivation to learn physics. Additionally, there is no statistically ($p > 0.808$) and practically ($\eta2 = 0.000$) mean difference between the contextual approach and non - contextual approach groups.

The study also involved development of three scales to measure Newton's Laws of Motion achievement (NLMAT), attitude towards Newton's Laws of Motion unit (ATT) and motivation to learn physics (MOT) of 10^{th} grade students.

- The Newton's Laws of Motion Achievement Test (NLMAT) was found to be reliable and valid tool to measure students' achievement for Newton's Laws of Motion Unit. The researcher and teachers may use this test to measure students' achievement for Newton's Laws of Motion Unit.

- The attitude of students are also a valuable construct to test effectiveness of learning and teaching environments. Attitude towards Newton's Laws of Motion Test (ATT) was found to be reliable and valid tool to measure students' Attitude towards Newton's Laws of Motion Unit. Relying on the conclusion of the study it can be advised to researchers and teachers to administer ATT to measure students' attitude towards Newton's Laws of Motion Unit.

- The motivation of students are also a valuable construct to test effectiveness of learning and teaching environments as well as achievement. Motivation to Learn Physics Test (MOT) was found to be reliable and valid tool to measure students' motivation to learn physics. Relying on the conclusion of the study it can be proposed to researchers and teachers to administer MOT to measure students' motivation to learn physics.

6. IMPLICATIONS AND RECOMENDATIONS

The chapter six three sections where the implications, the best practices of contextual approach development regarding the research study were reported. Moreover, implementation and recommendations for further researches regarding contextual approach summarized.

6.1. Implications

Following suggestions can be made grounded on the conclusions of the current research:

- The conclusions made by the inferential statistics revealed that scores in Newton's Laws of Motion Achievement Test of the students in contextual approach is significantly higher than students in non – contextual approach. Keeping this finding in mind contextual approach can be implemented to increase students' achievement and to increase effectiveness classroom environments.

- The conclusions made by the inferential statistics shown that attitude scores towards Newton's Laws of Motion content of the students in contextual approach is significantly higher than students in non – contextual approach. Keeping this finding in mind contextual approach can be implemented to increase students' attitudes and to increase effectiveness classroom environments.

- Ministry of education may focus on contextual approach to adapt curricula. In-service trainings may be administered to increase teachers' awareness regarding contextual approach.

- Faculty of education may improve their curricula to train preservice teachers regarding the importance and effectiveness of contextual approach.
- Science teacher may implement contextual approach in their learning environments. In practice the need so less changes in their lesson plans.
- Authors of textbooks can integrate contextual approach in their textbooks.

6.2. Suggested Best Practices of Contextual Approach Development and Implementation

This study revealed the effectiveness of contextual approach in the classroom environment. Keeping these findings in mind teachers and researcher may develop and implement contextual approach in learning environments. Based on the findings of the research study recommendations can be listed as follows:

- In order to increase students' conceptual perception it can be recommended to instructors providing contextual approach during their teaching as the curriculum developers offers.
- The contextual approach is effective for physics instruction. Therefore, rather than non – contextual approach using traditional method, the contextual approach with traditional method is suggested to be used in physics instruction.
- Besides the effectiveness in physics achievement, some other constructs such as attitude and motivation may benefit from contextual approach.

- Developing procedures may take time for the contextual approach to be implemented and the developers may become exhausted. It may be suggested to developers who wants to work on contextual approach it might be necessary step-by-step, systematic planning and to keep in mind about the time taking process.

- The major challenging part of the current research was context selection and giving decision on contexts. If the developer decides to find out challenging contexts for the students to allow them to comprehend course objectives may face with some challenges. To overcome these challenges, developers should search for everyday life examples, which fits the objectives of the course while deciding about a context.

- During development and context selection process it is advised to explore previously improved contexts to provide an example and a sense for context selection.

- The decision of the time requirements for a context to be covered is one other challenging consideration. This can be difficult while deciding about the duration for completing a context in classroom environment. It is strictly suggested to developers a careful decision making procedure is required about context coverage.

- The selected context may involve objectives more than one. While deciding about the duration the objectives and their proportion in the content should be taken into account. As less objectives and coverage, that much less time required for the presentations in classroom environments.

- The implementation of contextual approach involves and relies on the teacher guidance. It is very crucial and important to give proper guidance to teachers.

6.3. Recommendations for Further Researches

For the further studies, the recommendations can be listed as follows:

- The results of the research study revealed that students will be achieving more if they are taught with contextual approach rather than non-contextual approach. The limitation of the study is that the research administered to tenth graders. Thus, the generalizability of the research is limited to students in tenth grades. Keeping this finding in mind it can be recommended for the further researches to replicate the same topic (Newton's Laws of Motion) with students at different levels.

- The results of the research study revealed that students will be achieving more if they are taught with contextual approach rather than non-contextual approach. The limitation of the study is that the research administered to tenth graders on content of the Newton's Laws of Motion. Thus, the generalizability of the research is limited to students in tenth grades who are taught the Newton's Laws of Motion content. Keeping this finding in mind, it can be recommended for the further researches to replicate the research on tenth grades with different content areas.

- The results of the research study revealed that students will having better attitude towards Newton’s Laws of Motion content if they are taught with contextual approach rather than non-contextual approach. The research also be replicated with different grade levels than 10^{th} grades and different topics than Newton’s Laws of Motion unit.

- The evaluation and measurement of skill related objectives needs different measurement methods which have not been used in this research. For the further research it can be recommended to use performance based measurement methods to evaluate and measure students’ skills.

- The classroom sizes were nearly 24 students in each classes of the current research. In order to evaluate the effectiveness of the contextual approach with respect to non-contextual approach, a replication of the current study can be recommended for the further research with classes of different sizes.

- In the current study contexts were selected by the researcher. Prior to classroom activities it may be asked to students for appropriate selection of the contexts which can be used during lesson hours. This may ensure the contexts to be more interesting and appropriate for the students.

- In the current study, there were only the researcher himself to observe implementation process. Further studies may involve at least two observers, during the implementation of them in order to guarantee reliability of observations.

- The treatment and implementation of the research finished in late period of the academic year. So that the retention test were not administered to the students. The future studies may involve retention test with the purpose of evaluating the contextual approach and its effects during the time, in other words effects longevity the over non – contextual approach. After the implementation of the contextual approach in classroom environments it can be advised to administer retention tests after a while.

- Contextual approach may contribute to some other skills as well as achievement, attitude and motivation such as scientific literacy, problem solving skills, scientific process skills or critical thinking skills. In the current research the skills of the students were not measured. Thus, further studies might involve other skill variables for assess contextual approach and its contributions to those variables.

- Further studies may try to find out if female and male students are benefiting differently if contextual approach is used. It may also find out the reasons behind this situation.

- The teaching method is also important as well as teaching approach. Further studies may involve variables to search the effectiveness of teaching methods to reveal the difference between teaching approach and teaching method. It can be recommended to investigate the effect of teaching/learning methods compared with contextual approach for further studies and researches.

- In the current research, only objective test items are administered to students to measure students' physics achievement. For the further research, it can be recommended to use short answer and open ended test items in order to evaluate and measure students' achievement. Recognizably, some students probably achieved different progress in use of such test items.

- The students may gather new skills when they are taught with contextual approach which can be listed as problem solving skills, scientific literacy or scientific process skills. It can be recommended for the further researches to evaluate and asses the effectiveness of contextual approach instruction on the skill variables too.

- The use of contextual approach can also be investigated with the perspective of teachers. It is obvious that involvement of the teachers is a crucial aspect in students learning. The further studies may investigate teacher beliefs, involvement, contribution etc.

- The study shown the effectiveness of contextual approach with nontraditional method. There are also some other methodologies which shown effectiveness on students' achievement, attitude and motivation. Contextual approach can be investigated and compared with other methodologies.

- The study investigated quantitative attributes of contextual approach. Further studies may involve qualitative attributes.

- The study mostly involved high achieving students and the study shown the effectiveness of contextual approach on students' achievement, attitude, and motivation. Further studies may involve low and medium achieving students and the effectiveness of contextual approach on their achievement, attitude, and motivation.

- The sample of the study was 10^{th} grade level high school students. The study can be replicated for other schools like middle schools even college and university students.

- Data collector characteristics is threat to internal validly of the study. Future studies may have other data collector(s) than teachers unbiased to collect data.

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APPENDICES

A. EXPERT OPINION FORM FOR THE NEWTON'S LAWS OF MOTION ACHIEVEMENT TEST (NLMAT)

Purpose of the NLMAT: To find out if 10^{th} grade students are achieving the cognitive objectives of the Newton's Laws of Motion content.

Number of objectives: 11 cognitive objectives of 5 main topics (force, 1^{st}, 2^{nd}, and 3^{rd} law of Newton and inertia).

Estimated time: 20 min.

Number of Items: 7 True/False and 18 multiple choice, total 25 items.

General Evaluation:

Please choose the answer that best describes your opinion. You may submit your comments in the given fields. (1: I don't agree – 2: Can be improved – 3: I agree)

	Your Opinion				Your Comment
1	Directives are clear and easy to follow	1	2	3	
2	The level language is appropriate	1	2	3	
3	The duration is appropriate	1	2	3	
4	The terminology is appropriate	1	2	3	
5	The items don't give hint for the other items	1	2	3	
6	The contexts in the questions are familiar	1	2	3	
7	Font and size are legible	1	2	3	
8	Objectives are represented by enough number of items	1	2	3	

Objective List		Item	Consistent with Objective: Yes	Consistent with Objective: No	Question is wrong: Yes	Question is wrong: No	Boom's Taxonomy: Level	Appropriate	Not Appropriate	Comment
1. Regarding the force cause of motion: Students should be able to;										
1.1	Describe the force with examples based on the effects of it on objects.	1					**Knowledge**			
		2					**Knowledge**			
		3					**Knowledge**			
1.2	Describe the force as a vector quantity with examples.	4					**Knowledge**			
		5					**Knowledge**			
		6					**Knowledge**			
		7					**Knowledge**			
1.3	Calculate the resultant force from different ways.	10					**Application**			
		11					**Application**			
							Application			
2. When the net force is zero: Students should be able to;										
2.1	Explain the motion of the objects with examples.	12					**Comprehension**			
		13					**Comprehension**			
3. Regarding the object in motion with the influence of a net force: Students Should be able to;										
3.1	Solve problems using the relation of net force with acceleration and mass of an object.	14					**Application**			
		15					**Application**			
3.2	Explain the motion in one dimension with constant acceleration.	8					**Comprehension**			
		9					**Comprehension**			
4. Regarding the action reaction forces; Students should be able to										
4.1	Explains action-reaction pairs with examples.	16					**Comprehension**			
		24					**Comprehension**			
4.2	Calculate the acceleration of the systems with more than one body.	17					**Application**			
		25					**Application**			
4.3	Construct free-body diagrams.	18					**Application**			
		19					**Application**			
5. Regarding the inertia of an object: Students should be able to										
5.1	Explain inertia by relating motion of the object when it is at rest, moving with constant velocity and constant acceleration.	20					**Comprehension**			
		21					**Comprehension**			
5.2	Explain inertia as a measure of its mass with examples.	22					**Comprehension**			
		23					**Comprehension**			

B. CLASSROOM INVENTORY FORM

Physical Properties of Classroom	Yes	Partial	NO
6. Is lighting enough?			
7. Is the ambient temperature appropriate?			
8. Is there enough desks?			
9. Is there any video projector?			
10. Is there any interactive board?			
Question 4 and 5 if yes: How frequently they were used to present course materials?			

This form prepared separately, while being distributed to teachers merged with Observation Control List given in Appendix D.

C. ITEMAN OUTPUT OF NLMAT PILOT DATA

```
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Item analysis for data from file 01.txt                        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     0.782    0.813   0.580     1      0.782     0.813   0.580  *
                                          2      0.184    -0.716  -0.491
                                       Other    0.034    -0.652  -0.271

  2   0-2     0.732    0.792   0.589     1      0.732     0.792   0.589  *
                                          2      0.206    -0.620  -0.437
                                       Other    0.062    -0.689  -0.350

  3   0-3     0.686    0.556   0.425     1      0.686     0.556   0.425  *
                                          2      0.274    -0.431  -0.322
                                       Other    0.040    -0.629  -0.275

  4   0-4     0.407    0.292   0.231     1      0.407     0.292   0.231  *
                                          2      0.446    -0.097  -0.077
                                       Other    0.147    -0.325  -0.211
```

5	0-5	0.684	0.793	0.607	1	0.684	0.793	0.607	*
					2	0.184	-0.606	-0.416	
					Other	0.133	-0.566	-0.358	
6	0-6	0.627	0.481	0.377	1	0.627	0.481	0.377	*
					2	0.291	-0.220	-0.166	
					Other	0.082	-0.705	-0.389	
7	0-7	0.692	0.814	0.620	1	0.692	0.814	0.620	*
					2	0.234	-0.680	-0.493	
					Other	0.073	-0.555	-0.297	
8	0-8	0.537	0.570	0.454	1	0.537	0.570	0.454	*
					2	0.240	-0.410	-0.299	
					Other	0.223	-0.331	-0.237	
9	0-9	0.556	0.646	0.513	1	0.556	0.646	0.513	*
					2	0.243	-0.416	-0.304	
					3	0.164	-0.416	-0.278	
					4	0.000	-9.000	-9.000	
					Other	0.037	-0.271	-0.116	
10	0-10	0.455	0.460	0.366	1	0.260	-0.136	-0.100	
					2	0.455	0.460	0.366	*
					3	0.051	-0.365	-0.174	
					4	0.085	0.108	0.060	
					Other	0.150	-0.503	-0.328	

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

Item analysis for data from file 01.txt Page 2

		Item Statistics			Alternative Statistics				
Seq. No.	Scale -Item	Prop. Correct	Biser.	Point Biser.	Alt.	Prop. Endorsing	Biser.	Point Biser.	Key
11	0-11	0.850	0.640	0.417	1	0.850	0.640	0.417	*
					2	0.054	-0.308	-0.149	
					3	0.028	-0.586	-0.229	
					4	0.028	-0.536	-0.209	
					Other	0.040	-0.499	-0.219	
12	0-12	0.105	0.346	0.205	1	0.186	-0.018	-0.013	
					2	0.105	-0.124	-0.073	
					3	0.475	0.177	0.141	
					4	0.105	0.346	0.205	*
					Other	0.130	-0.500	-0.315	
13	0-13	0.562	0.493	0.392	1	0.102	-0.133	-0.078	
					2	0.059	-0.258	-0.129	
					3	0.181	-0.169	-0.116	
					4	0.562	0.493	0.392	*
					Other	0.096	-0.562	-0.325	
14	0-14	0.833	0.542	0.363	1	0.833	0.542	0.363	*
					2	0.054	-0.165	-0.080	
					3	0.040	-0.362	-0.159	
					4	0.011	-0.376	-0.106	
					Other	0.062	-0.615	-0.312	
15	0-15	0.661	0.319	0.247	1	0.661	0.319	0.247	*

					2	0.192	-0.044	-0.031	
					3	0.028	-0.396	-0.155	
					4	0.073	-0.051	-0.027	
					Other	0.045	-0.756	-0.346	
16	0-16	0.356	0.331	0.258	1	0.407	0.061	0.048	
					2	0.088	-0.185	-0.104	
					3	0.356	0.331	0.258	*
					4	0.059	-0.247	-0.123	
					Other	0.090	-0.544	-0.309	
17	0-17	0.760	0.630	0.459	1	0.760	0.630	0.459	*
					2	0.031	-0.338	-0.136	
					3	0.059	-0.544	-0.272	
					4	0.040	-0.195	-0.085	
					Other	0.110	-0.485	-0.292	

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

Item analysis for data from file 01.txt Page 3

		Item Statistics			Alternative Statistics				
Seq. No.	Scale -Item	Prop. Correct	Biser.	Point Biser.	Alt.	Prop. Endorsing	Biser.	Point Biser.	Key
18	0-18	0.215	0.548	0.389	1	0.138	-0.109	-0.070	
					2	0.105	-0.195	-0.116	
					3	0.192	0.101	0.070	

					4	0.215	0.548	0.389	*
					Other	0.350	-0.345	-0.268	
19	0-19	0.537	0.284	0.226	1	0.234	0.012	0.009	
					2	0.093	-0.153	-0.088	
					3	0.059	-0.071	-0.035	
					4	0.537	0.284	0.226	*
					Other	0.076	-0.576	-0.311	
20	0-20	0.799	0.679	0.475	1	0.799	0.679	0.475	*
					2	0.037	-0.328	-0.140	
					3	0.028	-0.566	-0.221	
					4	0.042	-0.220	-0.099	
					Other	0.093	-0.645	-0.370	
21	0-21	0.325	0.266	0.205	1	0.105	-0.124	-0.073	
					2	0.316	0.255	0.195	
					3	0.068	-0.134	-0.070	
					4	0.325	0.266	0.205	*
					Other	0.186	-0.547	-0.377	
22	0-22	0.345	0.463	0.359	1	0.056	-0.182	-0.090	
					2	0.141	0.270	0.174	
					3	0.186	-0.207	-0.143	
					4	0.345	0.463	0.359	*
					Other	0.271	-0.466	-0.348	
23	0-23	0.619	0.517	0.406	1	0.619	0.517	0.406	*
					2	0.096	-0.223	-0.129	
					3	0.096	-0.234	-0.135	
					4	0.065	-0.097	-0.050	
					Other	0.124	-0.522	-0.325	

24	0-24	0.130	0.148	0.093	1	0.178	-0.096	-0.065	
					2	0.407	0.307	0.243	?
	CHECK THE KEY				3	0.068	-0.159	-0.083	
	4 was specified, 2 works better				4	0.130	0.148	0.093	*
					Other	0.218	-0.356	-0.254	

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

Item analysis for data from file 01.txt   Page 4

		Item Statistics			Alternative Statistics				
Seq. No.	Scale -Item	Prop. Correct	Biser.	Point Biser.	Alt.	Prop. Endorsing	Biser.	Point Biser.	Key
25	0-25	0.785	0.632	0.450	1	0.785	0.632	0.450	*
					2	0.014	-0.058	-0.018	
					3	0.037	-0.376	-0.161	
					4	0.023	-0.633	-0.229	
					Other	0.141	-0.528	-0.340	

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Item analysis for data from file 01.txt   Page 5

There were 354 examinees in the data file.

Scale Statistics

Scale:	0
N of Items	25
N of Examinees	354
Mean	14.040
Variance	18.885
Std. Dev.	4.346
Skew	-0.428
Kurtosis	0.079
Minimum	0.000
Maximum	24.000
Median	14.000
Alpha	0.765
SEM	2.106
Mean P	0.562
Mean Item-Tot.	0.388
Mean Biserial	0.522

D. OBSERVATION CONTROL LIST

Physical Properties of Classroom	Yes	Partial	NO
11. Is lighting enough?			
12. Is the ambient temperature appropriate?			
13. Is there enough desks?			
14. Is there any video projector?			
15. Is there any interactive board?			
Question 4 and 5 if yes: How frequently they were used to present course materials?			
Approach Related Properties			
Non-Context Based Traditional Approach			
1. Did teacher instructed the content?			
2. Did teacher solve sample questions on the subject?			
3. Were students given the opportunity to solve sample questions?			
4. Was instruction teacher-centered?			
5. With respect to your opinion, was the instruction traditional?			
Context Based Traditional Approach			
1. Did teacher begin lesson with an interesting context?			
2. Was the context appropriate for the content?			
3. Was the transition from the context to the content appropriate?			
4. Did teacher instructed the content?			
5. Did teacher solve sample questions on the content?			
6. Were students given the opportunity to solve sample questions?			
7. Did the content covered based on the context introduced?			
8. Was instruction teacher-centered?			
9. With respect to your opinion, was the instruction traditional?			

School : ____

Class : ____

Date : ____

Duration : ____

Observer : ____

E. ATTITUDE TOWARDS NEWTON'S LAWS OF MOTION TEST (ATT)

ATTENTION! The "Newton's Laws of Motion" (NLoM) chapter covers:

• Newton's First Law of Motion

• Newton's Second Law of Motion

• Velocity change with the effect of constant force

• Relation of acceleration with the magnitude of force

• Newton's Third Law of Motion sections.

KUJDES! Ligjet e Njutonit (LN) perfshijne temat:

• Ligji i pare i levizjes i Njutonit

• Ligji i dyte i levizjes i Njutonit

• Ndryshimet e shpejtesise nen ndikimin e nje force konstante

• Ndryshimi i nxitimit ne varesi te magnitudes se forces

• Ligji i trete i Njutonit

1 I like the "Newton's Laws of Motion" chapter.

Mua më pëlqejnë temat e kapitullit Ligjet e Njutonit.

2 I have positive feelings about the NLoM chapter.

Unë kam mendim pozitiv për temat e kapitullit LN.

3 I believe that what I've learned from the NLoM chapter will make my life easier.
Unë besoj se përvetësimi i temave të kapitullit LN do të më lehtësojë jetën e përditshme.

4 I don't believe that the NLoM chapter will gain more importance in the future.
Unë nuk besoj se rëndësia e temave LN do të vijë duke u rritur në të ardhmen.

5 I believe that the NLoM chapter will be beneficial for my further studies.
Unë besoj se studimi i temave të kapitullit LN do të më shërbejë në studimet e mia të ardhshme.

6 I will do my best to be successful at the NLoM chapter.
Unë bëj çfarë është e mundur për të qenë i suksesshëm në kapitullin LN.

7 I will try my best for the NLoM chapter.
Unë mundohem të bëj më të mirën e mundshme për të qenë i suksesshëm në kapitullin LN.

8 I will not try harder if I do not succeed in the NLoM chapter.
Unë nuk do të bëj përpjekje të tjera nëse nuk arrij rezultate të kënaqshme në kapitullin LN.

9 I am sure that I can learn the NLoM chapter.
Unë jam i/e sigurt se do të arrij t'i përvetësoj temat e kapitullit LN.

10 I am sure that I can succeed in the NLoM chapter.

Unë jam i/e sigurt se do të jem i suksesshëm në përvetësimin e temave të kapitullit LN.

11 I am sure that I can solve the hard problems of the NLoM chapter.

Unë jam i/e sigurt se do të jem i suksesshëm në zgjidhjen e problemave dhe ushtrimeve të vështira të kapitullit LN.

12 I will try my best to solve the problems related to the NLoM chapter no matter how difficult they are.

Unë do të bëj më mirën e mundshme për të zgjidhur të gjithë problemat dhe ushtrimet e kapitullit LN.

13 I don't think that the NLoM chapter will have any importance in my prospective vocational life.

Unë nuk mendoj se temat e kapitullit LN do të më shërbejnë në jetën time profesionale.

14 I believe that what I've learned in the NLoM chapter will be useful in my daily life.

Temat e kapitullit Ligjet e levizjes se Njutonit do të më ndihmojnë mua në veprimtaritë e jetës së përditshme.

15 I like reading books about the NLoM chapter and its applications in technology.

Mua më pëlqen të lexoj libra që tregojnë dhe shpjegojnë zbatimet e temave të kapitullit LN në teknologji.

16 The NLoM chapter is entertaining for me.

Temat e kapitullit LN janë zbavitëse.

17 I don’t like studying on the NLoM chapter at school.

Mua nuk më pëlqen të mësoj temat e kapitullit LN në shkollë.

18 I believe I can cope with harder problems of the NLoM chapter.

Unë jam i sigurt se mund të zgjidh problema shumë të vështira nga kapitulli LN.

19 Talking with my friends about the NLoM after school is enjoyable.

Mua më pëlqen të flas me shokët pas mësimit për tema që kanë lidhje me kapitullin LN.

20 I would like to be given books and tools related with the NLoM chapter as gifts.

Mua më pëlqen të më bëjnë dhuratë libra apo materiale të tjera në lidhje me temat e kapitullit LN.

21 I believe I can solve the hardest problems of NLoM chapter if I have enough time.

Unë jam i/e sigurt se do të mund të zgjidh problemat e vështira të kapitullit LN në se do të kem kohë të mjaftueshme.

22 I like talking about the NLoM chapter or its applications in technology.

Mua më pëlqen të flas me shokët për temat e kapitullit LN dhe aplikimet e tyre në teknologji.

23 The NLoM chapter is effective in improving my manual skills.

Temat e kapitullit LN ndikojnë në zhvillimin e aftësive të mia praktike.

24 I don’t want to have more lesson hours for the NLoM chapter.

Unë nuk do të doja që kapitulli i LN të zhvillohej në më shumë orë mësimore se sa tani.

F. MOTIVATION FOR LEARNING PHYSICS TEST – FIRST VERSION

Physics Motivation Questionnaire / Pyetësor Motivues për Fizikën

In order to better understand what you think and feel about your physics courses, please respond to each of the following statements from the perspective of: "When I am in a physics course…"

Për të kuptuar më mirë se çfarë mendoni dhe ndjeni rreth lëndës së fizikës në shkollë, ju lutem përgjigjuni secilit nga pohimet e mëposhtme nga këndvështrimi: "Kur jam në një orë mësimi Fizike..."

When I am in a physics course

Kur jam në një orë mësimi Fizike

1 I enjoy learning the physics.

Mua më pëlqen të mësoj fizikë.

2 The physics I learn relates to my personal goals.

Fizika që mësoj ka lidhje me qëllimet e mia.

3 I like to do better than the other students on the physics tests.

Më pëlqen të dal më mirë se nxënësit e tjerë në testet e fizikës.

4 I am nervous about how I will do on the physics tests.

Jam i shqetësuar se si do të dal në testet e fizikës.

5 If I am having trouble learning the physics, I try to figure out why.

Nëse kam probleme me mësimin e fizikës, përpiqem të gjej shkakun.

6 I become anxious when it is time to take a physics test.

Përjetoj ankth kur afron koha për të kryer testin e fizikës.

7 Earning a good physics grade is important to me.

Për mua është e rëndësishme të marr një notë të mirë në fizikë.

8 I put enough effort into learning the physics.

Unë përpiqem mjaftueshëm për të mësuar fizikën.

9 I use strategies that ensure I learn the physics well.

Unë përdor strategji që më sigurojnë të mësoj mirë fizikën.

10 I think about how learning the physics can help me get a good job.

Unë mendoj se si të mësuarit të fizikës mund të më ndihmojë të gjej një punë të mirë.

11 I think about how the physics I learn will be helpful to me.

Unë mendoj se si të mësuarit të fizikës do të më ndihmojë.

12 I expect to do as well as or better than other students in the physics course.

Unë pres të jem të paktën aq i suksesshëm apo më mirë se sa nxënësit e tjerë në fizikë.

13 I worry about failing the physics tests.

Më shqetëson ideja e ngeljes në testet e fizikës.

14 I am concerned that the other students are better in physics.

Jam i shqetësuar që nxënësit e tjerë janë më mirë në fizikë.

15 I think about how my physics grade will affect my overall grade point average.

Mendoj se si nota ime e fizikës do të ndikojë në mesataren time të përgjithshme.

16 The physics I learn is more important to me than the grade I receive.

Ajo ç'ka mësoj nga fizika është më e rëndësishme për mua sesa nota që marr.

17 I think about how learning the physics can help my career.

Unë mendoj se si të mësuarit të fizikës mund të më ndihmojë në karrierën time.

18 I hate taking the physics tests.

Unë i urrej testet e fizikës.

19 I think about how I will use the physics I learn.

Mendoj se si do t'a përdor fizikën që mësoj.

20 It is my fault, if I do not understand the physics.

Është faji im nëse nuk e kuptoj fizikën.

21 I am confident I will do well on the physics labs and projects.

Jam i bindur se do të dal mirë në laboratorët dhe projektet e fizikës.

22 I find learning the physics interesting.

Më duket interesante të mësuarit e fizikës.

23 The physics I learn is relevant to my life.

Fizika që mësoj ka lidhje me jetën time.

24 I believe I can master the knowledge and skills in the physics course.

Une besoj se mund t’i zotëroj dijet dhe aftësite në lëndën e fizikës.

25 The physics I learn has practical value for me.

Fizika që mësoj ka vlera praktike për mua.

26 I prepare well for the physics tests and labs.

Unë përgatitem mirë për testet dhe laboratorët e fizikës.

27 I like physics that challenges me.

Më pëlqen fizika që më sfidon.

28 I am confident I will do well on the physics tests.

Jam i bindur se do të dal mirë në testet e fizikës.

29 I believe I can earn a grade of 10 in the physics course.

Kam besim se mund të marr 10 në lëndën e fizikës.

30 Understanding the physics gives me a sense of accomplishment.

Të kuptuarit e fizikës më jep një ndjenjë plotësimi.

G. MOTIVATION FOR LEARNING PHYSICS TEST – FINAL VERSION

Science Motivation Questionnaire II (SMQ-II) Albanian Language Version adopted as Physics Motivation Questionnaire II (PMQ-II) © 2011 Shawn M. Glynn, University of Georgia, USA

Physics Motivation Questionnaire / Pyetësor Motivues për Fizikën

Adopted by Ahmed Fatih Ersoy, Epoka University, Tirana - Albania

In order to better understand what you think and feel about your physics courses, please respond to each of the following statements from the perspective of: "**When I am in a physics course…**"

Për të kuptuar më mirë se çfarë mendoni dhe ndjeni rreth lëndës së fizikës në shkollë, ju lutem përgjigjuni secilit nga pohimet e mëposhtme nga këndvështrimi: "**Kur jam në një orë mësimi Fizike...**"

Response Scale: O Never O Rarely O Sometimes O Usually O Always

: O Kurrë O Rrallëherë O Ndonjëherë O Zakonisht O Gjithmonë

01. The physics I learn is relevant to my life.

01. Fizika që mësoj ka lidhje me jetën time

02. I like to do better than other students on physics tests.

02. Më pëlqen të dal më mirë se nxënësit e tjerë në testet e fizikës.

03. Learning physics is interesting.

03. Të mësuarit e fizikës është interesante.

04. Getting a good physics grade is important to me.

04. Për mua është e rëndësishme të marr një notë të mirë në Fizikë.

05. I put enough effort into learning physics.

05. Përpiqem mjaftueshëm të mësoj Fizikën.

06. I use strategies to learn physics well.

06. Përdor strategji për të mësuar mirë Fizikën.

07. Learning physics will help me get a good job.

07. Të mësuarit e Fizikës do të më ndihmojë të gjej një punë të mirë.

08. It is important that I get a "10" in physics.

08. Të marr notën 10-të në Fizikë është e rëndësishme për mua.

09. I am confident I will do well on physics tests.

09. Jam i bindur se do dal mirë në testet e Fizikës.

10. Knowing physics will give me a career advantage.

10. Njohuritë mbi fizikë më mundësojnë epërsi në karrierë.

11. I spend a lot of time learning physics.

11. Shpenzoj shumë kohë duke mësuar Fizikë.

12. Learning physics makes my life more meaningful.

12. Të mësuarit e Fizikës e bën jetën time më kuptimplotë.

13. Understanding physics will benefit me in my career.

13. Të kuptuarit e Fizikës do të më sjelli përfitime në karrierën time.

14. I am confident I will do well on physics labs and projects.

14. Jam i bindur se do të dal mirë në laboratorët dhe projektet e Fizikës.

15. I believe I can master physics knowledge and skills.

15. Besoj se mund t'i zotëroj njohuritë dhe aftësitë e Fizikës.

16. I prepare well for physics tests and labs.

16. Përgatitem mirë për testet dhe punën laboratorike të Fizikës.

17. I am curious about discoveries in physics.

17. Jam kurioz rreth zbulimeve në Fizikë.

18. I believe I can earn a grade of "10" in physics.

18. Besoj se mund të marr 10 në Fizikë.

19. I enjoy learning physics.

19. Më pëlqen të mësoj Fizikë

20. I think about the grade I will get in physics.

20. Mendoj për notën që do të marr në Fizikë.

21. I am sure I can understand physics.

21. Jam i sigurtë që mund ta kuptoj Fizikën.

22. I study hard to learn physics.

22. Studioj shumë për të mësuar Fizikë.

23. My career will involve physics.

23. Karriera ime do të ketë të përfshijë Fizikën.

24. Scoring high on physics tests and labs matters to me.

24. Notat e mira në testet dhe laboratorët e Fizikës kanë rëndësi për mua.

25. I will use physics problem-solving skills in my career.

25. Aftësitë e mia për zgjidhjen e problemeve të Fizikës do t'i përdor në karrierën time.

End. Thank you! Ju falemenderit!

H. SUMMARY OF AUSTRALIA SCIENCE & PHYSICS CURRICULUM

In the Science learning area students learn to investigate, understand and communicate about the physical, biological and technological world and value the processes that support life on our planet. Science helps students to become critical thinkers by encouraging them to use evidence to evaluate the use of science in society and the application of science in daily life.

The outcomes of the Science Learning Area Statement are organized into two parts. The Working Scientifically outcomes address the skills of scientific inquiry and the ways people use scientific information. The Understanding Concepts outcomes encompass distinctive scientific understandings, theories, ideas and knowledge, and draw from the traditional scientific disciplines. The paragraphs beneath each outcome exemplify, further explain and illustrate achievement of the outcome from a kindergarten to year 12 perspective. In some situations, teachers may choose to develop a science program based on the traditional disciplines of science. In others, an integrated approach, perhaps developed in the context of other learning areas, may be appropriate.

Science activities and investigations should be undertaken in contexts that have meaning for students, using issues that are relevant to their lives and local environments.

Earth and Beyond

Students understand how the physical environment on Earth and its position in the universe impact on the way we live.

Energy and Change

Students understand the scientific concept of energy and explain that energy is vital to our existence and to our quality of life.

Life and Living

Students understand their own biology and that of other living things, and recognize the interdependence of life.

Natural and Processed Materials

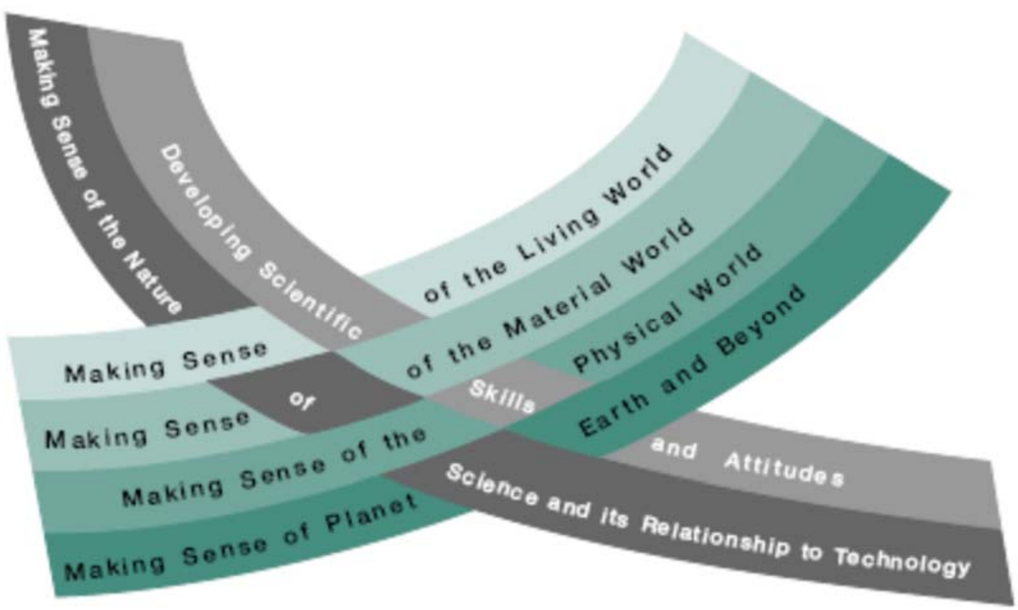
Students understand that the structure of materials determines their properties and that the processing of raw materials results in new materials with different properties and uses.

Years 10 to 12

The conceptual outcomes for Earth and Beyond, Energy and Change, Life and Living, and Natural and Processed Materials, align to some extent with subjects such as Geology, Physics, Biology and Chemistry, but there is also overlap. Students who choose to study specialist science courses, such as Physics or Biology, will develop and refine their science knowledge and skills in the context of the specialist area.

I. SUMMARY OF NEW ZEALAND SCIENCE CURRICULUM

Curriculum provides a framework of learning in science for all students. To promote a contemporary and comprehensive science education this curriculum statement has been organized into six integrated learning strands. Four of the strands – Making Sense of the Living World, Making Sense of the Physical World, Making Sense of the Material World, and Making Sense of Planet Earth and Beyond – provide the broad learning contexts through which the other two integrating strands are developed. These other two are Making Sense of the Nature of Science and its Relationship to Technology and Developing Scientific Skills and Attitudes.



The purpose of this curriculum statement is to provide direction for learning in science. Research in science education indicates that this learning is enhanced when; scientific knowledge, skills, and attitudes are first introduced in contexts which are relevant and familiar to the students and science is linked with other essential learning areas of The New Zealand Curriculum Framework.

LEARNING STANDARDS

Integrating Standards:

- Making Sense of the Nature of Science and its Relationship to Technology;
- Developing Scientific Skills and Attitudes;

The contextual strands:

Making Sense of the Living World:

In their study of the living world, students should be developing an awareness of New Zealand's plants and animals and an appreciation of the special features of the New Zealand environment.

Making Sense of the Physical World:

In their study of the physical world, students explore natural processes and physical phenomena associated with light, heat, sound, mechanics, electricity, magnetism, and other topics.

Making Sense of the Material World:

In their study of the material world, students will become aware of the nature and behavior of materials.

Making Sense of Planet Earth and Beyond:

The learning emphasis is on the development of an awareness of the unique nature of planet Earth within the solar system. Also important is the need to value Earth's resources in ways which recognize that the special environment it provides for living things is constantly changing and vulnerable.

The division does not mean that learning in each strand is to be developed independently from learning in other strands.

Science is both a process of enquiry and a body of knowledge; it is an integrated discipline. The development of scientific skills and attitudes is linked to the development of ideas in science. Similarly, as students' ideas evolve, they should be acquiring an understanding of the nature of science and its relationship to technology. Consequently, when planning and implementing a science program, the integrating strands should be interwoven with the four contextual strands. Teachers should also seek ways to reflect the integrated nature of science by linking achievement objectives and learning experiences across the four contextual strands, and with achievement objectives in other essential learning areas of The New Zealand Curriculum Framework.

CONTEXTS FOR LEARNING

Students learn effectively, and see relevance in learning science, when they have opportunities to develop and use their science ideas and skills, first in a variety of familiar contexts and later in other challenging situations. A range of sample learning contexts is suggested for each level. This allows the achievement objectives to be attained through an integrated learning approach. The integrated approach can be further facilitated by using achievement objectives from both within and across learning strands. Achievement objectives from other essential learning areas can also be used to help direct learning within a particular learning context.

The suggested contexts listed at each level are not intended to be exhaustive. It is expected that teachers will not only select from the sample learning contexts but also identify others which are appropriate to their students and which reflect local community characteristics and resources. The careful selection of contexts is an effective strategy for the development of an inclusive curriculum.

Scientific ideas can be clarified and extended through learning experiences which involve investigating technological devices and processes at all levels. Learning can also be advanced through study of the development of scientific ideas or concepts, both historically and within their own community. Examples from the New Zealand context would enhance students' understanding of the role of science and of scientists in society.

J. SUMMARY OF NEW TURKISH 9TH GRADE PROGRAM

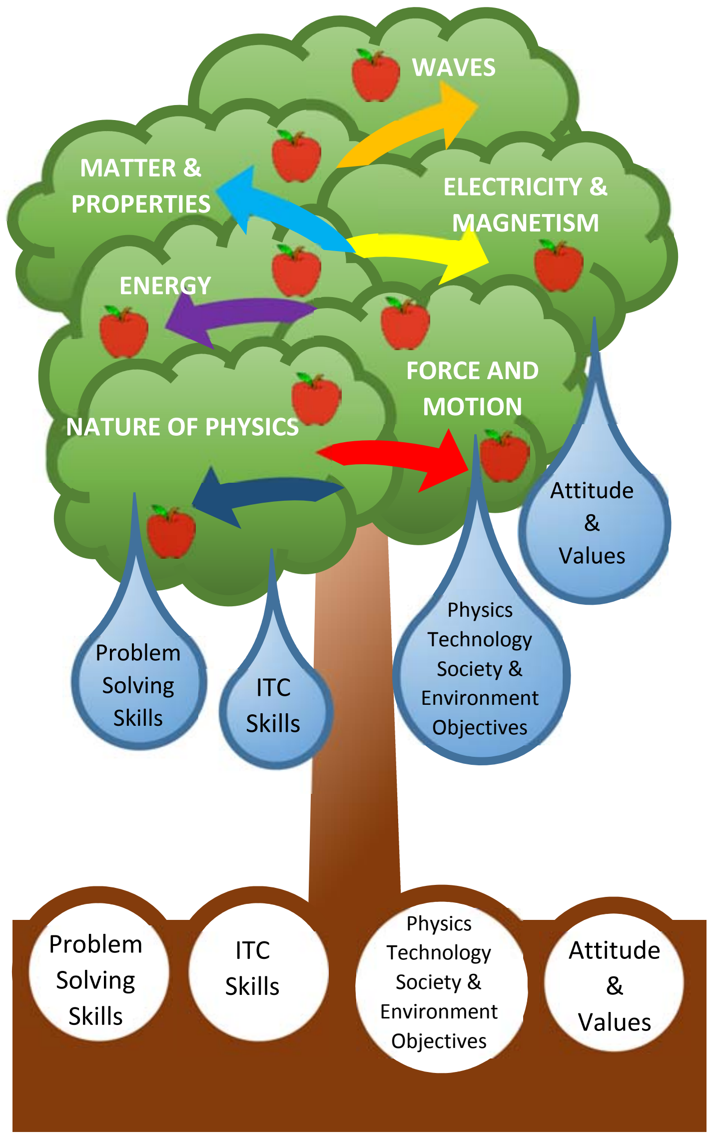
Meaningful learning in physics lessons is possible in media where validity of students' prior knowledge is controlled, real life contexts utilized, students are always minds on and usually hands on and conceptual change is possible.

The new physics programme of 9th classes based on real life context based learning and featured real life contexts (physics events and facts) where all students possible to face with. Physics subjects which are essential for everybody are given with real life links in this level. Necessary physics subjects will be given at conceptual level as much as possible in 10^{th}, 11^{th} and 12^{th} classes with spiral approach and real life links.

In the programme real life context based approach and Physics-Technology-Society objectives are nested in each other. Both approaches are linking abstract physics concepts and real life. Based on the researches it is evident that European countries mostly highlight real life context based approach and Americans highlight Science--Technology-Society-Environment objectives. In this program both approaches handled to complete each other.

It is assumed that learning is more easy, meaningful and permanent when it is needed and occurs in the natural environment. So that the programme makes necessary to start from real life events and learn physics concepts and laws rather than classic way of learning them before real life examples. In other words the programme embraces real life context based approach. This approach is the fundamental perspective of the programme.

Physics for everyone approach is accepted, real life links are built and content objectives for this level is interwoven within skill objectives.



9th Class Physics Contents

1. Nature of Physics - Fiziğin Doğası

2. Energy - Enerji

3. Matter and Properties - Madde ve Özellikleri

4. Force and Motion - Kuvvet ve Hareket

5. Electricity and Magnetism - Elektrik ve Manyetizma

6. Waves – Dalgalar

A Sample Unit

2. Ünite : Enerji

Önerilen Süre: 18 Ders Saati

A. Genel Bakış

Öğrenciler 6. sınıfta hareket enerjisi, elektrik enerjisi ve ısının; iletim, konveksiyon ve ışıma yoluyla taşınmasını öğrendiler.

7. sınıfta enerji; kinetik ve potansiyel enerji başlığı altında irdelenmiş, çekim potansiyel enerjisi ve esneklik potansiyel enerjisi potansiyel enerji çeşidi olarak vurgulanmıştır. Elektrik enerji kaynakları, enerji türü olarak ışıktan bahsedilmiştir.

8. sınıfta ise ısı ve sıcaklık, termometreler, enerji kaynağı olarak güneş ışığının fotosentez olayındaki rolü, elektrik enerjisi ve elektriksel güç anlatılmıştır.

B. Ünitenin Amacı

Bu ünitede öğrencilerin, i) enerji ile ilgili iş ve güç gibi temel kavramları kavramalarının ardından enerji tür ve biçimlerini anlamaları, enerjinin yoktan var edilemeyeceğinin, var olan enerjinin ise yok edilemeyeceğinin, sadece bir biçimden diğerine dönüşebileceğinin farkına varmaları, ii)yenilenebilir enerjinin öneminin ve avantajlarının farkına varmaları, iii) sıcaklık farkından dolayı cisimler arasında aktarılan enerji olan ısı'nın önemini kavramaları hedeflenmektedir.

C. Kavramları Vermek için Kullanılabilecek Yaşamdan Örnekler (Bağlamlar)

Kazanımlar **en az** bir bağlamın parçası olarak verilecek yani bağlamda kavram anlam kazanacak. Fakat ideali aynı kavramın birden fazla bağlam içerisinde verilmesidir.

a. *Enerji ve Çevre*: Enerji kullanımı bu şekilde devam ederse çevreye çok daha fazla zararlı olacaktır.
b. *Enerji ve Nüfus*: Nüfus artış hızı ile enerji tüketimi arasındaki bağlantı incelenir.
c. *Enerji ve Ekonomi*: Enerji arz-talebinin enerji fiyatına olan etkisi.
d. *Enerji kullanan mükemmel bir makine olarak insan vücudu*: Enerji dengesinin önemi
e. *İnsanlar, Isı ve Çevre:* Vücut sıcaklığının sabit tutulmasının önemi, sıcak kanlı ve soğuk kanlı hayvanların karşılaştırılması.
f. Sıcak ve soğuktan korunma

D. Öğrenilecek Bilimsel Kavramlar

a. İş, Güç, Enerji
b. Mekanik Enerji (potansiyel ve kinetik enerji),
c. Enerji Dönüşümleri ve Enerjinin Korunumu
d. Verim
e. Enerji Kaynakları: yenilenebilir ve yenilenemez enerji

K. RAW DATA

Student	Grade	Gender	School	Class	Teacher	Approach	Preatt	Premot	Prenlmat	Postatt	Postmot	Postnlmat
ST001	9,5	2	3	2	1	2	79	102	16	87	112	22
ST002	9,8	2	3	2	1	2	77	92	16	82	67	19
ST003	8,6	2	3	2	1	2	75	88	12	50	64	2
ST004	8,6	2	3	2	1	2	74	82	13	76	90	20
ST005	9,9	2	3	2	1	2	81	98	15	80	96	20
ST006	8,7	2	3	2	1	2	70	67	12	90	99	22
ST007	10	2	3	2	1	2	89	117	16	94	101	22
ST008	9,1	2	3	2	1	2	69	76	11	74	85	19
ST009	9,6	2	3	2	1	2	91	112	17	97	120	21
ST010	10	2	3	2	1	2	70	96	13	80	95	17
ST011	9	2	3	2	1	2	83	100	16	73	77	22
ST012	9,5	2	3	2	1	2	78	89	15	76	84	23
ST013	9,6	2	3	2	1	2	70	92	16	82	68	21
ST014	6,6	2	3	2	1	2	75	68	14	59	68	20
ST015	9,9	2	3	2	1	2	89	104	14	89	113	21
ST016	8,6	2	3	2	1	2	91	102	14	86	114	18
ST017	9	2	3	2	1	2	72	99	16	79	104	19
ST018	8,6	2	3	2	1	2	78	98	15	87	106	20
ST019	9	2	3	2	1	2	78	88	15	77	98	16
ST020	9,8	2	3	2	1	2	75	97	17	81	87	18
ST021	7,6	2	3	2	1	2	76	107	18	65	70	17
ST022	9,6	2	3	2	1	2	72	77	15	63	73	22
ST023	6,6	2	3	2	1	2	73	86	9	83	90	23
ST024	9,6	2	3	3	1	1	89	105	18	75	90	18
ST025	8,5	2	3	3	1	1	83	90	20	68	86	19
ST026	9,8	2	3	3	1	1	78	94	20	74	89	17
ST027	8,6	2	3	3	1	1	66	81	19	77	87	18
ST028	6,7	2	3	3	1	1	76	92	19	81	83	16
ST029	9,5	2	3	3	1	1	90	117	19	58	88	16
ST030	9,5	2	3	3	1	1	69	87	16	70	76	17
ST031	6,5	2	3	3	1	1	77	84	17	94	97	16
ST032	8,9	2	3	3	1	1	82	94	16	74	93	18
ST033	7,7	2	3	3	1	1	71	101	16	72	84	20
ST034	8,7	2	3	3	1	1	95	125	13	66	71	19
ST035	9,6	2	3	3	1	1	79	100	15	73	87	18
ST036	10	2	3	3	1	1	68	80	12	60	75	18
ST037	8,6	2	3	3	1	1	80	102	13	79	95	16
ST038	6,8	2	3	3	1	1	81	91	17	71	84	17
ST039	7,5	2	3	3	1	1	71	99	15	91	99	17
ST040	6,8	2	3	3	1	1	69	113	14	30	39	8
ST042	7,6	2	3	3	1	1	75	74	13	96	50	17
ST043	9,6	2	3	3	1	1	88	72	13	73	87	18
ST044	7,7	2	3	3	1	1	63	80	17	96	100	10

Student	Grade	Gender	School	Class	Teacher	Approach	Preatt	Premot	Prenlmat	Postatt	Postmot	Postnlmat
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ST046	7,6	2	3	1	1	1	70	90	14	76	88	14
ST047	7,6	2	3	1	1	1	88	111	12	72	67	13
ST048	9,9	2	3	1	1	1	87	107	17	86	104	20
ST049	7,7	2	3	1	1	1	82	111	14	78	116	17
ST050	7,8	2	3	1	1	1	74	77	15	72	53	16
ST051	7,1	2	3	1	1	1	88	99	14	78	92	14
ST052	8,7	2	3	1	1	1	58	64	12	72	75	17
ST053	9,9	2	3	1	1	1	83	99	15	75	95	17
ST054	7,5	2	3	1	1	1	81	94	14	74	95	19
ST055	6,6	2	3	1	1	1	77	115	18	68	89	12
ST056	7,6	2	3	1	1	1	92	95	16	93	107	17
ST057	8,6	2	3	1	1	1	75	71	14	62	73	15
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ST059	9,5	2	3	1	1	1	89	106	17	86	99	18
ST060	9,7	2	3	1	1	1	77	110	15	89	123	18
ST061	6,5	2	3	1	1	1	81	87	14	70	81	17
ST062	8,5	2	3	1	1	1	85	109	13	87	106	14
ST063	9,9	2	3	1	1	1	85	83	14	83	89	19
ST064	9,8	2	3	1	1	1	90	116	14	85	109	21
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ST066	9,7	2	3	1	1	1	88	100	17	82	78	18
ST067	8,8	2	3	1	1	1	80	98	12	85	105	19
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ST232	7	2	1	4	2	1	77	92	10	72	94	12
ST233	6,7	2	1	4	2	1	62	86	6	68	76	11
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ST238	8,6	2	1	3	2	2	70	103	12	69	71	7
ST239	6,9	2	1	3	2	2	69	93	12	68	56	14
ST240	9,8	2	1	3	2	2	83	78	9	95	105	19
ST241	6,8	2	1	3	2	2	96	116	17	84	92	16
ST242	9,5	2	1	3	2	2	68	78	5	68	93	15
ST243	8	2	1	3	2	2	75	96	15	80	93	8
ST244	10	2	1	3	2	2	83	114	18	80	117	20
ST245	9,4	2	1	3	2	2	71	82	14	93	106	10
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ST254	5,7	2	1	3	2	2	83	109	14	94	96	9
ST255	8,6	1	1	3	2	2	73	65	16	77	65	13
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ST278	9,2	2	4	2	3	2	81	83	21	79	88	18
ST279	9,8	2	4	2	3	2	86	84	21	81	88	18
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ST282	9,9	2	4	2	3	2	76	95	21	94	95	19
ST284	7	2	4	2	3	2	63	69	20	72	62	12
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ST312	6,8	1	2	2	4	2	82	98	10	86	113	15
ST313	7,7	1	2	2	4	2	81	96	13	81	90	19
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ST332	8,5	1	2	1	4	1	81	87	8	78	75	13
ST333	8,9	1	2	1	4	1	81	111	12	90	110	13
ST334	8,1	1	2	1	4	1	80	102	16	67	60	10
ST337	9,5	1	2	1	4	1	80	113	19	53	62	20
ST338	9,9	1	2	1	4	1	81	88	17	74	96	20
ST341	9,7	1	2	1	4	1	79	95	11	79	93	13
ST342	9,7	1	2	1	4	1	93	120	20	97	120	18
ST343	9,7	1	2	1	4	1	80	97	15	86	105	16
ST344	10	1	2	1	4	1	84	114	13	88	113	17
ST345	6,7	1	2	1	4	1	80	89	11	76	88	12
ST346	8,9	1	2	1	4	1	71	96	15	97	99	17
ST347	9,5	1	2	1	4	1	82	95	11	81	92	13
ST349	6,5	1	2	1	4	1	77	52	11	57	53	8
ST350	10	1	2	1	4	1	91	109	18	96	113	19
ST351	8,8	1	2	2	4	2	72	91	16	76	90	16
ST352	9,9	1	2	2	4	2	77	95	15	81	112	17
ST353	9,5	1	2	2	4	2	84	118	16	89	107	20
ST354	9,5	1	2	2	4	2	86	116	21	83	106	18
ST355	8,6	1	2	2	4	2	93	100	15	95	115	19
ST356	9,7	1	2	2	4	2	69	77	16	79	73	19
ST357	6,5	1	2	2	4	2	69	101	16	120	125	21

ST358	6,2	1	2	2	4	2	65	77	13	81	92	17
ST359	8,5	1	2	2	4	2	67	71	15	85	99	16
ST360	8	1	2	2	4	2	93	104	18	48	91	5
ST361	7,6	1	2	2	4	2	66	40	8	74	94	10
ST362	9,1	1	2	2	4	2	86	87	14	74	96	16
ST364	9,7	1	2	2	4	2	82	92	15	84	88	21
ST365	9,9	1	2	2	4	2	79	69	18	93	103	17
ST366	9,9	1	2	2	4	2	83	110	16	87	107	21
ST367	8,7	1	2	2	4	2	74	102	13	83	105	13
Student	Grade	Gender	School	Class	Teacher	Approach	Preatt	Premot	Prenlmat	Postatt	Postmot	Postnlmat
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ST370	8,7	1	2	3	4	1	85	115	15	83	116	21
ST371	9,5	1	2	3	4	1	91	115	15	97	120	22
ST372	9,9	1	2	3	4	1	95	109	17	94	119	21
ST373	9,5	1	2	3	4	1	81	116	15	90	113	19
ST374	9	1	2	3	4	1	80	90	13	77	95	13
ST376	9,2	1	2	3	4	1	76	97	19	81	97	17
ST377	7,1	1	2	3	4	1	67	82	15	109	90	19
ST378	9	1	2	3	4	1	88	105	10	90	106	15
ST379	8,6	1	2	3	4	1	74	86	14	84	108	15
ST381	7,9	1	2	3	4	1	74	94	14	87	95	18
ST382	7,9	1	2	3	4	1	85	99	11	84	106	16
ST383	8	1	2	3	4	1	72	108	14	87	106	18
ST384	7,1	1	2	3	4	1	65	80	7	70	96	10
ST539	8,3	1	5	4	5	1	73	104	19	83	107	19
ST540	8,9	1	5	4	5	1	71	93	15	75	91	21
ST541	10	1	5	4	5	1	81	95	17	82	94	21
ST542	9,3	1	5	4	5	1	77	101	20	74	96	21
ST543	9,9	1	5	4	5	1	69	106	19	86	113	18
ST544	8,2	1	5	4	5	1	79	77	17	83	92	15
ST545	7,8	2	5	4	5	1	75	95	11	68	92	20
ST546	9	1	5	4	5	1	84	117	15	84	111	18
ST547	9,8	2	5	1	5	2	82	83	11	80	89	19
ST548	8,6	1	5	1	5	2	70	77	11	72	83	14
ST549	9,5	1	5	1	5	2	75	101	9	85	98	17
ST550	8,1	1	5	1	5	2	71	87	6	75	80	14
ST551	9,9	2	5	1	5	2	91	113	12	91	124	19
ST552	9,9	2	5	1	5	2	81	91	19	71	101	21
ST553	9,9	1	5	1	5	2	93	95	12	87	94	17
ST554	9,9	2	5	1	5	2	75	88	10	74	89	19
ST555	9,9	1	5	1	5	2	101	108	19	86	97	17
ST556	8,9	2	5	4	5	1	79	102	14	82	108	17
ST557	8,8	1	5	4	5	1	81	103	15	92	102	21
ST558	7,3	1	5	4	5	1	86	94	13	76	96	19
ST559	9	2	5	4	5	1	75	79	14	71	74	16
ST560	8,8	2	5	4	5	1	72	96	15	70	95	20
ST562	7,8	2	5	4	5	1	66	74	6	69	78	18
ST563	8,1	1	5	4	5	1	76	95	11	79	96	15
ST564	9,7	2	5	4	5	1	64	79	14	69	85	18
ST565	9,1	1	5	4	5	1	76	101	14	78	93	19
ST566	9,8	2	5	4	5	1	66	81	13	72	105	20
ST567	8,9	2	5	4	5	1	67	88	14	68	94	17
ST568	9,9	2	5	3	5	1	93	111	15	88	112	14
ST569	9,1	1	5	3	5	1	75	95	13	73	102	11

ST570	9,7	1	5	3	5	1	79	96	17	79	95	12
ST571	8,9	2	5	3	5	1	96	90	12	85	89	13
ST572	7,6	1	5	3	5	1	74	72	11	72	79	20
ST573	9,7	2	5	3	5	1	83	105	12	93	111	12
ST574	9,6	2	5	3	5	1	81	102	9	81	113	14
ST576	9,9	1	5	3	5	1	93	113	15	87	108	21
ST577	8,9	1	5	3	5	1	87	102	12	78	97	17
ST578	8,3	2	5	3	5	1	63	77	7	63	74	14
ST580	9,7	1	5	3	5	1	92	113	12	96	116	19
ST581	8,2	2	5	3	5	1	67	90	10	63	84	11
ST582	9,2	2	5	3	5	1	70	82	12	57	73	15
ST583	9,7	2	5	3	5	1	65	76	13	68	96	15
ST584	8,8	2	5	3	5	1	96	116	13	88	117	13
ST585	10	2	5	2	5	2	96	115	19	99	117	22
Student	Grade	Gender	School	Class	Teacher	Approach	Preatt	Premot	Prenlmat	Postatt	Postmot	Postnlmat
ST586	10	2	5	2	5	2	82	111	20	86	116	23
ST587	10	2	5	2	5	2	70	100	18	75	101	19
ST588	9,6	2	5	2	5	2	82	112	20	82	112	22
ST589	9,8	2	5	2	5	2	85	110	11	81	106	18
ST590	9,2	2	5	2	5	2	71	112	9	78	107	16
ST591	8,4	2	5	2	5	2	80	111	9	76	94	19
ST592	10	1	5	2	5	2	90	109	16	84	108	17
ST593	8,8	2	5	2	5	2	99	115	18	90	119	16
ST594	9,7	1	5	2	5	2	93	117	12	95	115	16
ST595	7,5	1	5	2	5	2	75	77	8	67	82	16
ST596	8,4	2	5	2	5	2	65	102	10	76	88	19
ST597	9	1	5	2	5	2	76	102	11	87	116	19
ST598	8,4	1	5	2	5	2	68	80	8	65	77	19
ST599	8,7	1	5	2	5	2	81	124	14	77	107	16
ST600	6,8	1	5	2	5	2	81	92	14	83	76	18
ST601	8,2	1	5	2	5	2	80	113	12	72	122	19
ST602	9,6	2	5	1	5	2	70	86	3	66	95	9
ST603	8,3	2	5	1	5	2	51	45	5	73	80	10
ST604	8,4	2	5	1	5	2	70	90	8	77	87	19
ST605	6,3	1	5	1	5	2	61	59	7	74	71	12
ST606	9,8	2	5	1	5	2	91	104	14	76	96	19
ST607	9,3	1	5	1	5	2	57	61	10	58	52	21
ST609	9,2	2	5	1	5	2	79	105	16	88	93	22
ST610	9,7	1	5	1	5	2	79	102	12	78	98	20
ST611	8	2	5	1	5	2	84	115	10	86	108	18
ST670	10	1	5	7	6	2	87	89	19	91	109	17
ST671	9,9	1	5	7	6	2	90	115	16	88	102	20
ST672	10	1	5	7	6	2	77	102	18	92	113	21
ST673	10	1	5	7	6	2	82	97	18	92	111	21
ST674	9,6	1	5	7	6	2	91	110	20	88	98	20
ST675	8,7	1	5	7	6	2	85	103	12	84	93	17
ST676	10	2	5	7	6	2	78	100	16	83	100	18
ST677	8,7	1	5	7	6	2	74	82	11	78	85	14
ST678	9	1	5	7	6	2	83	83	16	86	91	17
ST679	8,2	2	5	7	6	2	66	62	11	58	62	13
ST680	10	2	5	7	6	2	87	99	18	84	97	22
ST681	6,6	1	5	7	6	2	75	77	17	78	81	16
ST682	8,5	1	5	7	6	2	61	60	13	84	70	10
ST684	9,5	2	5	7	6	2	83	88	13	78	90	18

ST685	9,6	2	5	7	6	2	93	112	14	86	103	19
ST686	10	2	5	7	6	2	76	94	15	85	104	19
ST687	9,9	2	5	7	6	2	80	99	15	88	102	18
ST688	9,9	2	5	7	6	2	73	86	12	70	91	19
ST689	6,2	1	5	7	6	2	50	108	6	65	79	1
ST690	5,6	2	5	7	6	2	71	77	12	80	79	18
ST693	9,5	1	5	8	6	1	82	94	18	79	99	21
ST694	10	1	5	8	6	1	80	105	20	82	97	20
ST695	9,8	1	5	8	6	1	74	102	16	79	93	18
ST696	9,9	1	5	8	6	1	79	105	15	93	119	17
ST697	9,9	2	5	8	6	1	73	86	15	75	83	15
ST698	8,7	1	5	8	6	1	71	85	14	76	89	17
ST699	9,8	1	5	8	6	1	72	108	14	76	110	16
ST700	8,7	1	5	8	6	1	78	113	15	88	97	8
ST701	9,5	2	5	8	6	1	88	98	10	75	102	17
ST702	9,9	2	5	8	6	1	70	93	13	72	92	11
ST703	9,9	1	5	8	6	1	90	92	15	79	86	18
ST704	9,9	1	5	8	6	1	79	81	9	75	94	15
ST705	8,3	1	5	8	6	1	79	74	9	85	85	19
Student	Grade	Gender	School	Class	Teacher	Approach	Preatt	Premot	Prenlmat	Postatt	Postmot	Postnlmat
ST706	8,5	1	5	8	6	1	78	102	8	77	107	16
ST707	9,7	2	5	8	6	1	91	116	12	81	109	12
ST710	9,8	2	5	8	6	1	77	90	9	78	92	17
ST711	9,5	1	5	8	6	1	69	95	11	73	91	15
ST712	8	2	5	6	6	2	80	81	9	81	96	6
ST713	8,9	2	5	6	6	2	84	88	18	82	92	18
ST714	9,9	2	5	6	6	2	85	92	18	87	99	18
ST717	9,8	1	5	6	6	2	87	105	15	82	97	20
ST718	9,9	1	5	6	6	2	76	90	20	88	99	21
ST719	9	2	5	6	6	2	90	105	20	82	91	21
ST720	10	1	5	6	6	2	96	100	15	72	72	19
ST721	9,9	1	5	6	6	2	78	100	13	77	97	15
ST722	10	2	5	6	6	2	82	109	16	95	114	20
ST723	9	1	5	6	6	2	75	98	8	73	92	16
ST724	9,9	2	5	6	6	2	18	45	11	76	81	15
ST725	5,8	1	5	6	6	2	78	87	12	69	68	16
ST726	6,4	1	5	6	6	2	76	90	7	70	79	17
ST727	8,9	2	5	6	6	2	78	145	10	73	92	14
ST728	9,5	1	5	6	6	2	87	101	14	82	96	16
ST729	9,8	1	5	6	6	2	100	117	12	104	118	21
ST731	9,9	1	5	5	6	1	82	100	17	79	96	19
ST732	9,9	2	5	5	6	1	72	94	20	73	92	17
ST733	10	1	5	5	6	1	95	117	20	90	113	21
ST735	9	1	5	5	6	1	83	95	15	68	91	4
ST736	9,7	1	5	5	6	1	75	97	20	73	93	21
ST737	8,6	2	5	5	6	1	71	65	17	64	68	18
ST738	6,3	2	5	5	6	1	68	83	16	59	76	9
ST740	9,9	1	5	5	6	1	79	113	17	77	104	11
ST741	8,2	2	5	5	6	1	70	65	18	68	67	14
ST742	8,6	1	5	5	6	1	71	79	18	73	75	16
ST743	9,6	1	5	5	6	1	85	102	15	82	107	21
ST744	5,7	1	5	5	6	1	69	63	14	78	99	11
ST745	9,5	2	5	5	6	1	75	99	14	87	102	20
ST747	9,7	2	5	5	6	1	66	85	14	73	88	15

ST748	9,7	2	5	5	6	1	64	78	17	68	65	18
ST749	9,6	2	5	5	6	1	73	101	13	87	102	21
ST750	7,4	1	5	5	6	1	74	96	17	67	87	21

L. RAW DATA FOR ATTITUDE TOWARDS NEWTON'S LAWS OF MOTION PRETEST

Student	Gender	Approach	att01	att02	att03	att04	att05	att06	att07	att08	att09	att10	att11	att12	att13	att14	att15	att16	att17	att18	att19	att20	att21	att22	att23	att24
ST001	2	2	4	4	3	3	5	4	4	2	4	3	3	4	2	3	4	3	2	3	3	2	3	4	3	4
ST002	2	2	4	4	3	3	4	4	4	2	5	4	3	4	3	2	3	4	2	3	2	2	3	2	3	4
ST003	2	2																								
ST004	2	2	4	4	3	2	3	4	4	2	3	3	2	5	3	4	4	3	3	1	3	2	2	4	3	3
ST005	2	2	4	4	4	3	3	5	5	2	4	3	3	5	3	4	4	4	2	3	2	2	3	2	4	3
ST006	2	2	4	4				4	4	1	3	3	3	4	1	4	5	4	1	3	4	4	3	4	4	3
ST007	2	2	4	4	5	3	3	4	4	1	5	5	4	4	3	4	4	2	3	4	4	4	3	4	5	3
ST008	2	2	4	4	4	2	2	4	4	2	3	3	2	4	4	4	2	2	3	1	2	2	3	2	3	3
ST009	2	2	4	4	5	3	4	5	5	1	4	4	4	5	1	5	4	4	2	3	4	4	5	4	4	3
ST010	2	2	2	3	4	2	3		2	2	3	3	3	4	3	4	4	4	3	3	2	4	4	2	3	3
ST011	2	2	4	4	5	3	4	4	5	2	4	3	3	5	2	3	2	2	2	3	4	3	4	4	4	4
ST012	2	2	4	3	5	2	4	3	4	1	3	3	3	5	2	4	3	4	3	3	2	2	5	3	4	3
ST013	2	2	4	4	3	2	3	3	3	4	3	4	3	4	3	3	4	4		2	2	3	4		3	2
ST014	2	2	4	4	3	2	4	3	4	1	4	3	3	5	4	3	4	3	2	1	2	2	3	3	4	4
ST015	2	2	4	4	5	3	3	4	4	5	5	5	4	4	2	3	4	4	1	3	4	5	3	4	4	2
ST016	2	2	5	4	4	2	3	4	5	1	4	4	3	4	3	5	5	5	1	4	4	4	4	5	5	3
ST017	2	2	3	4	3	2	4	4	4	2	3	3	3	5	2	4	2	4	2	3	2	2	4	1	4	2
ST018	2	2	4	4	4	4	3	3	3	2	4	3	3	4	2	3	3	4	2	3	3	2	4	4	3	4
ST019	2	2	4	5	3	3	4	4	5	2	4	4	5	4	3	2	4	4	1	3	2	1	4	2	4	1
ST020	2	2	4	3	4	3	3	4	4		3	3	3	4	3	3	2	3	3	3	3	3	4	4	4	2
ST021	2	2	4	4	3	3	3		5	1	4	4	4	5	2	4	3	4	2	3	3	2	4	3	3	3
ST022	2	2	4	4	3	3	3	4	4	3	4	3	3	3	4	2	2	4	2	2	1	1	3	2	4	4
ST023	2	2	4	5	5	4	3	5	5	2	5	4	2	4	4	1	1	3	1	1	1	1	2	3	3	4
ST024	2	1	4	4	4	3	3	5	5	1	4	4	4	4	3	4	4	4	2	4	4	4	4	4	4	3
ST025	2	1	4	4	5	2	5	4	5	1	4	5	5	5	1	4	4	4	1	4	4	4	3			5
ST026	2	1	4	3	4	2	3	4	4	2	3	3	3	4	3	3	4	4	2	3	2	2	4	4	4	4
ST027	2	1	4	3	3	2	3	3	3	2	4	4	3	2	3	3	4	2	3	3	1	1	3	1	3	3
ST028	2	1	4	3	4	2	3	4	4	2	3	3	3	4	3	3	4	4	2	3	2	2	4	2	4	4
ST029	2	1	5	4	4	2	5	5	5	1	5	5	5	5	3	5	4	4	1	4	3	1	4	3	4	3
ST030	2	1	3	5	3	1	4	5	5	1	4	4	4	5	1	3	2	2	1	4		2	4	2	3	1
ST031	2	1	4	4	3	3	4	4	4	1	5	4	3	4	3	4	4	2	2	3	1	2	3	2	4	4
ST032	2	1	4	4	5	2	4	4	4	3	4	4	3	4	2	4	4	4	2	3	3	2	3	3	4	3
ST033	2	1	4	4	3	3	3	4	4	2	4	4	3	4	3	5	2	3	2	3	1	1	1	2	3	3
ST034	2	1	4	4	4	2	4	5	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
ST035	2	1	3	3	4	2	4	4	4	1	3	3	3	5	1	5	3	5	2	3	3	4	4	3	4	3
ST036	2	1	3	3	4	2	4	3	3	2	2	3	3	4	2	2	3	4	3	3	2	2	2	2	4	3
ST037	2	1	4	4	4	2	4	4	5	2	4	3	3	4	2	4	4	4	2	3	4	3	3	3	3	2
ST038	2	1	4	4	5		5	5	5	5	4	4	4	4	4	1	2	2	4	3	2	2	4	1	4	3
ST039	2	1	4	4	4	2	1	4	4		1	3	3	4	4	4	4	2	3	2	3	4	3	4		4
ST040	2	1	4	4	3	3	4	1	4	2	3	3	3	4	3	3	2	4	2	3	2	2	3	2	3	2
ST042	2	1	4	5	4	4	1	4	2	3	5	1	2	5	3	1	5	4	1	3	5	2	4	1	2	4
ST043	2	1	4	4	4	4	3	4	4	4	4	4	4	4	4	4	4	3	1	4	1	4	4	4	4	4
ST044	2	1	4	4	3	3	3				3	3	3	4	2	3	3	3	2	4	2	2	3	2	4	3
ST045	2	1	4	3	5	5	3	5	4	1	5	5	5	4	1	5	5	5	4	5	5	3	3	3	3	3

ST046	2	1	3	3	3	2	4	5	5	2	3	3	3	4	5	2	1	2	2	2	4	1	4	4	2	1
ST047	2	1	4	4	5	2	4	5	5	1	5	4	3	5	1	4	4	4	1	3	4	5	4	4	5	2
ST048	2	1	4	4	5	2	4	5	5	2	4	4	3	4	3	4	4	4	2	3	4	3	3	4	5	2
ST049	2	1	4	4	3	3	3	4	4	2	4	3	4	4	3	3	4	4	2	3	3	3	4	4	4	3
ST050	2	1	4	4	3	3	4	4	4	2	3	2	2	4	3	4	2	2	3	2	2	2	4	2	4	5
ST051	2	1	5	5	5	1	5	4	4	3	5	3	3	4	1	4	4	4	2	3	4	3	4	4	5	3
ST052	2	1	4	4	1	3	3	4	4	3	3	3	3	3	3	1	1	3	1	1	1	1	3	1	3	1
ST053	2	1	4	4	3	3	4	4	4	1	4	4	3	4	3	4	4	4	2	3	4	3	3	4	4	3
ST054	2	1	4	3	3	2	3	4	5	3	4	3	3	5	4	4	3	4	2	3	3	4	4	3	3	2
ST055	2	1	3	3	4	2	4	4	4	2	4	3	3	4	2	4	4	3	2	3	3	2	3	4	4	3
ST056	2	1	4	4	4	2	4	5	5	1	4	4	4	4	3	5	5	4	2	3	3	4	5	5	5	3
ST057	2	1	4	5	3	3	2	4	5	2	5	4	3	5	3	3	2	4	1	3	1	1	3	2	2	5
ST058	2	1	3	4	4	2	3	4	4	2	4	3	4	4	4	4	4	4	2	3	1	2	3	3	4	4
ST059	2	1	4	4	4	2	5	5	5	1	4	4	3	5	1	4	4	4	1	3	4	4	4	5	5	4
ST060	2	1	4	4	3	3	3	4	4	1	4	4	4	4	3	3	4	4	1	3	2	3	4	4	3	1
ST061	2	1	5		4	4	2	4	4	1	5	3	3	5	4	4	3	4	2	3	2	3	4	5	5	2
ST062	2	1	4	4	5	2	4	5	5	1	4	4	3	5	3	3	4	3	2	3	2	3	4	4	5	3
ST063	2	1	4	4	4	3	4	4	4	5	3	3	3	5	2	4	4	4	1	3	4	4	3	4	4	2
ST064	2	1	5	4	4	2	4	4	5	1	5	5	5	5	1	4	3	5	1	4	4	3	5	4	4	3
ST065	2	1	4	3	4	2	3	4	4	2	3	3	3	4	2	4	4	4	2	3	4	4	3	4	4	2
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ST582	2	1	4	4	5	2	1	4	5	2	3	3	2	5	2	5	1	3	2	2	1	2	3	3	4	2
ST583	2	1	4	4	5	2	1	4	5	2	3	3	4	4	5	1	1	1	5	3	1	1	3	1	1	1
ST584	2	1	4	4	5	3	5	5	5	1	5	5	5	5	1	4	4	5	1	5	4	3	5	4	5	3

ST585	2	2	5	5	5		4	5	5	1	5	5	5	5	3	5	4	5	1	5	4	5	5	3	5	1
ST586	2	2	5	4	4	2	3	5	5	1	4	4	3	5	3	4	3	4	2	3	2	2	4	4	4	2
ST587	2	2	4	4	3	2	4	5	5	1	4	3	4	4	3	3	2	3	2		2	2	3	2	3	2
ST588	2	2	4	4	3	2	5	5	5	1	4	4	4	5	2	4	3	3	2	4	1	2	4	2	5	4
ST589	2	2	4	4	3	2	4	5	5	2	4	4	4	5	2	4	3	4	2	3	3	3	4	4	4	3
ST590	2	2	4	4	3	3	4	3	4	1	4	4	4	4	1	3	2	3	1	2	2	2	4	2	3	4
ST591	2	2	4	4	4	3	3	4	4	2	4	4	4	4	4	4	4	4	2	2	2	2	4	2	2	4
ST592	1	2	4	3	3	5	4	5	5	1	5	5	5	5		3	3	1	5	5	3	4	5	3	4	4
ST593	2	2	5	4	4	3	5	5	5	1	5	5	5	5	1	4	5	5	1	5	4	4	4	5	5	4
ST594	1	2	5	5	5	2	5	5	5	1	5	5	5	5	1	4	2	5	1	5	3	5	4	4	3	3
ST595	1	2	5	5	5	3	3	5	5	1	5	5	3	4	1	1	5	4	1	1	1	1	1	1	4	5
ST596	2	2	4	4	1	3	4	4	3	2	4	4	3	3	1	1	3	3	2	4	3	1	4	1	3	
ST597	1	2	4	4	3	3	2	4	4	1	5	4	4	4	3	3	4	4	2	3	2	2	3	2	3	3
ST598	1	2	4	4	3	2	3	3	4	1	4	3	3	5	1	3	2	3	1	3	2	2	3	1	4	4
ST599	1	2	3	4	4	2	5	4	4	1	5	5	5	4	1	4	3	4	1	3	3	3	4	3	4	2
ST600	1	2	3	4	4	2	5	4	4	1	5	5	5	4	1	4	3	4	1	3	3	3	4	3	4	2
ST601	1	2	3	4	4	4	5	4	4	1	4	4	4	5	3	4	2	1	1	3	3	2	3	4	4	4
ST602	2	2	4	4	3	3	3	3	5		4	4	3	4	3	3	2	2	2	4	2	2	2	3	3	2
ST603	2	2	3	3	1	2	1	4	4	3	3	3	3	3	1	1	1	1	1	3	1	1	3	1	1	3
ST604	2	2	2	4	3	3	3	4	4	2	2	3	3	4	3	4	4	2	2	1	1	5	3	2	3	3
ST605	1	2	4	4	2	2	2	1	1	3	2	2	3	2	4	2	2	2	5	3	1	1	4	4	2	3
ST606	2	2	4	5	5	1	4	5	5	1	5	5	5	5	2	4	4	4	1	4	3	4	5	4	5	1
ST607	1	2	3	3	1	2	1	4	4	4	2	3	1	2	4	2	1	3	3	1	1	1	3	1	3	4
ST609	2	2	3	4	4	1	5	4	4	2	5	5	4	5	1	3	3	4	3	3	2	3	4	4		3
ST610	1	2	5	4	4	3	4	4	4	1	4	4	3	4	2	4	2	4	1	2	4	2	3	4	4	3
ST611	2	2	4	4	4	3	5	4	4	3	4	4	3	4	2	4	3	4	2	3	3	3	4	3	4	3
ST670	1	2	4	4	2	2	3	5	5	2	4	4	4	5	2	3	5	4	2	4	4	5	5	4	3	2
ST671	1	2	4	5	4	1	5	5	5	1	5	4	4	5	2	3	4	3	1	4	4	5	5	5	5	1
ST672	1	2	4	4	4	3	3	4	4	1	5	4	3	4	3	4	2	4	2	3	2	2	3	2	4	3
ST673	1	2	4	4	4	3	4	4	4	2	5	5	5	5	3	3	2	3	2	5	2	2	3	3	4	1
ST674	1	2	4	4	3	3	5	4	4	2	5	5	5	4	2	3	4	4	2	4	5	3	4	5	4	3
ST675	1	2	4	4	1	3	4	4	4	1	5	4	5	5	4	2	3	5	1	4	3	2	5	4	5	3
ST676	2	2	4	4	3	3	4	5	5	1	5	5	4	5	1	2	3	2	2	4	1	2	3	4	1	5
ST677	1	2	3	3	4	3	3	4	4	1	3	3	3	4	4	3	4	4	3	3	2	2	2	2	3	4
ST678	1	2	4	4	3	5	3		5	4	5	5	5	5	3	2	4	4	1	3	4	2	3	4	3	2
ST679	2	2	4	3	2	2	3	4	4	4	3	3	1	4	3	2	2	3	2	2	2	2	1	4	4	2
ST680	2	2	4	4	5	2	3	5	5	1	4	4	4	5	4	4	3	4	1	4	4	2	4	4	5	2
ST681	1	2	4	4	4	3	4	4	4	2	4	3	3	4	2	5	2	2	2	3	1	1	4	1	4	5
ST682	1	2	4	4	3	3	3	3	3	4	4	4	4	4	1	1	1	4	1	4	1	1	1	1	1	1
ST684	2	2	4	4	2	3	5	4	5	2	5	4	3	4	4	4	2	4	2	3	2	4	2	2	5	4
ST685	2	2	4	4	4	3	4	5	5	2	4	4	4	4	3	4	4	4	1	4	4	5	4	5	4	4
ST686	2	2	4	4	3	3	2	5	5	2	4	4	4	5	4	3	2	2	2	3	2	1	3	2	3	4
ST687	2	2	4	5	3	2	5	5	5	2	4	5	4	5	3	3		4	2	3	2	2	4	2	4	2
ST688	2	2	4	3	3	4	4	4	4	4	4	4	3	4	4	2	1	2	4		1	1	3	2	3	5
ST689	1	2	4	2	3		1	5		3	4	2	3	1	3	4		3	1			3	1	3		4
ST690	2	2	2	2	3	2		4	4	2	4	4	4	4	5	2		3	4	3	1	3	3	3	4	5
ST693	1	1	4	4	2	2	4	4	4	1	4	4	4	4	3	2	4	4	1	3	5	4	4	5	5	1
ST694	1	1	4	4	2	2	4	5	5	1	5	5	5	5	3	2	2	4	1	5	1	1	5	1	3	5
ST695	1	1	3	3	2	4	3	4	4	3	3	3	4	4	3	2	2	3	4	4	2	1	4	3	4	2
ST696	1	1	5	4	2	2		5	5	1	4	4	3	5	4	3	5	4	1		4	3	4	5	3	3
ST697	2	1	3	3	3	3	2	5	4	1	4	4	3	4	3	3	2	3	3	3	2	1	4	3	4	3
ST698	1	1	4	4	3	4	3	4	4		4	3	3	4	4	2	3	2	2	3	2	2	3	2	2	4
ST699	1	1	2	2	5	2	5	5	5	1	4	4	4	4	2	4	2	3	2	3		1		4	3	5
ST700	1	1	3	4	4	3	4	4	4	2	4	4	4	4	3	4	4	3	2	3	2	2	3	2	3	3
ST701	2	1	4	4	4	4	5	5	5	2	4	3	3	5	3	4	4	4	1	4	4	4	3	4	4	1
ST702	2	1	3	2	4	3	5	4	4	1	3	4	4	5	3	3	2	3	3	2	1	1	1	1	3	5

ST703	1	1	5	5	4	4	2	4	4	1	5	4	5	5	5	4	5	3		5	2	3	5	2	5	3
ST704	1	1	4	4	3	3	4	2	3	2	4	3	4	4	3	4	1	2	3	4	5	1	5	2	4	5
ST705	1	1	3	4	4	4	4	3	3	1	4	4	4	3	1	2	2	3	3	3	3	4	3	4	5	5
ST706	1	1	4	3	2	3	5	4	4	2	4	4	4	4	2	3	4	3	2	3	2	1	4	3	4	4
ST707	2	1	4	4	4	2	5	5	5	1	5	5	5	5	2	4	4	4	2	3	4	3	4	4	4	3
ST710	2	1	3	4	3	3	3	4	4	2	5	5	4	5	3	3	2	3	2	3	2	1	5	2	3	3
ST711	1	1	4	4		2	4	5	5	2	4	4	3	3	3	2	2	3	2	3	1	1	4	2	3	3
ST712	2	2	5	5	2	3	4	4	4	2	5	4	3	4	3	2	2	5	2	3		4	3	4	4	3
ST713	2	2	4	4	5	2	4	4	4	2	5	5	4	4	3	3	2	3	3	4	2	3	4	3	4	3
ST714	2	2	4	4	5	2	4	4	4	4	4	4	4	5	2	3	2	3	3	3	4	3	3	4	4	3
ST717	1	2	4	4	5	4	3	5	5	1	5	5	5	5	4	3	2	3	2	5	2	1	4	2	4	4
ST718	1	2	5	5	4	1	5	3	1	2	5	4	4	2	1	4	2	3	3	4	3	2	5	4	3	1
ST719	2	2	4	4	5	3	4	4	4	2	5	5	3	4	3	3	5	5	2	5	2	2	4	2	5	5
ST720	1	2	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
ST721	1	2	5	5	3	3	3	5	5	1	4	4	5	5	3	2	2	4	2	3	1	1	4	1	4	3
ST722	2	2	5	4	3	2	4	5	5	1	5	5	4	5	2	3	2	4	1	3	2	3	4	3	5	2
ST723	1	2	3	4	3	2	3	3	4	4	4	4	3	5	4	4	1	2	3	2	2	2	2	3	4	4
ST724	2	2	4	4	3	3	4																			
ST725	1	2	3	4	4	2	5	4	5	2	3	3	3	4	2	5	2	4	2	3	2	1	4	4	4	3
ST726	1	2	3	3	2	2	4	4	5	1	4	3	4	4	4	2	3	3	2	3	1	4	5	4	2	4
ST727	2	2	5	5	3	2	4	5	4	2	4	3	3	5	3	3	4	1	1	1	4	2	3	4	5	2
ST728	1	2	4	4	3	4	5	5	5	2	4	4	4	5	3	2	4	4	2	4	3	1	5	4	3	3
ST729	1	2	4	5	4	3	5	5	4	2	5	5	4	5	2	5	5	5	2	4	4	5	4	4	5	4
ST731	1	1	4	4	3	3	4	4	4	2	4	4	3	4	3	3	4	4	2	3	4	3	3	4	3	3
ST732	2	1	4	4	3	3	2	4	4	2	4	4	3	4	4	3	1	2	3	3	1	1	3	2	3	5
ST733	1	1	4	5	5	2	5	4	5	1	5	5	5	5	2	5	5	5	1	5	2	3	5	4	5	2
ST735	1	1	4	4	3	2	4	3	5	1	4	4	4	5	3	2	5	4	3	3	2	2	4	4	5	3
ST736	1	1	4	4	3	3	3	4	4	1	5	4	4	5	3	2	2	4	2	3	2	1	3	2	3	4
ST737	2	1	3	3	4	4	2	4	4	2	3	3	3	4	5	2	2	3	3	2	1	1	3	2	4	4
ST738	2	1	3	3	2	4	1	5	5	3	3	3	2	5	5	1	1	1	3	1	4	3	1	3	3	3
ST740	1	1	4	4	4	2	3	5	5	2	4	4	3	4	3	2	2	4	2	3	2	4	3	2	5	3
ST741	2	1	4	4	5	1	3	5	5	1	3	3	2	4	5	2	1	3	3	1	2	1	3	1	3	5
ST742	1	1	3	3	4	2	3	4	4	1	4		1	4	3	3	4	4	1	3	3	3	3	4	4	3
ST743	1	1	4	4	3		4	4	5	1	4	5	4	5	4	4	4	3	2	5	4	2	5	4	3	2
ST744	1	1	4	4	4	4	2	4	3	3	3	2	2	4	5	3	2	2	3	2	2	3	2	2	2	2
ST745	2	1	4	4	3	2	3	4	4	2	4	4	3	4	3	3	4	4	2	3	2	2	3	1	3	4
ST747	2	1	2	3	4	2	1	5	5	1	4	4	3	3	4	3	1	2	2	3	1	1	3	1	4	4
ST748	2	1	4	4	1	1	2	5	4			3	4	4	5	3	1	3	1	3	1	1	5	1	3	5
ST749	2	1		4	3	2	5	4	4	2	4	4	3	4	4	3	3	3	2	3	1	2	4	3	3	3
ST750	1	1	4	4	3	3	3	3	3	4	3	4	4	5	3	3	3	3	1	1		3	3	3	4	4

M. RAW DATA FOR MOTIVATION FOR LEARNING PHYSICS PRETEST

Student	mot01	mot02	mot03	mot04	mot05	mot06	mot07	mot08	mot09	mot10	mot11	mot12	mot13	mot14	mot15	mot16	mot17	mot18	mot19	mot20	mot21	mot22	mot23	mot24	mot25
ST001	4	5	5	5	4	5	5	5	4	3	3	4	4	5	5	4	5	4	4	5	3	4	4		3
ST002	3	5	1	3	4	3	5	5	4	3	5	4	5	2	5	3	3	3	4	5	3	4	2	4	4
ST003	4	5	2	4	1	4	5	2	5	3	5	5	1	3	5	2	4	2	3	3	5	5	1	4	5
ST004	2	3	5	4	3	4	5	5	3	5	5	2	3	2			3	3	5	4	5	3	3	3	2
ST005	5	4	3	4	4	4	4	5	3	4	5	4	5	3	3	2	3	5	4	5	4	4	3	4	4
ST006	5	4		5	4	5	5	5		5	5		4		5	5					5		5		
ST007	5	4	4	4	5	5	5	5	5	5	5	5	5	3	5	3	4	5	5	5	5	5	5	5	5
ST008	3	4		3	4	3	5	5	3	2	5	3	4	1	5	1	2	3	3	4	3	3	1	3	3
ST009	4	4	5	5	4	5	4	5	5	5	5	4	5	4	5	3	5	4	5	5	4	4	4	4	5
ST010	4	3	3	5	3	4	4	4	4	3	5	4	4	3	5	4	4	4	4	5	3	3	3	4	4
ST011	5	4		5	4	5	5	5	3	3	4	4	5		5	4	5	4	4	5	4	5	4	4	4
ST012	3	5	4	4	3	4	5	5	2	2	5	3	4	4	5	5	3	2	2	5	3	3	2	3	3
ST013	3	3	2	2	5	4	5	5	4		5	4	5	3	5	3	3	5	4	5	3	4	2	4	4
ST014	3	5	3	3	4	2	4	4	2	3	2	2	4	2	3	2	4	3	2	4	1	1	1	2	2
ST015	5	3	5	4	5	5	5	5	4	3	5	4	5	2	5	3	3	5	4	5	4	4	3	4	4
ST016	4	4	4	5	5	3	5	5	4	5	5	4	5	2	5	3	4	5	4	5	5	3	4		4
ST017	4	3	5	5	4	5	5	5	3	3	5	3	5	3	5	3	4	4	5	5	2	3	2	4	4
ST018	3	5	5	4	5	5	5	5	3	2	5	3	4	4	5	5	5	3	4	5	3		2	4	4
ST019	3	4	1	3	3	2	5	5	4	5	5	4	3	2	5	2	2	4	3	5	3	3	4	4	4
ST020	3	5	3	5	4	4	5	5	4	3	5	3	4	3	5	3	3	3	4	5	3	3	4	4	4
ST021	5	5	5	3	4	3	5	5	5	3	5	5	4	2	5	4	4	5	5	5	3	4	3	5	5
ST022	4	3	3	1	4	1	5	5	3	3	5	4	4	1	5	1	1	3	4	4	3	3	1	3	3
ST023	4	1	5	2	3	2	5	5	4	5	5	4	4	1	5	1	1	3	4	5	3	4	2	4	4
ST024	5	5	5	4	4	5	5	4	4	4	5	4	5	3	5	3	3	4	3	5	4	4	4	4	4
ST025	4	2	4	4	3	3	5	5	4	4	3	5	4	2	3	2	2	4	5	5	3	4	1	4	5
ST026	4	3	5		4	3	5	5	5	5	5	4	4	3	5	4	3	4	4	4	3	3	1	4	4
ST027	4	3	3	3	1	3	4	4	5	2	5	4	4	3		2	4	4	4	4	3	3	1	4	4
ST028	4	3	5	2	4	2	5	5	5	5	5	4	4	1	5	2	3	4	4	4	3	3	1	4	5
ST029	5	5	5	4	4	4	5	5	5	5	5	5	5	4	5	4	5	4	5	5	4	5	4	5	5
ST030	4	5	1	4	4	3	5	5	5	3	5	3	2	2	5	3	2	3	3	5	2	3	2	4	4
ST031	4	3	4	2	3	3	5	4	3	5	3	2	4	1	4	3	4	4	4	4	3	4	2	3	3
ST032	4	4		3	4	3	5	4	4	4	5	4	4	3	5	3	3	4	4	5	4	4	3	4	4
ST033	4	5	5	3	3	3	4	4	5	5	5	4	4	3	5	3	4	4	4	4	4	4	4	4	4
ST034	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
ST035	4	3	1	3	3	5	5	4	4	5	5	4	4	3	5	5	4	5	4	5	5	4	4	3	3
ST036	4	3	3	2	2	2	3	4	3	3	5	4	4	2	2	2	3	3	3	3	3	4	4	4	5
ST037	5	4	5	3	4	3	4	5	4	5	5	4	5	3	4	3	3	4	4	5	4	4	4	4	4
ST038	4	5	4	4	4	4	5	5	4	4		4	4	2	5	1	1	3	5	5	2	5	2	4	5
ST039	4	5	5	3	4	5	5	4	4	5	5	4	4	3	5	5	5	4	4	5		3		4	4
ST040	5	3	4	5	4	5	5	5	4	5	5	4	5	5	5	4	5	5	4	5	4	5	4	4	4
ST042	3	2	5	1	4	1	5	3	5	5	3	1	3	1	5	3	2	4	2	5	1	3	4	1	2
ST043	3	3	4	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	2	2	3	3	1	4	4
ST044	3	3	3	4	3	3	5	3	3	4	4	3	3	3	5	3	2	3	3	3	3	2	3	3	3
ST045	5	4	4	4	3	2	3	5	4	2	3	1	4	2	3	4	3	1	3	5	4	2	3	4	2
ST046	4	3	5	5	4	3	5	5	3	3	5	4	5	2	5	2	3	3	3	5	2	2	3	3	3
ST047	5	4	5	5	4	3	5	5	5	5	4	5	4	3	5	4	3	5	5	5	4	4	4	5	5
ST048	4	5	4	5	4	4	5	5	5	5	5	4	5	3	5	3	3	5	4	5	4	4	4	3	4

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ST569	5	5	5	4	5	4	5		5	5	5	5	5	3	5	3	4	5	5	5	4	5	4	5	5
ST570	4	5	5	3	3	3	5	5	4	4	5	4	3	2	5	4	2	4	4	5	3	4	2	4	4
ST571	4	2	5	1	4	1	5	4	4	5	5	4	4	1	5	2	3	4	5	4	4	4	2	4	4
ST572	4	2	2	3	3	3	4	3	3	3	3	3	4	1	4	3	3	3	3	4	3	2	2	2	2
ST573	5	5	4	5	4	4	5	4	3	4	5	5	5	4	5	3	3	5	4	4	4	4	2	4	5
ST574	4	5	4	4	4	2	2	5	5	5	3	4	5	3	4	3	3	5	4	5	5	4	5	4	5
ST576	5	4	5	5	4	5	5	4	5	5	5	5	4	3	5	3	4	4	5	4	4	5	5	5	5
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ST580	5	5	5	4	5	4	5	5	3	5	5	5	5	3	5	3	4	5	5	5	4	5	3	5	5
ST581	5	4	3		4	3	5	5		5	3	5	4	3	3	5	4	5	4	5	1	4	1	4	5
ST582	5	4	5	1	3	1	5	4	4	3	3	3	3	1	5	1	1	4	4	5	2	4	4	4	3
ST583	2	5	5	2	2	2	5	5	3	2	3	3	4	1	5	1	1	3	4	4	2	3	1	3	5
ST584	4	4	5	4	5	5	5	5	5	5	5	5	5	4	5	4	4	5	5	5	5	4	3	5	5
ST585	5	5	5	4	5	5	5	5	4	5	2	5	5	4	5	3	4	5	5	5	4	5	5	5	5
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ST597	5	3	5	5	4	3	5	5	4	4	5	3	5	3	5	2	3	5	5	4	4	4	4	3	4
ST598	4	4	5	3	3	2	5	4	2	2	5	3	4	1	5	1	3	3	3	4	2	3	1	4	4
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ST601	5	5	5	4	5	5	5	5	3	5	5	4	5	5	5	5	5	5	5	4	4	4	3	3	4
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ST604	4	3	4	3	4	3	5	4	3	4	4	4	3	3	5	3	3	3	4	4	3	4	2	3	5
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ST609	4	5	4	5	3	4	4	5	5	5	4	5	4	4	4	5	4	5	4	3	4	4	3	4	4
ST610	4	5	3	5	4	5	5	4	4	5	5	3	4	4	4	4	4	5	3	3	3	4	4	4	4
ST611	5	5	5	5	3	5	5	4	3	5	5	4	3	5	5	5	5	5	5	5	5	5	5	4	4
ST670	5	4	3	3	2	4	4	3	2	5	3	4	2	3	4	3	3	5	4	3	3	4	5	4	4
ST671	5	5	3	5	4	5	5	5	5	5	2	5	5	4	5	3	5	5	5	4	5	5	5	5	5
ST672	4	3	5	2	2	5	5	5	5	5	4	4	5	2	5	3	2	5	5	5	4	5	4	4	4
ST673	4	5	2	3	2	5	5	3	3	5	3	5		3	5	3	5	5	5	5	4	5	3	4	5
ST674	5	5	5	5	3	4	5	4	3	5	5	5	4	3	5	3	5	5	5	5	4	5	3	4	5
ST675	3	4	5	4	4	3	5	4	5	5	4	5	4	3	4	3	4	5	4	5	3	4	3	5	5
ST676	5	5	4	3	4	2	5	5	4	5	4	4	5	2	5	2	2	4	5	5	5	4	3	4	4
ST677	4	3	4	3	3	3	4	4	4	4		5	4	2	4	2	2	4	3	4	2	4	3	3	4
ST678	4	2	5	2	4	2	2	5	3	4	3	5	3	1	3	1	2	5	3	5	3	4	2	5	5
ST679	3	5	2	1	3	1	5	2	2	4	4	3	3	1	4		5	3	2	2	1	1	1	2	2
ST680	5	3	5	4	2	3	5	5	3	5	5	4	2	2	5	3	3	5	5	5	4	4	3	4	5
ST681	3	3	3	4	2	3	4	3	3	4	4	3	2	2	4	3	3	3	3	3	3	3	3	3	3
ST682	3	2	2	3	2	3	2	3	3	2	3	2	3	3	2	3	2		2	3	2	3	2	3	2
ST684	4	5	5	2	4	1	5	5	5	4	5	4	5	1	5	1	1	3		5	4	3	3	3	5
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ST686	3	5	5	3	4	3	5	4	4	4	5	4	4	2	5	2	2	3	4	5	2	4	2	5	5
ST687	5	4	4	4	4	3	5	4	3	5	5	5	3	3	4	3	3	5	5	4	3	4	3	4	4
ST688	4	5	5	3	3	3	5	4	2	2	5	4	4	1	5	1	1	3	5	5	2	3	1	5	5
ST689	5	4	5	5	4	2	5	5	4	3	5	5	4	5	5	1	5	4	5	3	5	5	5	4	5
ST690	2	4	2	3	3	4	4	4	2	3	5	4	4	1	3	1	3	2	4	5	2	3	1	4	4
ST693	5	5	5	5	4	2	5	5	2	5	5	5	4	1	5	1	1	5	4	4	2	4	1	4	5
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ST697	4	5	4	2	3	2	5	4	3	4	5	4	4	1	3	2	2	5	3	4	2	4	3	4	4
ST698	4		4		3	2	5	5	4	4	5	5	3	1	5	1	1	5	5	4	4	4	3	4	4
ST699	3	5	4	4	4	5	5	5	5	5	5	5	4	5	5	3	5	3	5	5	4	4	1	4	5
ST700	5	3	5	5	4	4	5	5	5	5	5	5	5	4	4	4	4	4	4	5	4	5	4	5	5
ST701	5	5	4	3	4	3	5	5	4	5	5	5	4	2	3	3	3	4	5	4	3	3	3	4	4
ST702	3	5	5	3	3	2	5	3	3	4	5	5	5	2	5	2	2	3	5	5	2	4	2	5	5
ST703	5	4	5	1	2	1	5	4	4	5	5	5	2	1	5	1	1	4	5	3	4	5	5	5	5
ST704	4	4	2	3	2	4	2	2	4	5	2	5	2	3	2	4	3	2	3	4	3	4	2	5	5
ST705	3	3	2	3	4	2	1	2	1	3	5	5	4	1	3	2	1	5	5	2	3	4	2	3	5

ST706	4	4	4	5	3	5	5	4	2	4	4	5	4	5	5	4	3	4	4	4	4	4	4	4	4
ST707	5	4	4	5	5	5	5	5	5	4	5	5	5	4	5	4	5	5	5	5	4	4	3	5	5
ST710	3	3	4	3	4	3	5	5	4	4	5	4	4	3	4	3	3	4	4	3	2	4	2	4	3
ST711	4	5	3	5	4		4	4	2	5	5	5	4	3	5	3	4	5	4	5	2	3	1	5	5
ST712	5	4	4	1	4	1	4	5	5	5	2	4	4	1	3	1	1	5	4	4	2	3	1	4	4
ST713	4	4	4	4	3	4	4	3	5	4	4	4	2	2	4	2	3	4	4	3	3	4	3	3	4
ST714	4	3	3	4	4	4	5	5	3	3	5	3	4	3	3	4	4	3	4	5	3	3	2	4	4
ST717	5	3	4	5	3	4	5	4	5	4	4	5	2	3	4	3	4	5	5	4	5	5	4	5	5
ST718	5	5	2	5	1	5	3	1	1	5	3	5	1	5	3	5	5	5	4	2	3	5	3	4	4
ST719	5	3	5	5	5	3	5	5	4	5	5	3	5	3	5	2	2	5	5	5	3	5	4	3	5
ST720	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
ST721	5	3	2	5	2	5	5	4	3	5	5	5	3	3	5	2	5	4	5	5	3	4	2	5	5
ST722	5	5	5	4	3	4	5	5	3	5	5	5	4	2	5	4	5	5	4	4	4	5	3	5	5
ST723	4	5	4	5	4	4	5	4	2	5	5	5	4	5	5	2	3	4	4	4	2	2	2	5	4
ST724	4	5	4	4	3	2	5	2	3	4	5	3	1												
ST725	4	3	2	5	3	5	5	3	3	4	4	3	3	3	5	5	5	4	4	3	2	3	2	3	1
ST726	3	4	5	4	3	4	5	5	3	4	5	4	4	2	4	2	4	3	3	3	4	3	2	4	3
ST727	3	3	4	5	3	3	5	4	5	3	5	3	5	3	5	4	5	5	5	4	2	3	2	3	3
ST728	5	5	5	3	4	3	5	5	3	5	4	4	2	3	5	3	4	5	5	4	4	4	3	4	4
ST729	5	5	5	4	5	5	5	4	5	5	5	4	5	5	5	5	5	4	4	5	5	5	4	4	4
ST731	5	5	4	3	3	2	5	5	5	5	5	5	4	3	5	2	2	5	4	4	3	4	3	5	4
ST732	4	5	5	2	4	2	5	5	5	5	5	4	4	2	5	2	2	4	4	4	3	3	2	4	4
ST733	5	5	5	5	3	5	5	2	5	5	5	5	4	5	5	5	5	4	5	5	4	5	5	5	5
ST735	5	4	3	4	2	5	3	2	5	3	5	5	2	4	2	3	5	5	2	2	5	5	5	4	5
ST736	4	2	5	4	3	5	5	5	4	4	5	4	4	2	5	3	4	4	3	4	2	4	3	5	4
ST737	3	1	4	2	2	2	4	3	2	2	3	3	3	1	4	1	1	3	3	3	2	3	4	3	3
ST738	4	2	5	3	5	1	4	5	3	5	5	1	5	5	5	1	1	4	1	5	3	3	3	1	3
ST740	5	5	5	4	4	3	5	5	5	5	5	5	4	3	5	4	4	5	5	5	4	5	3	5	5
ST741	1	2	3	1	4	1	4	5	1	3	4	3	5	1	4	1	1	3	4	5	1	3	1	3	1
ST742	4	3	3	4	3	2	3	4	3	5	2	3	3	2	2	3	4	5	4	4	3	3	2	3	2
ST743	4	4	5	4	4	3	5	5	3	4	5	5	4	2	5	3	4	4	5	4	4	5	1	5	5
ST744	3	2	3	4	4	2	4	3	1	2	4	2	2	2	3	2	2	3	2	3	3	1	2	2	2
ST745	5	3	4	5	4	5	5	4	2	3	4	4	4	3	4	3	5	4	5	5	3	4	3	4	4
ST747	3	2	5	4	3	2	5	5	5	2	4	3	4	1	5	1	2	3	4	4	4	4	2	4	4
ST748	5	1	4	1	3	1	5	5	1	1	5	4	2	1	5	1		4	5	4	5	3	2	5	5
ST749	5	4	4	4	4	4	5	5	3	4	5	5	4	4	4	4	4	4	3	3	3	4	3	4	5
ST750	5	5	5	5	5	5	5	5	2	3	4	4	4	3	4	3	2	1	3	3	4	3	4	5	4

N. RAW DATA FOR NEWTON'S LAWS OF MOTION ACHIEVEMENT TEST PRETEST

Student	nlmat01	nlmat02	nlmat03	nlmat04	nlmat05	nlmat06	nlmat07	nlmat08	nlmat09	nlmat10	nlmat11	nlmat12	nlmat13	nlmat14	nlmat15	nlmat16	nlmat17	nlmat18	nlmat19	nlmat20	nlmat21	nlmat22	nlmat23	nlmat24	nlmat25
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ST002	1	1	1	2	1	1	1	1	1	2	1	2	3	1	1	1	1	1	1	1	2	2	1	2	1
ST003	1		1	1		1	1		2	2	1		3	1	1		1			1			3		1
ST004	2	1	1	3	3	1	1	3	1	4	1	3	4	1	1	1	1	5	4	1	3	3	3	2	1
ST005	1	1	1	1	2	1	1	2	2	2	1	3	4	2	1	3	1	5	4	1	3	3	3	2	1
ST006	1	1				1	1	1	1	2	1	2		1	2	2	1	1	1		2	2	1	2	1
ST007	1	1	1	2	1	1	1	1	1	2	1	2	3	1	1	1	1	1	1	1	2	3	1	2	1
ST008	1	1	1	2	1	2	1	1	2	1	4	3	3	1	4	5	5	3	2	1	4	5	1	2	1
ST009	1	1	1	1	1	2	1	1	1	2	1	1	4	1	1	2	1	1	1	1	4	3	2	2	1
ST010	1	1	1	2	1	2	3	1	1	2	1	1	3	1	1	1	1	3	1	5	4	3	4	2	1
ST011	1	1	2	1	1	2	1		1	2	1	3	4	1	1	1	4	3	4	1		4	1	4	2
ST012	1	1	1	3	1	1	1	3	1	2	1	3	3	1	1	4	4	1	1	1	2	4	1	1	1
ST013	1	1	1	1	1	2	3	3	1	2	1	3	4	1	1	3	4	3	3	1		4	1	4	2
ST014	1	1	1	2	1	2	1	3	1	5	4	1	4	1	3	1	1	2	1	1	4	4	4	4	1
ST015	1	1	2	2	1	2	1	1	1	2	1	2	3	1	1	1	1	1	1	1	4	3	2	2	1
ST016	1	1	1	1	2	1	1	2	1	1	1	1	4	1	2	2	1	2	3	1	4	3	2	2	1
ST017	1	1	1	2	1	1	1	1	3	2	1	2	1	1	1	2	1	5	4	1	5	1	1	2	1
ST018	1	1	1	2	1	1	1	1	3	2	1	2		1	1	1	1	5	2	1	5	3	1	2	1
ST019	1	1	1	2	1	1	1	1	1	2	1	2	3	1	2	1	1	1	2	1	2	2	1	1	1
ST020	1	1	1	2	1	1	1	1	1	2	1	3	4	1	3	1	1	5	4	1	3	2	1	2	1
ST021	1	1	1	2	1	1	1	1	1	2	1	3	4	1	1	1	1	1	4	1	2	2	1	2	1
ST022	1	1	1	3	1	3	1	1	3	2	1	1	4	1	1		1		4	2		2	1	2	1
ST023	1	1	1			1		2		1	2	2	3	1	2	2	1	4	1	4	2	2	1	2	1
ST024	1	1	1	2	1	1	1	1	1	2	1	1	4	1	1	3	1	1	4	1		5	1	3	4
ST025	1	1	1	2	1	1	1	1	1	2	1	3	4	1	1	3	1	4	4	1	2	3	1	2	1
ST026	1	1	1	1	1	1	1	1	1	2	1	3	1	1	1	3	1	4	4	1	2	3	1	2	1
ST027	1	1	1	1	1	1	1	2	1	2	1	3	1	1	1	3	1	4	4	1	2	3	1	2	1
ST028	1	1	1	1	1	1	1	1	1	2	1	3	3	1	3	3	1	4	4	1	2	3	1	2	1
ST029	1	1	1	2	1	1	1	1	1	2	1	1	3	1	1	3	1	4	4	1	2	3	1	2	1
ST030	1	1	1	1	3	1	1	3	1		1	1	3	3	1	3	1	4	4	1	2	3	1	2	1
ST031	1	1	1	1	2	1	1	2	1	2	1	1	3	3	1	3	1	4	4	1	2	3	1	2	1
ST032	1	1	1	2	1	1	1	1	1	2	1	1	3	1	2	1	1	5	4	1	2	3	1	2	1
ST033	1	1	3	3	1	2	1	1	1	2	1	3	3	3	1	3	1	4	4	1	2	3	1	2	1
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ST035	1	1	1	2	1	2	1	1	1	4	1	3	1	1	1	1	1	5	4	1	3	5	5	4	1
ST036	1	1	2	2	1	1	2	2	1	4	1	3	1	1	1	1	1	5	4	1	3	5	5	5	1
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ST564	1	1	1	2	1	2	1	4	4	1	5	5	5	1	1	3	1	5	5	1	5	5	5		1
ST565	1	1	1	2	1	1	1	2	3	4	1	1	1	1	1	3	1	5	4	1	5	5	2	5	1
ST566	1	1	1	1	3	2	1	1	3	2	1	1	4	1	1	3	1	3	1	1	2	2	2	5	5
ST567	1	1	3	2	1	1	1	1	3	4	1	3	4	1	1	1	1	5	4	1	5	5	5	5	5
ST568	1	1	1	1	1	3	1	3	1	1	3	4	4	1	1	1	4	1		1	2	2	3	4	1
ST569	1	1	1	2	1		1	1		2	1	1	2	1	1	3	1	1	4	1	2	2	2	1	1
ST570	1	1	1	2	1	2	1	3	1	2	1	2	3	1	1	3	1	4	4	1	2	2	1	4	3
ST571	1	2	1	1	1	2	1	3	3	2	4	2	4	3	5	1	1	5	4	1	4	2	3	5	1

ST572	1	1	1	3	1	2	1	2	1	5	1	2	3	4	1	1		2	4	1	2	2		4	3
ST573	1	2	1	2	1	1	1	2	2	4	1	1	2	1	1	1	1	1	3	1	5	3	1	1	1
ST574	1	2	1	1	1	3	3	2	2	4	1	1	2	1	2	1	1	1	3	1	2	3	5	1	1
ST576	1	1	1		1	2	1		1	2	1	2	5	1	1	1	1	5	1	1	2	4	1		1
ST577	1	1	1		1	2	1		1			2	3	2	1	3	3	5	3	1	2	4	2	4	1
ST578	1	1	2	2	1	2	1	2	3	1	1	2	3	5	5	3	2	1	4	5	5	5	5	5	5
ST580	1	1	1	2	1	2	1	2	1		1	1	4	1	2	1	5	5	1	1	4	2	1	1	5
ST581	1	1	1	3	3	2	1	3	1	1	1	1	2	2	1	4	1	2	4	1	5	3	3	2	5
ST582	3	1	1	2	1	1	1	3	1	1	1	2	2	1	4	2	1	2	4	1	4	1	3	2	5
ST583	3	1	1	2	1	1	1	3	1	1	1	2	2	1	4	2	1	2	4	1	4	1	3	2	1
ST584	1	2	1	1	1	2	1	2	1	1	1	2	3	1	4	3	1	1	4	1	4	1	3	2	3
ST585	1	1	1		1	1	1	1	1	2	1	3	2	1	1	3	1	3	1	1	2	4	1	4	1
ST586	1	1	1	1	1	1	1	1	1	2	1	3	5	1	1	1	1	3	4	1	4	4	1	2	1
ST587	1	1	2	1	1	1	1	1	1	1	1	2	4	1	1	3	1	3	4	1	1	2	1	2	1
ST588	1	1	1	1	1	1	1	1	1	2	1	3		1	1	1	1	3	4	1	4	4	1	2	1
ST589	2	1	1	2	1	1	1	1	1	4	1	3	2	2	2	2		3	1	1	2	2	1	2	1
ST590	3	1	1	3	1	3	1	3	3	5	5		3	1	2	3	1	5	3	1	1	5	1	2	5
ST591	2	1	1	2	1	1	1	1	1	4	5	3	5	5	1	5	5	3	3	1	2	5	5	2	5
ST592	1	1	2	2	1	1	1	1	1	2	1	3	3	2	2	1	1	4	1	1	4	4	1	2	1
ST593	1	1	2	1	1	1	1	1	1	2	1	3	3	2	1	1	1	4	1	1	4	4	1	2	1
ST594	1	3	3	3	1	1	1	1	1	1	1	1	3	1	1	1	5	5	1	1	1	3	1	5	1
ST595	1	1		3	1	3	2	3	2	4	1	1	4	1	4	3	5	5	3	1	5	5	3	1	5
ST596	1	1	1	2			2	3		1	3	2	4	1	2	3	1	1	1	1	5	5	5	4	1
ST597	1	1	1	2	1	2	2	3	2	1	3	2	4	1	2	3	1	1	1	1	5	5	5	4	1
ST598	1	1	2	1	1	1	1	3	2	1	5	3	1	5	3	5	1	5	5	1	5	5	5	5	5
ST599	2	1	1	2	1	1	1	1	1	1	4	3	3	1	2	3	5	1	4	1	2	5	1	4	1
ST600	2	1	1	2	1	1	1	1	1	1	4	3	3	1	2	3	1	5	4	1	2	5	2	4	1
ST601	1	3	1	2	1	1	1	1	3	1	1	1	1	1	1	5	1	5	1	1	5	5	2	1	1
ST602	1	1	1	2																					
ST603	3	2	3	1	2	1	3	2	1	5	4	2	4	5	4	2	3	5	1	3	5	5	5	1	1
ST604	1	3	3	2	1	2	1	2	3	5		5	4	1	3	3	5	4	3	1	5	3	5	5	5
ST605	1	1	1	2	3	3	2	1	1	1		1	4	2	4	2	3	2	3	4	1	2	3	2	1
ST606	1	1	1	1	1	1	1	1	3	2	2	2	4	1	3	1	1	1	1	4	1	4	4	2	1
ST607	1	1	1	1	1	1	1	2	2	5	1	5	5	5	1	1	3	5		1	5	5	5	5	5
ST609	1	1	1	1	1	1	1	1	1	2	4	3	3	1	1	1	3	5	4	1	4	5	1	5	5
ST610	1	1	1	3	1	1	1	3	1	2	5	3	5	1	1	1	5	3	4	5	5	5	1	2	5
ST611	1	1	1	3	1	1	1	3	3	2	1	3	5	1	2	5	5	5	1	1	5		5	5	5
ST670	1	1	1	1	1	2	1	1	1	2	1	3	4	1	1	3	1	1	4	1		3	1	2	1
ST671	1	1	1	2	1	1	1	1	1	2	1	1	4	1	1	1	5	1	1	1	2	4	1	1	5
ST672	1	1	1	3	3	1	1	1	1	2	1	1	4	1	1	1	1	1	4	1	4	4	2	2	1
ST673	1	1	1	3	3	1	1	1	1	2	1	1	4	1	1	1	1	1	4	1	4	4	2	2	1
ST674	1	1	1	2	1	1	1	1	1	2	1	1	4	1	1	3	1	4	1	1	2	2	1	4	1
ST675	1	1	1	2	1	1	1	3	3	2	1	3	4	2	1	3	5	5	1	1	5	3	5	1	3
ST676	1	1	1	2	1	1	1	1	1	2	2	1	4	1	1	1	4	2	4	1	5	4	3	1	1
ST677	1	1	1	3	3	3	1	3	1	2	1	1	4	1	2	5	5	5	5	1	5	2	1	5	3
ST678	1	1	1	1	3	1	1	3	3	4	1	1	4	1	2	1	1	2	4	1	4	5	1	4	1
ST679	1	1	1	2	3	3	1	1	3	4	1	1	5	1	2	1	1	2	2	1	5	5	1	2	1
ST680	1	1	1	1	1	1	1	2	3	2	1	1	2	1	2		1	5	4	1	4	4	1	4	1
ST681	1	1	1	1	1	1	1	1	1	4	1	3	1	1	4	3	1	2	2	1	4	4	3	1	1
ST682	1	1	1	1	1	1	1	1	1	4	1	2	4	4	3	1	5			2	2	4	4	4	2
ST684	1	1	3	1	1	1	1	3	1	4	1	1	4	1	3	1	1	1	1	1	2	3	3	1	1
ST685	1	1	1	2	1	2	1	1	1	2	2	2	3	1	1	2	3	2	4	1	3	1	3	4	1
ST686	1	1	1	2	1	2	1	1	1	2	2	2	4	1	1	2	3	3	4	1	3	1	3	4	1
ST687	1	1	1	1	1	3	1	3	1	2	1	3	4	1	3	1	1	1	4	1	3	3	2	1	1
ST688	1	1	3	1	1	3	1	3	1	4	1	1	4	1	3	1	1	1	1	1	2	3	3	1	1
ST689	1	3	2		1	2	1	3	1	5	5	3	2	5	2	3	5	5	4	4	3	5	5	2	4
ST690	1	1	1	1	3	3	1		1	4	3	1	4	1	4	3	1	1	3	1	2	3	3	3	1
ST693	1	1	1	2	1	1	1	1	1	2	4	2	4	1	1	3	1	3	1	1	5	4	1	2	1
ST694	1	1	1	2	1	1	1	1	1	2	1	2	4	1	1	3	1	4	1	1	2	4	1	2	1
ST695	1	1	1	2	1	1	1	2	2	2	1	2	4	1	1	1	1	4	4	1	2	2	3	2	1
ST696	1	1	2	3	1	1	3	1	1	2	1	2	4	1	1	1	1	5	4	1	3	2	4	5	1
ST697	1	1	1	2	1	1	1	3	3	2	1	3	4	1	1	1	5	4	4	1	2	2	1	2	5
ST698	1	1	1	2	1	2	1	2	1	1	1	5	1	1	1	3	5	5	4	1	5	5	4	4	1
ST699	1	1	1	3	1	2	1	3	3	1	1	5	4	1	1	3	1	5	4	1	5	1	1	1	4
ST700	1	1	1	3	1	3	1	2	1	1	1	4	5	5	1	3	1	1	4	1	2	3	1	1	1
ST701	1	1	1	3	1	3	1	2	1			2	2	5	3	3	1	5	4	2	2	3	2	1	1
ST702	1	1	3	2	1	1	1	3	2	5	1	3	4	1	1	3	1	5	1	2	3	5	1	1	1
ST703	1	1	1	3	1	3	1	3	1	2	1	4	3	1	4	3	1	5	5	1	2	5	1	1	1
ST704	1	1	1	2	1	3	1	3	3	5	1	5	5	1	3	3	5	5	2	2	5	3	1	5	5
ST705	1	1	1	2	1	3	3	3	1	5	4	2	1	1	1	3	2	1	4	3	5	5	5	5	5
ST706	1	2	1	3	3	1	3	2	2	1	1	5	4	1	2	3	5	5	3	4	5	5	2	2	1
ST707	1	1	1	3	1	1	2	3	3	1	1	1	3	4	1	4	1	1	4	1	2	2	1	2	1

ST710	1	3	2	2	3	1	1	3	3	1	1	3	1	1	1	1	2	1	4	1	1	2	4	3	1
ST711	1	1	1	3	3	2	3	1	1	3	1	3	4	1	1	1	5	1	2	1	5	5	1	2	5
ST712	1	1	1	2	3	1	1		3	3	1	3	1	1	4	3	5	3	1	1	5	5	3	2	5
ST713	1	1	1	2	1	1	2	1	1		1	2	4	1	1	3	1	3	4	1	4	4	5	1	1
ST714	1	1	1	2	1	1	2	1	1	5	1	2	4	1	1	3	1	3	4	1	4	4	2	1	1
ST717	1	1	1	2	1	2	1	2	1	2	1	3	4	3	4	3	1	1	2	1	4	2	1	1	1
ST718	1	1	1	1	1	1	1	1	1	2	1	2	4	3	1	3	1	2	4	1	4	1	1	2	1
ST719	1	1	1	1	1	1	1	1	1	2	1	2	4	3	1	3	1	2	4	1	4	1	1	2	1
ST720	1	1	1	3	1	1	1	3	1	2	1	2	5	1	1	3	5	3	4	1	5	5	1	5	5
ST721	2	1	1	1	1	1	1	3	3	5	1	5	4	1	1	2	5	5	5	1	5	5	1	1	1
ST722	1	1	2	1	1	1	1	1	1	1	1	3	1	1	1	1	1	1	2	1	2	4	1	1	1
ST723	1	3	1	1	3	2	3	3	1	1	5	3	4	1	1	3	4	5	1	4	5	5	5	1	5
ST724	1	1	1	2	1	2		3	3	5	4	3		1	1	3	4		2	5	4	4	4	4	1
ST725	1	1	1	1	3	2	3	1	1	2	1	3	4	1	2	1	1	2	2	2	4	3	4	1	3
ST726	1	1	2	3	1	3	1	3	3	5	5	3	4	5	4	1	5	5	4	1	5	3	2	2	5
ST727	1	1	1	1	1		1	1	3	5	1	2	1	5	2	1	5	3	2	4	4	3	2	5	1
ST728	1	1	1	3	3	1	1	2	1	4	1	3	3	1	1	2	1	5	1	1	1	4	1	2	1
ST729	1	1	1	2	2	1	1	1	2	1	3	1	4	1	1	1	1	1	2	4	4	1	2	1	1
ST731	1	1	1	2	1	2	1	1	1	4	1	3	4	1	1	1	1	1	4	1	4	1	1		1
ST732	1	1	1	3	1	2	1	1	1	2	1	3	4	1	1	3	1	1	1	1	4	4	1	4	1
ST733	1	1	1	2	1	3	1	1	1	2	1	3	4	1	1	3	1	1	4	1	3	4	1	4	1
ST735	1	1	1	3	3	2	1	1	2	4	1	2	4	5	1	3	1	3	4	1	3	5	1	4	1
ST736	1	1	1	2	1	3	1	1	1	2	1	3	4	1	1	3	1	1	4	1	3	4	1	4	1
ST737	1	1	3	1	1	1	1	3	1	2	1	2	2	3	1	5	1	1	4	1	3	4	1	4	1
ST738	1	1	1		1		1		1	1	1	2	2	1	1	1	1	1	1	1	4	4	1	4	1
ST740	1	1	1	2	1	2	1	1	1	2	1	2	4	2	1	2	1	2	4	1	2	4	2	4	1
ST741	1	1	1	2	1	2	1	3	1	2	1	1	3	1	1	3	1	2	4	1	3	4	1	4	1
ST742	1	1	1	2	1	2	1	2	1	2	1	1	3	1	1	3	1	5	4	1	3	4	1	4	1
ST743	1	3	1	2	1	2	1	1	3	4	1	3	4	1	1	2	1	4	4	1	2	5	1	1	1
ST744	1	2	1	3	1	2	1	3	1	3	1	1	2	1	1	1	1	4	4	1	4	2	1	2	4
ST745	1	1	2	2	1	1	2	1	2	5	1	3	1	1	1	3	4	4	4	1	2	5	1	3	1
ST747	1	1	1	2	3	2	3	2	1	3	1	1	2	1	1	1	1	4	4	1	4	2	1	1	1
ST748	1	1	1	3	1	1	1	1	2		1			1	1	3	1	1	4	1	3	4	1	1	1
ST749	1	1	2	2	1	1	1	1	2	5	1	3		1	1	3	4	4	4	1	2	5	3	3	4
ST750	1	1	2	2	1	1	1	1	1	3	1	5	4	1	1	1	1	2	4	1	2	4	2	4	1

O. RAW DATA FOR ATTITUDE TOWARDS NEWTON'S LAWS OF MOTION POSTTEST

Student	att01	att02	att03	att04	att05	att06	att07	att08	att09	att10	att11	att12	att13	att14	att15	att16	att17	att18	att19	att20	att21	att22	att23	att24
ST001	4	4	3	3	5	4	4	4	4	4	4	5	3	3	4	4		3	4	3	4	4	3	4
ST002	5	4	3	2	3	4	4	3	4	4	4	4	3	3	4	4	2	3	3	4	3	2	3	4
ST003	1	1	2	4	1	5	5	1	1	1	1	3	5	1	1	1	5	1	1	1	1	1	1	5
ST004	3	4	2	2	3	5	5	2	3	3	3	4	3	4	4	4	2	2	4	2	4	4	2	2
ST005	4	4	4	2	3	5	5	2	4	3	4	4	3	4	2	4	2	3	2	2	4	2	4	4
ST006	5	5	5	2	5	4	4		4	4	3	4	5	5	4	4	2	3	4	4	3	4	5	2
ST007	4	4	4	4	3	4	4	2	4	5	4	5	2	4	4	5	1	4	3	5	4	5	5	5
ST008	4	2	4	2	4	3	4	3	3	3	2	4	2	4	4	4	3	3	2	1	3	2	4	4
ST009	5	5	4	2	5	5	5	2		5	5	5	2	5	4	5	1	5	5	5	5	5	5	2
ST010	4	4	4	2	4	4	4	2	4	3	4	5	3	4	3	4	3	3	3	2	3	2	3	3
ST011	4	4	4	2	3	4	4	2	3	4	4	4	3	2	2	3	2		3	3	4	2	3	4
ST012	4	3	3	3	4	4	5	2	3	3	3	3	3	4	3	3	3	2	3	2	3	3	4	3
ST013	5	4	3	2	3	4	4	3	4	4	4	4	3	3	4	4	2	3	3	4	3	2	3	4
ST014	3	2	1	1	3	4	4	5	3	3	1	3	5	1	1	1	5	1	1	1	1	1	3	5
ST015	5	5	5	1	5	5		4	4	3	3	5	3	3	5	5	2	3	4	4	3	4	5	3
ST016	5	4	5	3		4	5	1	3	4	4	4	2	5	4	4	2	3	5	4	4	4	5	2
ST017	4	4	4	5	4	4	4	2	4	4	3	4	2	2	3	2	2	3	2	2	4	4	4	3
ST018	4	4	3	3	4	3	4	3	4	4	4	4	2	4	3	4	2	4	4	3	4	4	4	5
ST019	4	4	3	2	3	4	4	2	4	4	4	4	3	4	4	4	2	3	2	2	2	2	3	4
ST020	4	4	3	3	4	4	4	1	4	4	4	4	3	3	4	4	3	3	3	2	4	3	3	3
ST021	4	4	3	3	1	4	4	3		4	4	2	5	1	2	3	2	3	1	1	4	2	3	2
ST022	4	4	1	4	2	3	3		3	3	2	4	4	2	2	2	2	1	2	1	4	2	4	4
ST023	5	3	4	2	5	3	2	5	3	1	5	4	2	4	3	3	1	4	2	5	3	4	5	5
ST024	3	3	4	4	4	5	2	2	4	4	4	4	3	3	2	3	3	3	2	2	3	2	3	3
ST025	2	2	3	3	3	4	4	3	3	3	3	3	2	4	3		3	3	3		4	3	4	3
ST026	4	4	3	3	4	5	5	1	4	4	3	5	2	3	2	2	2	3	2	1	4	2	3	3
ST027	3	3	3	5	4	5	5	1	5	4	3	3	3	3	3	3	2	3	2	2	3	3	3	3
ST028	4	4	4	4	4	4	4	2	4	3	3	5	4	3	3	4	3	3	2	2	4	2	2	4
ST029	4	2	2	3	3	4	4	4	3	3	2	4	1	1	1	2	3	2	1	1	3	1	2	2
ST030	4	4	3	3	3	4	4	2	3	3	3	4	4	2	2	2	3	2	1	1	4	2	3	4
ST031	4	4	3	3	2	5	5	4	3	5	4	4	3	5	4	4	5	4	3	4	5	3	4	4
ST032	4	4	3	3	3	5	5	1	3	3	3	5	3	3	3	4	2	3	3	2	3	3		3
ST033	3	2	4	3	4	3	1	1	3	3	3	3	3	3	3	3	3	3	2	3	4	4	4	4
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ST562	2	4	2	3	2	4	4	2	4	4	4	4	4	1	1	2	4	2	2	2	4	2	2	4
ST563	3	4	4	4	5	5	5	5	4	4	2	4	5	5	1	1	5	1	1	1	1	2	2	5
ST564	2	4	1	4	1	3	4	2	4	4	4	4	5	1	1	3	4	3	1	1	4	1	4	4
ST565	4	4	3	3	3	4	4	2	4	4	4	4	3	3	3	4	2	3	2	2	3	3	4	3
ST566	4	4	4	2	4	5	5	1	4	4	4	4	1	4	1	3	2	3	1	1	3	1	4	3
ST567	4	3	3	2	4	5	5	2	4	4	3	4	2	3	1	1	2	2	1	2	2	2	3	4
ST568	5	5	4	2	4	4	4	1	5	5	5	5	3	4	4	5	1		2	3	5	5	5	2
ST569	4	4	2		4	5	5	3	4	4	3	4	4	2	2	4	3	3	1	1	3	1	3	4
ST570	4	3	3	4	3	5	4	2	4	4	4	5	3	2	3	4	2	4	2	1	4	2	3	4
ST571	4	4	4	5	4	4	3	2	4	4	3	4	5	4	2	4	3	3	2	2	5	4	3	3
ST572	3	4	3	3	3	3	3	3	4	4	2	4	4	2	2	4	3	2	2	2	2	3	4	3
ST573	4	4	4	2	5	5	5	1	5	4	5	5	3	4	4	4	2	5	3	3	5	4	4	3
ST574	5	5	3	2	3	5	5	2	5	4	4	4	3	2	3	4	1	3	2	3	3	4	4	2
ST576	4	4	4	2	3	5	5	2	5	5	4	5	3	4	3	4		4	3	3	4	4	5	2
ST577	4	4	3	2	3	4	4	1	4	4	4	4	3	3	4	4	1	4	2	2	4	4	4	2
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ST580	5	5	4	4	4	5	5	1	5	5	5	5	1	4	4	4	1	5	4	4	5	5	4	2
ST581	5	5	4		2	2	4	4	5	4	3	4	3		1		1		1	3	3	3	3	3
ST582	4	4	2	1	1	5	5	2	3	3	2	4	5	1	1	4	2	1	1	1	1	1	1	2
ST583	2	2	2	4	2	4	4	4	4	4	2	3	5	5	2	2	2	2	1	2	2	1	2	5
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ST585	5	5	4	2	4	5	5	1	5	5	5	5	3	5	5	5	1	5	4	5	5	4	5	1
ST586	5	5	4	2	5	5	5	1	5	5	5	5	2	4	3	4		1	3	3	4	4	5	1
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ST594	5	5	5	2	5	5	5	2	5	5	5	5	1	5	3	5	1	5	3	3	5	4	5	1
ST595	5	5	3	1		3	3	3	3	3	2	4	1	4	5	3	1	1	1	3	3	4	5	1
ST596	4	4	5	2	4	4	4	2	4	3	3	4	2	4	3	2	2	3	2	3	3	4	3	2
ST597	4	4	3	3	3	5	5	5	1	4	4	5	3	3	4	4	2	4	4	3	4	3	4	3
ST598	2	2	3	3	1	4	4	4	3	3	2	4	4	3	1	1	4	2	1	1	4	1	3	5
ST599	5	5	5	3		4	4	3	4	3	3	4	2	4	3	4	2	3	2	1	4	3	4	2
ST600	4	4	3	3	3	5	5	1	4	4	4	5	3	3	4	4	2	4	4	2	4	2	3	3
ST601	1	4	2	1	5	5	5	1	5	5	5	5	1	5	3	1	1	3	1	1	5	1	1	5
ST602	4	4	3	3	3	3	4	1	4	3	2	2	3	3	2	2	4	2	2	2	2	2	2	4
ST603	4	3	3	3	3	4	5	2	3	2	3	4	3	3	2	3	4	3	2	2	3	2	3	4
ST604	4	4	3	3	3	4	4	2	4	4	4	4	4	3	3	2	2	3	2	1	4	3	4	3
ST605	4	2	2	1	3	2	2	4	5	4	3	2	4	2	2	2	3	5	5	2	5	4	2	4
ST606	4	4	3	3	4	4	4	2	4	4	4	4	3	3	3	4	3	2	1	1	4	2	4	2
ST607	2	3	2	2	1	4	4	5	2	2	1	1	2	3	2	1	4	1	1	1	3	3	3	5
ST609	4	4	4	3	5	4	4	3	4	4	4	4	3	4	3	4	3	3	3	3	3	3	4	5
ST610	5	4	4	2	4	4	4	1	4	3	3	4	2	4	3	4	2	2	3	3	2	4	4	3
ST611	4	4	4	3	5	4	4	2	4	4	4	4	2	4	4	4	2	4	3	3	4	3	4	3
ST670	5	4	4	3	4	5	5	2	5	5	4	5	2	2	4	4	1	4	4	5	5	4	3	2
ST671	4	4	4	3	5	5	5	1	5	4	4	4	3	3	3	4	2	4	3	2	5	4	4	3
ST672	4	3	5	2	3	5	5	1	5	5	5	5	3	3	4	4	4	3	3	3	5	4	5	3
ST673	4	3	5	2	3	5	5	1	5	5	5	5	3	3	4	4	4	3	3	3	5	4	5	3
ST674	4	4	4	2	4	5	5	2	5	5	4	4	3	3	4	4	1	4	4	3	4	4	4	2
ST675	4	4	2	3	2	4	4	1	5	4	4	4	5	3	5	4	2	4	3	3	4	4	4	2
ST676	5	4	4	1	5	4	5	1	4	4	4	4	2	4	4	4	1	3	3	2	4	4	4	3
ST677	4	4	3	3	3	4	4	2	4	4	4	4	5	2	3	4	3	3	2	3	2	2	3	3
ST678	4	5	3	4	3	5	5	2	5	5	5	5	3	2	3	3	1	4	3	3	4	3	4	2
ST679	3	3	2	4	2	4	4	3	4	3	1	4	4	3	1	1	1	1	1	1	1	1	3	3
ST680	4	4	4	3	3	4	4	1	4	4	4	4	3	5	3	4	1	4	3	3	5	3	4	3
ST681	4	4		2	4	4	4	4	4	4	4	4	2	4	2	4	2	3	2	4	3	2	4	4
ST682	4	2	4	2	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	1	1	2
ST684	4	4	4	5	1	4	5	2	4	4	3	4	5	4	1	1		3	2	4	3	2	4	5
ST685	4	5	4	3	4	5	5	2	4	4	3	4	3	4	3	4	1	3	3	2	4	4	4	4
ST686	4	5	3	2	3	5	5	1	5	5	4	5	3	3	2	4	4	4	2	2	4	2	4	4
ST687	4	4	4	2	5	5	5	1	5	5	4	4	2	4	4	3	2	3	4	2	5	4	4	3
ST688	4	4	3	2	3	4	5	2	4	4	4	4	4	2	1	3	2	3	1	1	4	1	3	2
ST689	4	1	4	2	3	5	4	1	3	4	3	4	1	5	3	2	1	3	2	2	1	4	2	1
ST690	2	3	3	2	2	4	4	4	4	3	4	4	5	2	2	3	3	4	2	3	4	4	4	5
ST693	4	4	4	2	3	4	4	2	4	4	4	4	3	4	1	4	2	4	3	2	3	4	4	2
ST694	4	4	2	3	4	5	5	5	5	5	4	5	3	2	2	2	2	4	1	1	5	3	2	4
ST695	4	4	3	3	3	5	5	4	4	4	4	5	3	3	2	4	1	4	1	1	5	2	3	2
ST696	5	5	3	2	3	5	5	5	5	5	5	5	3	3	3	4	3	4	1	3	4	5	4	3
ST697	3	3	3	3	3	4	4	2	4	4	3	3	3	3	2	3	2	4	3	3	5	3	3	2
ST698	4	4	4	3	2	4	4	2	4	4	2	4	4	4	2	4	2	3	1	2	3	2	3	5
ST699	4	4	3	2	4	5		1		5	5	5	2	3	2	4	2	5	3	2	5	4	4	2
ST700	4	4	4	4	3	3	3	4	5	5	1	2	3	4	4	4	4		5	4	4	5	4	5
ST701	4	4	3	2	4	4			4	4	3	5	1	4	4	4	1	4	4	4	3	4	4	1
ST702	4	4	3	3	3	5	5	3	4	3	3	5	3	3	1	2	3	3		2	3	2	2	3

ST703	4	4	2	4	1	4	4	1	4	4	4	4	4	2	4	3	2	4	2	3	4	3	4	4
ST704	4	4	4	3	4	4	4	4	4	4	4	4	3	4	2	3	4	4	1	1	1	1	3	1
ST705	4	4	3	4	4	4	4	4	3	5	5	4	1	3	2	4	3	3	2	3	3	4	5	4
ST706	4	4	3	4	4	4	4	2	4	4	3	3	2	3	4	4	2	3	2	2	4	2	3	3
ST707	4	4	2	2	3	5	5	1	5	5	5	5	3	2	4	3	2	4	2	2	3	3	3	4
ST710	4	4	3	3	3	4	4	3	4	4	4	4	3	3	2	4	2	3	2	2	4	3	3	3
ST711	4	4	3	4	4	5	5	2	4	4	3	4	1	4	1	3	2	4	1	1	2	2	3	3
ST712	3	3	2	4	3	5	5	2	4	4	4	5	4	1	4	4	2	3	3	2	3	2	4	5
ST713	4	4	3	1	4	5	5	1	5	5	4	5	3	3	2	3	2	4	2	3	5	3	4	2
ST714	5	4	4	3	4	5	5	2	4	4	4	4	3	3	4	4	2	4	3	2	4	4	4	2
ST717	4	4	4	5	3	5	5	1	4	5	4	4	3	3	2	4	2	4	2	1	4	2	3	4
ST718	5	5	4	3	5	2	2	1	5	5	5	5	1	4	4	5	1	5	3	2	5	4	4	3
ST719	4	5	4	3	3	5	5	2		5	4	5	3	3	4	4	2	3	2	3	3	4	4	2
ST720	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
ST721	4	3	2	2	3	4	4	1	4	4	4	4	3	2	4	4	2	4	3	4	4	2	3	3
ST722	5	5	4	2	5	5	5	1	5	5	5	5	2	4	5	5	2	4	3	3	5	4	4	2
ST723	4	4	3	3	4	5	5	1	4	4	4	3	3	2	2	2	2	2	3	2	3	2	3	3
ST724	4	4	4	3	3	2	2	2	4	4	4	5	3	4	2	3	2	3	2	2	3	4	4	3
ST725	4	4	3	2	5	4	4	2	3	3	3	3	2	3	2	2	2	2	2	2	3	2	3	4
ST726	3	3	2	4	3	4	4	2	3	3	3	4	4	2	3	2	3	3	1	2	3	3	3	3
ST727	4	4	4	3	5	4	4	1	5	4	3	4	2	3	2	2	2	2	3	2	2	2	4	2
ST728	4	4	3	3	4	5	5	2	5	4	4	5	3	3	2	4	1	4	2	1	5	3	3	3
ST729	5	5	5	3	4	5	5	3	5	5	5	5	2	4	5	5	2	4	4	4	5	5	5	4
ST731	4	4	3	3	3	4	4	2	4	4	4	4	3	3	2	4	2	3	3	3	3	4	4	2
ST732	3	4		4	2	4	4	3	4	4	3	4	5	2	2	3	4	3	1	3	3	3		5
ST733	5	5	5	1	5	4	4	1	5	5	5	4	1	5	3	5	1	5	2	2	5	4	5	3
ST735	2	3	4	2	5	1	2	2			3	4	4	5	5	5	3	4	2	3	2	5	1	1
ST736	4	3	2	3	3	4	4	2	4	5	3	4	5	3	2	2	2	3	1	1	4	2	3	4
ST737	3	3	3	4	2	4	4	2	3	3	3	4	3	2	1	2	3	3	1	1	2	1	4	3
ST738	3	3	4	4	3	4	3	4	3					3	2		3	3	3	3	2	3	3	3
ST740	4	4	2	4	3	4	4	1	4	4	4	4	2	4	4	4	2	3	4	1	3	4	3	1
ST741	3	3	4	3	2	5	5	1	4	4	3	5	5	1	1	1	3	2	1	1	2	2	3	4
ST742	4	4	3	3	3	4	5	2	3		4	4	3		3	4	1	3	3	3	4	4	3	3
ST743	4	4	3	2	4	4	5	1	4	4	5	5	3	3	1	4	4	4	3		4	3	4	4
ST744	4	4	4	4	4	4	4	2	4	4	4	4	4	2	2	2	4	2	2	2	2	2	4	4
ST745	4	4	3	3	4	4	4	2	4	4	5	5	3	5	4	4	2	4	2	2	5	2	3	5
ST747	4	3	2	5	3	4	5	1	4	4	4	4	5	2	1	2	2	3	1	1	4	1	4	4
ST748	4	3	3	2	1	4	4	3	3	4	4	5	1	4	1	3	2	3	2	4	2		5	1
ST749	4	4	3	3	4	4	4	2	4	4	5	5	3	5	4	4	2	4	2	2	5	2	3	5
ST750	1	2	3	4		2	3	5	1	3	3	1	3	1	4	5	4	4	4	3	4	2	4	1

P. RAW DATA FOR MOTIVATION FOR LEARNING PHYSICS POSTTEST

Student	mot01	mot02	mot03	mot04	mot05	mot06	mot07	mot08	mot09	mot10	mot11	mot12	mot13	mot14	mot15	mot16	mot17	mot18	mot19	mot20	mot21	mot22	mot23	mot24	mot25
ST001	4	5	4	5	4	5	5	5	5	4	5	4	5	5	5	5	5	4	4	5	4	4	4	4	3
ST002	1	3	3	4	5	3	5	4	2	1	1	1	5	1	3	3	4	3	2	3	3	2	1	2	2
ST003	1	4	3	4	5	4	5	5	3	1	1	2	5	3	5	1	3	1	1	1	1	2	1	1	1
ST004	3	3	3	4	5	4	5	5	4	4	5	4	5	2	2	3	2	5	4	5	5	3	2	2	1
ST005	4	4	3	3	5	3	5	5	4	4	5	4	5	3	5	2	2	4	4	5	3	4	2	4	4
ST006	5	5	4	5	4	5	5	4	5	5	5		4	3		4	5	5	4	4	4	3	5	3	3
ST007	5	5	4	5	5	5	5	5	5	5	4	5	4	3		3	5	5		2	4	4	4	4	5
ST008	2	5	4	3	4	3	5	5	3	3	5	3	5	2	5	2	2	3	4	4	3	3	2	2	3
ST009	5	5	5	5	3	5	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	4	4
ST010	4	4	3	3	3	3	5	5	5	3	5	4	5	3	3	3	4	5	4	5	3	4	2	3	4
ST011	3	2	3	3	4	3	2	5	3	1	4	4	5	1	4	3	3	3	4	4	2	2	1	3	5
ST012	3	5	4	3	4	3	4	4	3	2	5	3	5	3	5	3	2	3	3	5	2	3	1	3	3
ST013	1	3	3	4	5	3	5	4	2	1	1	1	5		3	3	4	3	2	4	4	2	1	2	2
ST014	1	3	3	4	5	3	5	4	2	1	1	1	5	1	3	3	4	3	2	4	4	2	1	2	1
ST015	5	5	5	5	4	4	5	5	5	5	4	2	5	5	5	5	4	5	3	5	5	5	4	3	5
ST016	5	5	4	5	5	4	5	5	4	4	5	4	5	3	5	4	5	5	4	5	5	5	5	4	4
ST017	4	4	4	4	3	3	4	5	5	4	5	4	5	5	5	5	5	4	4	5	4	4	3	3	3
ST018	4	4	4	4	4	4	4	4	4	4	5	4	5	5	5	4	4	4	5	5	4	4	3	4	5
ST019	4	4	4	3	2	3	5	5	4	3	5	5	4	3	5	3	3	3	4	5	5	4	4	4	4
ST020	3	5	2	3		3	5	4	3	3	5	3	5	3	5	3	3	4	3	5	3	3	3	4	4
ST021	4	5	2	3		1	2	3	5	5	4	3	4	1	5	2	1	3	3	1	1	3	3	3	3
ST022	3	2	3	1	4	1	5	5	3	2	5	3	4	1	5	1	1	3	4	4	3	3	1	3	3
ST023	4	3	5	4	2	4	3	5		2	4	5	3	4	2	5	4	3	5	4	3	5	3	5	3
ST024	3	5	4	4	4	2	5	4	3	3	4	4	4	3	4	3	3	3	4	4	3	4	2	4	4
ST025	3	3	5	3	4	3	5	3	4	3	5	3	4	2	3	3	3	3	5	4	3	3	3	3	3
ST026	3	3	4	2	5	2	5	5	4	3	5	4	5	3	5	3	2	2	4	5	2	4	1	4	4
ST027	3	5	2	3	4	3	5	4	3	3	5	4	5	2	5	2	3	2	5	5	3	4	2		5
ST028	2	5	5	4	3	2	5	3	3	2	5	5	3	3	5	2	3	3	3	3	2	3	1	4	4
ST029	3	5	3	3	5	3	5	5	4	2	5	2	5	3	5	3	2	3	4	5	2	3	2	3	3
ST030	2	2	3	3	4	3	5	5	2	2	5	3	4	2	5	2	3	2	4	4	1	3	1	3	3
ST031	4	5	5	4	4	3	5	5	5	4	5	3	4	1	5	2	4	3	4	4	2	3	5	3	5
ST032	5	4	3	3	4	3	5	5	4	4	5	4	3	3	5	3	3	3	3	5	3	3	3	3	4
ST033	3	3	1	4	4	3	5	5	4	4	5	3	3	3	3	3	3	3	3	5	3	3	2	3	3
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ST562	3	1	5	1	4	1	5	5	3	2	5	3	4	3	5		3	2	5	4	1	4	1	4	4
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ST568	5	5	5	4	5	4	5	5	5	5	5	5	5	3	5	3	4	5	5	5	4	5		5	5
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ST574	5	4	5	5	4	3	5	5	4	5	5	4	5	4	5	4	4	5	5	5	4	5	4	4	5
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ST671	5	5		5	4	5	5	4	3	5	2	5	4	4	3	3	4	5	5	5	4	5	2	5	5
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ST677	4	3	4	2	3	2	4	4	3	4	4	4	4	2	4	2	2	4	4	4	4	4	3	4	3
ST678	4	3	4	3	4	3	4	5	4	3	4	5	5	2	4	2	2	3	5	5	2	5	2	4	4
ST679	4	3	2		3	1	4	4	1	2	5	3	3	1	5	1	2	3	3	4	1	2	1	2	2
ST680	5	5	5	4	2	3	5		4	4	5	5	2	3	5	2	3	4	5	5	3	4	4	5	5
ST681	3	3	3	4	2	4	4	3	2	4	3	4	2	3	4	3	4	3	4	3	3	3	4	3	3
ST682	3	2	3	1	3	2	4	3	1	3	2	3	3	1	4	2	1	3	4	4	4	3	3	4	4
ST684	4	2	5	2	4	1	5	4	5	4	5	5	5	1	5	2	2	4	3	5	4	3	3	3	4
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ST687	4	4	3	5	3	5	5	4	3	5	4	4	4	4	5	3	4	4	5	5	3	4	3	4	5
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ST700	5	5	5	5	5	4	4	4	3	5	1	4	4	4	5	4	2	4	4		5		5	5	5
ST701	4	5	4	4	4	4	5	5	5	5	5	4	5	3	5	4	2	4	4	4	2	3	3	4	5
ST702	4	5	4	3	3	2	5	4	3	2	5	4	3	1	5	2	5	3	5	5	3	4	3	4	5
ST703	4	5	5	2	2	1	5	5	2	4	4	4	1	1	5	1	1	4	4	5	2	5	4	5	5
ST704	5	5	2	4	2	4	2	4	5	3	3	4	2	4	4	4	3	4	4	4	4	4	4	5	5
ST705	3	3	4	3	3	2	4	4	4	4	4	5	5	1	2	2	3	4	5	4	2	3	2	4	5
ST706	4	4	3	4	4	5	4	4	5	5	5	5	5	5	5	3	5	4	4	4	4	4	4	4	4
ST707	4	4	5	5	5	4	5	5	4	3	4	5	5	4	4	5	4	4	5	4	3	5	3	5	5
ST710	4	3	4	3	4	3	5	4	4	5	5	4	4	3	4	3	3	4	4	3	3	4	2	3	4
ST711	4	4	3	4	3	4	4	4	1	2	3	4	4	3	4	3	4	4	5	5	3	4	2	5	5
ST712	5	5	4	1	4	1	4	5	5	5	5	5	5	1	5	1	1	5	5	4	3	5	3	4	5
ST713	4	4	4	5	3	4	5	3	4	3	4	4	3	2	4	3	3	4	5	4	3	4	3	3	4

ST714	4	4	3	4	4	4	5	5	4	4	4	4	4	3	5	3	3	4	5	5	3	4	3	4	4
ST717	4	4	4	3	4	3	5	5	4	2	3	4	3	3	5	5	4	3	4	5	4	4	4	4	4
ST718	5	5	4	5	1	5	4	2	2	5	2	5	1	5	2	5	5	5	5	2	4	5	5	5	5
ST719	5	5	4	5	1	5	4	2	2		3		4	3	5	2	5	5	5	2	4	5	5	5	5
ST720	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3		3	3	3	3	3	3	3	3
ST721	5	5	2	4	3	4	5	5	4	4	5	5	3	3	5	3	4	4	4	4	2	4	2	4	4
ST722	5	5	5	4	5	5	5	5	3	5	5	5	4	4	5	4	5	5	5	5	4	3	3	5	5
ST723	5	4	4	4	3	4	5	5	1	4	4	4	4	4	5	2	3	3	5	4	1	3	1	5	5
ST724	4	4	4	3	2	3	4	2	2	4	4	3	3	2	4	2	3	4	3	3	3	3	4	4	4
ST725	3	2	3	3	3	2	4	4	3	3	3	2	3	4	1	2	2	3	3	3	1	3	3	3	2
ST726	3	4	4	2	3	2	4	2	2	4	4	4	2	3	4	3	3	4	3	3	3	4	3	3	3
ST727	4	3	2	5	3	3	5	5	3	2	5	3	3	3	5	3	3	4	5	5	3	5	2	4	4
ST728	5	5	5	4	3	3	5	3	1	5	3	4	3	3	5	3	4	5	5	3	4	4	1	5	5
ST729	5	5	5	5	5	5	5	4	5	5	5	4	5	5	5	5	5	5	4	5	4	5	4	4	4
ST731	5	5	5	3	3	3	5	4	5	5	5	4	3	2	5	2	2	5	4	4	3	3	3	4	4
ST732	4	5	5	2	3	2	5	4	5	4	5	4	3	2	5	2	2	3	4	4	3	4	2	5	5
ST733	5	3	5	5	1	5	5	5	5	5	5	5	2	5	5	5	5	4	5	3	5	5	5	5	5
ST735	4	3	2	4	5	5	3	5	4	2	3	4	5	3	3	4	2	3	5	4	4	3	2	4	5
ST736	5	3	4	3	3	4	5	4	3	3	5	5	4	2	5	3	4	4	5	4	2	3	1	4	5
ST737	3	4	3	1	4	1	4	4	3	3	4	4	3	1	3	1	2	3	3	3	2	2	2	3	2
ST738	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	4	3	3	3	3	3	3	3
ST740	5	5	5	5	3	3	5	3	3	5	5	5	4	3	5	3	5	5	1	5	3	5	3	5	5
ST741	2	4	3	2	4	1	5	5	1	1	5	3	4	1	5	1	1	3	5	1	3	1	3	2	1
ST742	4	3	2	3	3	4	5	5	3	3	2	3	3	2	3	1		5	5	5		3	1	4	3
ST743	4	5	4	4	4	5	5	5	3	4	5	5	3	5	4	4	5	4	4	4	3	5	3	5	5
ST744	3	5	5	3	3	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
ST745	4	3	3	5	4	4	5	5	2	3	5	5	5	3	5	3	5	5	5	5	2	5	1	5	5
ST747	3	2	5	4	3	2	5	5	4	2	4	4	4	2	5	2	3	2	5	5	4	4	1	4	4
ST748	4	3			3	4	1	4	1	3	4	2	3	1	4	2	3	1	2	3	4	2	4	2	5
ST749	4	3	3	5	4	4	5	5	2	3	5	5	5	3	5	3	5	5	5	5	2	5	1	5	5
ST750	4	4	3	5	2	3	2	2	3	5	4	5	5	5	4	3	2	4	5	4	2	2	2	3	4

Q. RAW DATA FOR NEWTON'S LAWS OF MOTION ACHIEVEMENT TEST POSTTEST

Student	nlmat01	nlmat02	nlmat03	nlmat04	nlmat05	nlmat06	nlmat07	nlmat08	nlmat09	nlmat10	nlmat11	nlmat12	nlmat13	nlmat14	nlmat15	nlmat16	nlmat17	nlmat18	nlmat19	nlmat20	nlmat21	nlmat22	nlmat23	nlmat24	nlmat25
ST001	1	1	1	1	1	1	1	1	1	2	1	4	4	1	2	3	1	4	4	1	2	4	1	2	1
ST002	1	1	1	2	1	2	1	2	1	2	1		4	1	1		1	4	4	1	2	4	1	4	1
ST003	1		1	3	3	3	3	3	3	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
ST004	1	1	1	2	1	2	1		1	1	1	4	4	1	1	3	1	4	4	1	2	4	1	4	1
ST005	1	1	1	2	1	2	1	1	2	1	1	4	4	1	1	3	1	4	4	1	2	4	1	4	1
ST006	1	1	1	1	1	2	1	1	1	2	1	4	4	1	1		1	4	4	1	2	4	1	4	1
ST007	1	1	1	1	1	2	1	1	1	2	1	4	4	1	1	1	1	4	4	1	2	4	1	4	1
ST008	1	1	2	2	1	1	1	1	1	1	1	4	1	1	1	3	1	3	4	1	2	4	1	4	1
ST009	1	1	1	2	1	2	1	1	2	2	1	4	4	1	1	3	1	4	4	1	2	4	1	4	1
ST010	1	1	1	3	1	3	1	1	3	2	1	1	4	1	1	3	1	4	1	1			1	2	1
ST011	1	1	1	1	1	2	1	1	1	2	1	4	4	1	2	3	1	4	4	1	2	4	1	4	1
ST012	1	1	1	1	1	2	1	1	1	2	1	4	4	1	1	3	1	4	4	1	2	4	1	4	1
ST013	1	1	1	2	1	1	1	2	1	2	1	3	4	1	1	3	1	4	4	1	2	4	1	4	1
ST014	1	1	1	2	1	2	1		1	1	1	4	4	1	1	3	1	4	4	1	2	4	1	4	1
ST015	1	1	1	1	1	2	1	1	1	2	1	4	4	1	2	1	1	4	4	1	2	4	1	4	1
ST016	1	1	1	2	1	2	3	1	1	1	1	4	4	1	1	3	1	1	1	1	4	2	1	4	1
ST017	1	1	1	2	1	1	1	1	1	2	1	4		1	1	1	1	4	4	1	2		1	2	1
ST018	1	1	1	2	1	2	3	1	1	1	1	4	4	1	1	3	1	4	4	1	4	2	1	4	1
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ST020	1	1	2	1	1	2	1	1	1	1	1	4	1	1	1	3	1	3	3	1	2	4	1	4	1
ST021	1	1	1	2	1	2	1	1	2	1	1	2	4	1	2	1	1	4	4	1	2	4	1	4	1
ST022	1	1	1	1	1	1	1	1	1	2	1	5	4	1	2	3	1	4	4	1	2	4	1	4	1
ST023	1	1	1	1	1	2	1	1	1	2	1	4	4	1	1	3	1	4	4	1	2	4	1	4	1
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ST680	1	1	1	1	1	1	1	1	1	2	1	1	4	1	1	1	1	4	4	1	4	4	1	2	1
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ST704	1	1	2	3	1	1	1	1	3	2	1	1	3	1	1	1	1	1	4	1	2	5	1	2	1
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ST718	1	1	1	1	1	1	1	1	1	2	1	2	4	1	1	1	1	3	4	1	4	4	1	2	1
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ST735	3	3	3	3	3	3	3	3	2	5	1	5		1	1	5	5	2	1	1	5	5			
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ST737	1	1	1	2	1	1	1	1	2	2	1	2	4	1	1	1	1	3	4	1	1	4	1	2	1
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ST740	1	2	1	2	1	1	2	1	2	1	2	3	4	1	1	1	1	3	1	1	2	2	3	3	1
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ST742	1	2	1	1	1	2	2	1	1	3	1	3	4	1	1	3	1	3		1	2	4	2	4	1
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ST744	1	1	1	2	1	1	1	1	2	5	2	3	4	3	1	1	2	5	4	1	2	3	2	2	4
ST745	1	1	1	2	1	1	1	1	1		1	3		1	1	3	1	4	4	1	4	4	1	2	1
ST747	1	1	1	2	1	1	1	1	2	1	1	1	4	3	1	1	1	3	4	3	1	4	1	2	1
ST748	1	1	1	3	1	1	1	1	1	1	1	4	4	4	1	3	1	2	1	1	3	4	1	2	1
ST749	1	1	1	2	1	1	1	1	1	1	1	3	4	1	1	3	1	4	4	1	4	4	1	2	1
ST750	1	1	1	2	1	1	1	1	1	1	1	3	4	1	1	3	1	4	4	1	4	4	1	2	1

R. NEWTON'S LAWS OF MOTION ACHIEVEMENT TEST

PART I – True-False Questions

You should mark **True** of **False** in the answer sheet depending on your answer. If you cannot do or don't know the answer please mark "I don't know/I couldn't solve" box.

1. A force can change the direction of the motion.

2. Force can change the shape of an object. An example to this property of force is elongation of a spring when a force applied on it.

3. The goalkeeper applies a force to catch the ball.

4. If the direction of the of the force changes it becomes another force.

5. We may define a force with its components.

6. The directions and magnitudes of two equivalent forces are equal.

7. If a force multiplied with a negative number its direction changes.

8. Acceleration is directly proportional with the force causes the motion.

9. The rain drop accelerates until it reaches it terminal velocity.

PART – 2: Multiple Choice Questions

There exists only one right answer to each question. Mark the right answer on answer sheet. If you cannot do or don't know the answer please mark "I don't know/I couldn't solve" box.

10. Two spring balances, X and Y, each have a mass of 200 grams. A mass of 100 grams is attached to spring balance Y, as shown in Figure A. Spring balance Y with the 100-gram mass is then connected to spring balance X, as shown in Figure B. What would be the reading on each spring balance in Diagram Q?

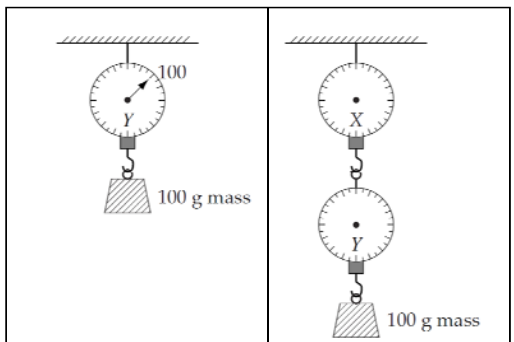
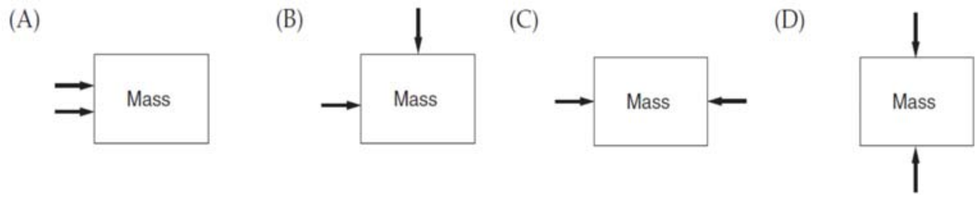


Figure A Figure B

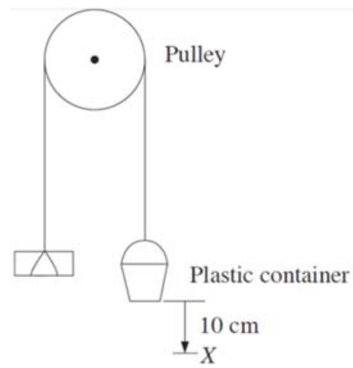
	Spring balance X (g)	Spring balance Y (g)
(A)	200	100
(B)	300	100
(C)	300	300
(D)	500	300
(E)	I don't know/I cannot do	

11. Which arrangement of forces will lead to the greatest net force on the 10 kg mass?



(E) I don't know/I cannot do

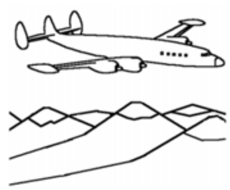
12. Some students set up the equipment shown below. They added sand to the plastic container until the weight of the container and its contents exactly balanced the weight of the brick. The string used had negligible mass.
One of the students then moved the plastic container 10 cm downward to position *X*, held it steady, and released it. When the container was released it:



(A) moved slowly back to its original position.
(B) started to move downward.
(C) moves up and down several times before stopping at its original position.
(D) remained at position X
(E) I don't know/I cannot do.

13. Which one of the following(s) is(are) moving under the influence of balanced forces?

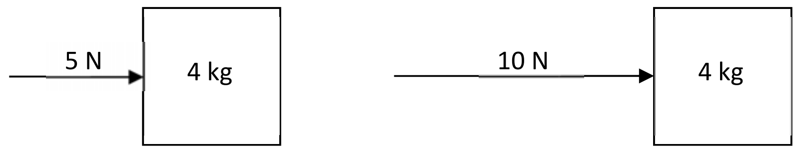





I	II	III	IV
Surfing Boy	Boot at maximum velocity	Plane with constant velocity	Paratrooper moving with terminal velocity

(A) Only I (B) II and IV (C) II and III (D) II, III and IV (E) I don't know/I cannot do.

14. What will happen to the acceleration of an object if the force acting on it is doubled as shown in the figure?



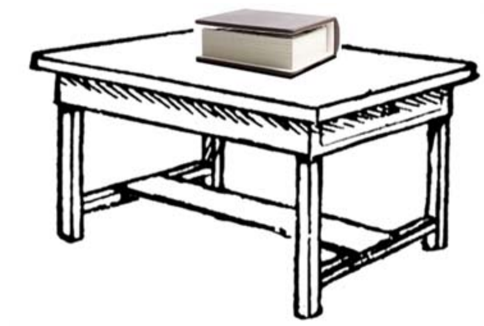
(A) It will be doubled.
(B) It will halve.
(C) It will stay the same.
(D) It will change direction.
(E) I don't know/I cannot do.

15. Two cars taking part in a race are lined up at the starting line. When the race starts, the forces supplied to both cars are equal. What is the best way to describe the acceleration of each car?

BENZ =1800 kg BMW=1300 kg

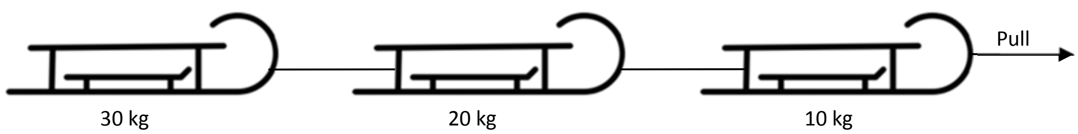
(A) BMW should accelerate more than BENZ because BMW has less mass.
(B) BENZ should accelerate more than BMW because BENZ has greater mass.
(C) Both cars should accelerate equally because they both start at the same time.
(D) Both cars should accelerate equally because they are both experiencing the same force.
(E) I don't know/I cannot do.

16. There exist action and reaction pairs in between the book and table when we put it on the table as shown in the figure. Which one of the followings explains why book is not moving?



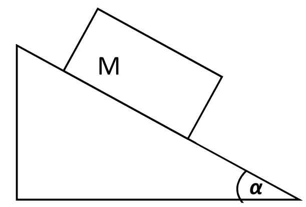
(A) The forces are opposite in direction.
(B) The magnitudes of the forces are equal.
(C) The net forces on each object are equal to zero.
(D) The forces are in the same direction.
(E) I don't know/I cannot do.

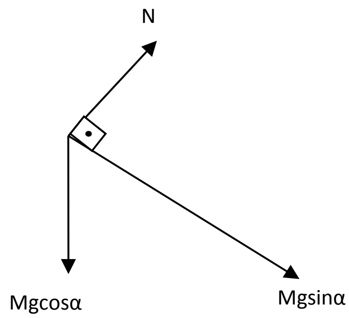
17. Three sleds are being pulled horizontally on frictionless horizontal ice using horizontal ropes as shown in the figure. The pull is horizontal and the magnitude is 120 N. Find the acceleration of the system.



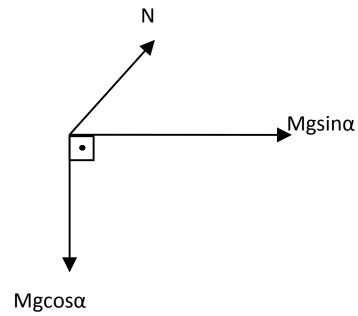
(A) 2 m/s^2 (B) 4 m/s^2 (C) 6 m/s^2 (D) 12 m/s^2 (E) I don't know/I cannot do.

18. The first two steps in solution of Newton's second law problems are to select an object for analysis and then to draw free body diagrams for that object. Which one of the followings is the free body diagram of mass ***M*** on a frictionless inclined plane of an angle ***α***?

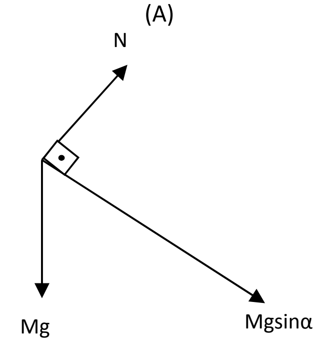




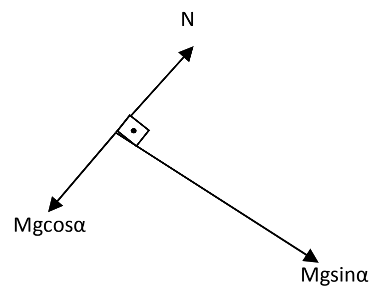
(A)



(B)



(C)

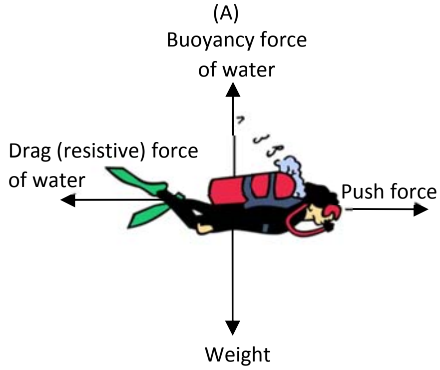


(D)

(E) I don't know/I cannot do.

19. Which one of the following free body diagrams is correct?

(A)

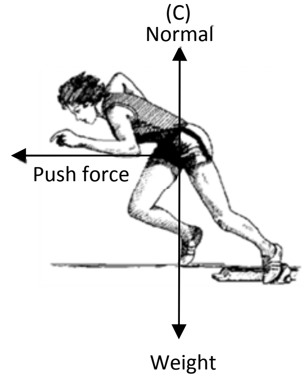


Diver moving horizontally
with constant velocity

(B)

Basketball player
jumped to shoot

(C)



Sprinter accelerating
horizontally

(D) All of the above

(E) I don't know/I cannot do.

20. A crash-test dummy without a seatbelt was in the front seat of a moving car. During the crash-test the car hit a solid wall head-on. Which statement best describes the motion of the dummy on impact?

(A) The dummy moved forward off the seat.

(B) The dummy was pushed back into the seat.

(C) The dummy stayed in the same position.

(D) The dummy moved up and hit the roof of the car.

(E) I don't know/I cannot do.

21. Which one of the statements is(are) true?

I. Only an object, which is at rest, has inertia.

II. Object moving with constant velocity has inertia.

III. Object accelerating constantly has inertia.

IV. Inertia is inherited property of matter independent of its motion and the measurements made on it.

(A) Only I (B) II and III (C) I and IV (D) II, III and IV (E) I don't know/I cannot do.

22. The students after learning the inertia and its relation with mass, they have conducted following experiments. Which one of the following(s) is(are) example(s) of this statement?

I. Idlir and his friends are experimenting by changing the number of the books over his head. And one of his friends was dropping a heavy hammer to the books from same height. Idlir says that as the number of the books over his head is being increased he feels less pain.

II. Genc tries to push and give a start to a toy car and a real car. She says that it is easier to give a start to a toy car.

III. Two seemingly identical bricks at rest on the physics lecture table. Yet one brick consists of mortar and the other brick consists of Styrofoam. Without lifting the bricks Anila gives the bricks an identical push in an effort to change their state of motion. She recognized that the brick that offers the least resistance is the brick with the least mass.

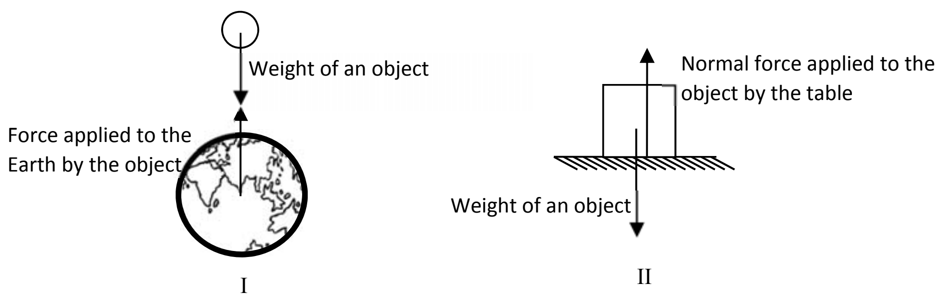
(A) Only I (B) Only II (C) Only III (D) I, II and III (E) I don't know/I cannot do.

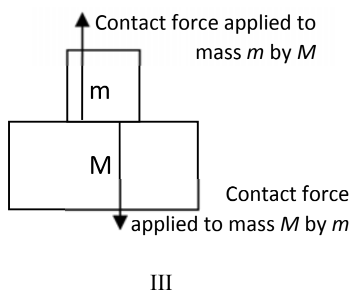
23. Which one of the following statements is(are) true?

I. A more massive object has a greater tendency to resist changes in its state of motion.
II. A more massive object has a smaller tendency to resist changes in its state of motion.
III. The tendency of an object to resist changes in its state of motion doesn't vary with mass.

(A) Only I (B) Only II (C) Only III (D) I and II (E) I don't know/I cannot do.

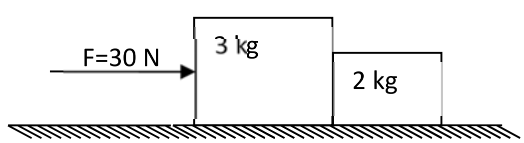
24. Which one of the following(s) is(are) action and reaction pairs?





(A) Only I (B) Only II (C) Only III (D) I and III (E) I don't know/I cannot do.

25. What will be the acceleration of the objects in the figure when a 30 N net force applied? Ignore friction.



(A) 6 m/s² (B) 10 m/s² (C) 15 m/s² (D) 30 m/s²

(E) I don't know/I cannot do.