ADAMA SCIENCE AND TECHNOLOGY UNIVERSITY

SCHOOL OF APPLIED NATURAL SCIENCE

APPLIED PHYSICS PROGRAM

# THE ROLE OF CONTEXT-BASED PHYSICS INSTRUCTION IN THE EFFECTIVENESS OF TECHING PHYSICS

A THESIS SUBMITTED TO THE APPLIED PHYSCIS PROGRAM IN PARTIAL FULFILMENT FOR THE REQUIREMENT OF MASTER OF SCIENCE IN PHYSICS

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**ADAMA, ETHIOPIA**

**Dec. 2016**

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## Abstract

*The purpose of this research was to study the effectiveness of context-based learning on preparatory students in the 11$^{th}$ grade in terms of conceptual achievement. In this research, pre-test/post-test quasi-experimental design with non-equivalent control group, involving a 2(group) x 2(time) factorial design was used. The research experiment was initiated immediately after the pre-test is given. The experimental group was given a learning approach based on real life context-based learning, whereas the control group was given the traditional learning approach. Two-tiered tests are used for determining differentiation in conceptual achievements of the two groups related to "Floating, Sinking, Buoyancy and Pressure" concepts by using conceptual questions. Data for the research were collected with the "Pressure Conceptual Test". When the results of the research were examined, it was found that the context-based learning group's conceptual achievements scores were significantly higher than the traditional learning group. The study also investigates the current status of context- based physics instructions in preparatory school. By employing a descriptive survey method the study comprehensively assesses the context-based approach in 11$^{th}$ grade physics by selecting the topic of pressure and buoyancy. From the study made by comparing the result of controlled and experimental groups, it was found that the conceptual achievements of students that attended in the context-based instructional approach were by far greater than that of the traditional approach. Results of research indicated the adjusted post-test mean scores of the C0ntext-Based Group Learning ($M_a$=34.60) were significantly higher than the Traditional Learning Group ($M_a$=28.89). As all participants agreed, the inclusion of context-based conceptual achievement and the evolution of physics results assumed to be one of the remedies of the poor activities of students in preparatory school.*

# CHAPTER ONE

## 1. Introduction

### 1.1 Background of the study

For many years, educational underachievement has been associated with many factors, for example socioeconomic and language background factors. However, there is increasing evidence to suggest that teacher and teaching quality is a determining factor of students' achievement (Darling-Hammond, 2000, 2006; Darling-Hammond & Baratz-Snowden, 2005; Ell & Grudnoff, 2013; IEA, 2012).To improve the quality of teaching researchers outlined three general interesting areas of knowledge that beginning teachers must acquire, and this has implications for what is included in initial teacher education programs. Firstly, knowledge of learners and how they learn and develop with in a social context; secondly, understanding the subject matter and curriculum goals (skill to be taught) in light of the social purposes education, and thirdly, understanding the teaching in light of the context and learners to be taught as informed by a productive classroom environment.

Practical activities are essential in all level of science education and in particular it is highly significant in teaching physics in preparatory schools to help students in internalizing and understanding the theoretical knowledge of physics. The government of Ethiopia has supported a practical problem- solving approach to teaching and learning physics. The challenge facing the Ministry of Education is how to implement its objectives and how to improve the traditional teaching approaches by conducting context-based teaching approaches. Tekeste (1990), in his introductory part described science education in Ethiopia as being in crisis due to irrelevant and inappropriate methods which had failed to incorporate relevant practical experience. The present and post-1992 Ethiopian government has begin to develop science teaching as a process of enquiry and to look a fresh at the methods of instruction. The new Education Policy and sector strategy (EMPDA, $1994_{a,\ b}$) addresses issues, for example, the purpose of science education, the context for the science curriculum, teacher education, and conditions that help the development of practical work in school science. Accordingly, the primary science curriculum has been replaced, and a new secondary curriculum is to be started in from the beginning of the millennium. The Ministry of Education (MOE, 1997, 1998), recognizing that reform of school education requires accompanying reform in teacher-training, has redrafted the teacher education program. For instance, several studies suggest that teachers' views, understanding and practice evolve from their own education and training programs. These experiences strongly influence not only what science is taught, but also how it is taught.

Therefore, based on the above description context-based learning in physics education at all level in general and at the preparatory level in particular are regarded as one of the necessary elements to promote students to relate their knowledge with their daily life experience and students achievement in learning physics. To accomplish the goal of context-based teaching approach, the equipment and experiments have to be carefully selected to give students a relevant experience (World Bank report, 1993). The World Bank report (1993) further elaborated that the understanding is enhanced if the activities are coming from the daily life of the students. Provision of relevant equipments is a necessary, but not sufficient condition for successful physics teaching. Other factors such as pre-service and in-service teacher training influence the quality of physics teaching in context. In order to increase practical activities in teaching physics, the curriculum as well as the textbooks should be designed with context-based approach. The best way to learning physics in different grades levels is, every lesson should be associated with students past knowledge and life experience; that is physics in context. This makes physics learning and teaching more tangible, interesting, live and unforgettable and it contributes to widen the skill and knowledge of the students.

So, several researchers argued that context-based approach is preferred for students' knowledge retentions and make students positive attitudes towards physics. To develop research in the field, the science community and especially the research community must be careful to design and provide detailed descriptions of the preparation and implementation of context-based physics instructions. Among the many variables to be reported carefully are (based on, Luneta et al., 2007): learning objectives, the nature of the instructions provided by the teacher; the nature of the activities and the student-student and teacher-student interactions during the context-based approach instructions should be designed accordingly.

Physics has been regarded as a difficult subject for students. The long-term goal of effective physics teaching is to help the student in the deep learning of concepts. When students learn physics, a subject that encompasses many abstract concepts, they start the process by misconception that leads them away from scientific fact which obstructs the effective teaching of physics (Dykstra et al., 1992). The long-term goal of effective physics teaching is to help the student in the deep learning of concepts (Murphy &Whitelegg, 2006). The traditional learning environment that is usually preferred in the schools has proven to be unsuccessful in the realization of this goal (McDermot, 1991; Khan & Ahmad, 2014).

## 1.2 Statement of the problem

Theory and practice must support each other to form an integrated experience. In Ethiopia, two aspects i.e. academic and pedagogical content are not given comparable credit or attention, with pedagogical content knowledge not being seriously considered, Tekeste (1990). Although in teacher training programs for physics students give plenty of courses, the methods to relate their knowledge and concepts with their life experience are completely neglected. The Ministry of Education of the Federal Democratic Republic of Ethiopia, states in its policy as it gives much concern to the importance of science to produce well qualified, scientifically literate and competent educated manpower. In order to fulfill the demand of the country's 70:30 ratio, more emphasis must to give to science fields and students are expected to gain adequate practical knowledge parallel to the theoretical knowledge of science disciplines. The current concern of the Ethiopian Education Policy is to produce quality and large number of graduates year after year in different fields of science. The policy states that 70% of students who pass the higher education institutes entrance examination will join various fields of science (Amdissa, 2008:53). But the implementation of practical works in Secondary as well as preparatory schools and producing quality educated man power is under serious problems and questionable. It needs a current investigation how the policy is carried out and how much it achieves its objectives and strategies.

Hence, from different research results there is a significant difference on students' physics achievements between the traditional teaching method and the context-based approach in students' knowledge retentions, attitudes towards physics and misconceptions. Students are not well acquired physics knowledge using traditional way of learning and that is why the quality of graduate students decline from time to time and to assure this assumption conducting research is necessary. I believe that it is very important to assess and investigate the role of context-based instruction approaches for effective teaching physics in preparatory schools; and also the challenges to implement this approach through the current curriculum, teachers' former knowledge and experience, schools' facilities to conduct this approach and using the existing textbooks.

In the traditional physics classroom, generally a teacher- centered type of instruction has conducted in preparatory school according to many educators opinions. In traditional teaching approach, simply students listen to lesson, take notes and solve problems centered on memorization and computation. It has lack of to relate concepts to students' real life. Traditional teaching approach contributes to the problem of misconceptions and unsatisfactory conceptual understanding in introductory physics. Some of the problems encountered in traditional physics instruction were not solved. These problems were that scientific knowledge were not associated with daily life (Demircioglu, Demircioglu&Calik, 2009; Gilbert, 2006; Stolk, Bulte, de Jong & Pilot, 2009a) and the students had difficulties in application of science knowledge in different contexts (Gilbert, 2006). As a result students have little interest to learn physics, always they score poor result in the exam and they have negative attitude towards physics subject.

In order to-get-rid of these problems and to increase the quality of education, educators advised to implement context-based instruction approach as an alternate approach compared to the traditional instruction in preparatory school students' for the achievement and knowledge retention of physics subject matter and attitudes towards physics in recent years. But these researchers haven't got any written document as far as the effectiveness of context-based approach is concerned in different educational institutes and bureaus in Ethiopia. The current curriculum and physics textbooks which are used in Ethiopia are competence-based rather than context-based.

The present physics teaching approach in preparatory schools is a traditional approach as a result students are not happy to learn physics; because they couldn't relate their work with their real daily life, they have also the problem of knowledge retention and they score poor result in the exam. The present study attempt to give insight and evaluate the effectiveness of the role of context-based physics instruction for students' attitudes towards physics and investigates what students think they have gained with context-based physics instruction. Besides this, in this research we can see how to explore the effectiveness of context-based learning physics in preparatory students by considering one topic; that is pressure in solids and pressure in liquids and gases.

The following questions are the frame for this study:

1. What are the current practices for in Ethiopian preparatory schools and how might they apply context-based instruction for teaching physics?
2. Are there any effects of context-based physics instruction on students and physics teachers?
3. Are there any effects of context-based physics instruction on students' attitude towards physics?
4. How do the students assess context-based physics instruction application about gains?

## 1.3 Objectives of the study

### 1.3.1 General objective

The general objective of this study is to investigate the effectiveness of the role of context-based physics instruction approach for teaching physics in preparatory schools.

### 1.3.2 Specific objectives

The specific objectives of this study are to:

- explore effectiveness of context-based instruction on teaching physics in preparatory schools
- relate researchers findings of the effect of context-based instruction in teaching physics with the current problems of teaching physics in preparatory schools by considering pressure as a topic
- argue literatures and research results of context-based approach in teaching physics produced by different researchers
- Check the effectiveness of context-based instruction in preparatory schools in Ethiopia.

## 1.4 Significance of the study

- This study is important to investigate the context-based instruction and present the findings regarding the effectiveness of the context-based instruction on student outcomes.
- It provides insight for policy makers and developers how to implement context-based instructional approach in preparatory schools as planned by the curriculum.

- It could be of some use to syllabus designers in science education and also, inspiring teachers and schools to carry out context-based approach as designed by the curriculum or syllabus to produce well qualified science graduates.
- It has a great importance for implementation of periodical workshops, seminars and training for science teachers about context-based instructions approach and updating their skills and experience.
- Besides this, physics teachers can use the findings of this study to apply context-based approaches by relating their past experience during their teaching.
- The most important use of this study is to increase students' attitudes towards physics and they can develop more positive attitudes towards physics. It is also known that students' attitude is highly associated with their achievement. This can reflect on students' outcomes as higher engagement and greater understanding of physics.

# CHAPTER TWO

## 2. Literature review

### 2.1 Introducing Context-Based Approach

A variety of definitions can be attributed to the context-based approaches. It would make sense to refer different dictionaries and explore the meaning of the word "context" as a starting point. The Oxford Dictionary defines the word with two parallel explanations; one of which is "the circumstances that form the setting of an event, statement, or idea and terms of which it can be fully understood" and the other is "the parts of something is written or spoken that immediately precede and follow a word or passage and clarify its meaning". When the reflection of these descriptions on teaching is considered it is seen that context-based approaches mainly aim to give meaning to scientific concepts within a context relevant to students' lives.

Science education has some problems: Overload, Isolated facts, Lack of transfer, Lack of relevance, insufficient emphasis. "Contexts" are used as the basis for curriculum design and classroom teaching for eliminate each of these problems. The meaning of "context" is "coherence", "connection" and "relationship" (Gilbert, 2006).

In the literature, there are a lot of definitions about context-based approach stated by many researchers and they defined context-based approach as an approach that based on the applications of context and science in order to develop the scientific opinion. Ingram (2003) stated "context-based learning includes learning in the contexts and the learning takes place in close relationship with the experienced daily life". In Sozbilir, Sadi, Kutu &Yildirim, (2007)'s study, they explained context-based as "submitting the scientific concepts with the events chosen from daily life to the students". Many researchers focus on the attribute that appreciate the contribution of physics to their lives and provide way to acquire a better understanding of the world. A context-based approach enable the students to see the relevance and possible applications of their learning results on the one hand, and to tie new topic into their pre-knowledge, interest, and ideas to enable successful learning process, in the light of constructivist learning theories, on the other hand.

In the literature, there is the statement that "enthusiasm of learning increase with the connection of knowledge to the students' daily life" about the context (Choi & Johnson, 2005). So, what does the context that helps to increase learning desire of the student in science teaching mean? The context is described as "in any concept, the pattern of events, cases and relationships or connection or context in any concept" by Turkish Language Association (TLA, 2015). In science programs, with the context-based concept it is meant that the content should be associated to a real situation or an event which the students encounter or may encounter in daily life. The content should also be associated to any technological device which students are closely familiar. The conducted studies reveal that the most important way to increase students' interest to physics is associating the scientific information with the events in daily life (Barker & Millar, 1999; 2000; Potter & Overton, 2006). The association of scientific knowledge with the events in daily life positively affects the attitudes of students toward physics (Graber, Erdmann &Schlieker, 2002; Hofstein & Kesner, 2006; King & Ritchie, 2007). In order to help students to develop positive attitudes towards physics, the subject should be taught within the context which the students are familiar in their daily life.

## 2.2 Theories Underlying Context-Based Education

The role of the context-based approach has been discussed in educational setting as one of the innovative instructional approaches and the solution of the current problem of teaching physics. Many countries throughout the world have implemented context-based physics projects or programs to make physics more relevant to students' lives. Some of the countries which utilized these programs are the Netherlands, USA, Germany, UK, Canada and Australia. The long- term goal of the effectiveness of physics in context teaching is to help the students in the deep learning of concepts (Murphy & Whitelegg, 2006). The traditional learning environment that is usually preferred in the school has proven to be unsuccessful in the realization of this goal (McDermtt, 1991; Khan and Ahmed 2014). During a traditionally designed instruction, the teacher introduces the concepts, make arithmetical calculations on the board and rarely demonstrate experiments. In the mean while, students listen to the teacher, write down what is required to be learned and occasionally ask questions or make comments (Taasoobshirazi and Carr, 2008). Such an instruction possibly results in students' memorization. Because the exams include real-life problems, it is important to design the curriculum by considering context-driven problems or topics. In the designing of the curriculum involved in the context-based approach, the vital element is “teacher factor”. Unless teachers follow the reforms in education, it is difficult to expect teachers to apply context-based approach in their classrooms. In other words, because teachers tend not to use the new approach and not to give up using the traditional approach, teachers have to be given in-service education and they should be informed about the reforms, so their professional development should be cared.

Context-based approaches aim to develop and sustain a sense of wonder and curiosity in young people about the natural world (Demircioglu et al., 2009). At the same time, a context can help students to connect scientific knowledge to real life (Lye, Fry & Hart, 2001). The students are required to induce meanings by using contexts, thus justifying a “need-to-know” approach to content (Yigit, 2010). Thus, students’ interest and positive attitudes towards physics have been increased (Wierstra, 1984 Whitelegg& Edwards, 2001; Lavonen et al., 2005; Rayner, 2005; Basir, Alinaghizadeh&Mohammadpour, 2008; Tekbiyik, 2010; Tekbiyik&Akdeniz, 2010; Yayla, 2010).The study, which will focus on preparatory schools physics education in Ethiopia seek insight context-based instruction approaches promote excellence in physics teaching and also the number of students, and possibly teachers, involvement can improve. It also investigates how context-based approaches teaching physics influence students’ perceptions of physics and their consequent desire to continue with physics. The effectiveness of the role of context-based instruction as compared to the traditional instruction of physics in preparatory school for students’ achievements and knowledge retention on physics subject matter and students’ attitude towards physics is believed by educators. The present study determines the role of context-based physics instruction about students’ attitude towards physics. And, it investigates what students think they have gained with context-based physics instruction. The focus of this study is to explore the effectiveness on conceptual understanding of innovative approach as an alternative to traditional approaches, specifically with respect to conceptual change and context-based learning.

In order to eliminate these problems, the instructional methods should be improved for students to become more competent and acquire sufficient physics knowledge using context-based physics teaching approach rather than traditional teaching approach. Students should get the basic skills of physics in context in different concepts to be creative, innovative and problem-solving citizens.

However, the actual practice and associated problems of context-based teaching physics in preparatory schools is not known. Furthermore, from my experience and observations there is little concern and attention about context-based approach. I want to understand the actual practices of preparatory schools in carrying out context-based teaching methods and the constraints that impede these activities. Moreover, the research tries to investigate the teachers and educational experts to respond for this better approach as a solution of current problems of physics teaching for preparatory students.

The focus of this research is to explore the effectiveness on conceptual understanding of innovative approaches as an alternative to traditional approach. This approach has been introduced as an alternative to traditional learning in recent years (Taasoobshirazi & Carr, 2008). The context-based approach, whose theoretical framework is based on constructivist learning theory, is student-centered. With context-based learning, students are able to see why they learn something and how they can use that knowledge (Glynn & Koballa, 2005). In the literature, there are many studies that defend context-based physics teaching or developing a context to study physics (e.g. Whitelegg & Parry, 1999; Astin et al., 2002; Colicchia, 2005). In the Netherlands, USA, Germany, UK, Canada, Australia and other countries, context-based physics projects or programs have been effectively used in rendering physics more relevant to student experience.

This study examines the role of context-based physics instruction on preparatory students achievement compared to traditional physics instruction in a preparatory school. In the traditional physics classroom, generally a teacher-centered type of instruction has conducted in preparatory schools according to many teachers and supervisors opinions. Students listen to lessons, take notes, and solve problems-centered on memorization and computation. Traditional teaching approach contributes to the problem of misconceptions and unsatisfactory conceptual understanding of introductory physics. The decline in interest in the number of students learning physics could be due to a combination of factors including the perceptions that physics is a “hard” subject with low levels of students’ achievements; the perceived nature of the subject as being highly mathematical and abstract; and how the subject is taught at the preparatory school level.

A few works of research in the literatures were encountered on context-based learning in physics education but these studies were conducted with a single group (Kaschalk, 2002; Cooper et al., 2003). At the same time, studies on the effects of context-based learning in physics, on learning outcomes, (such as motivation, problem- solving and achievement) and studies that compare these effects with the effects of traditional learning are considerably few (Wiersta&Wubbels, 1994; Murphy et al., 2006; Tural, 2013). In their review of context-based physics instruction and assessment, Taasoobshirazi& Carr ( 2008) pointed to the difficulties in implementing context-based learning in physics education and to the extent of the research that focused on learning outcomes and the significant methodological flaws in the research, emphasizing that there was a need more and better designed studies.

In order to evaluate the effectiveness of context-based instruction approach one topic is considered in this study. The topic of pressure, especially pressure in liquids and gases, is a familiar realm that students have had experience with in many aspects of their lives, one which they find interesting; it is a subject that forms the basis of courses of higher education (She, 2002). The topic of pressure is one that encompasses both invisible and abstract conceptions and about which students have misconception (She, 2002), In addition, a review of the literature shows that students have many misconceptions about the subject of pressure (e.g. Tytler, 1998; Parker & Haywood,2000; She,2002; Fassoulopoulos et al,. 2003; Besson&Viennot, 2004; Havu-Nuutinen, 2005). Studies on pressure and buoyancy reveal that students have various misconceptions, such as "buoyancy increases as the amount of liquid increases", "buoyancy depends on the size of an object", "pressure is dependent on the amount of liquid" and "there is no such thing as atmospheric pressure."

There has been no research on topics of pressure on the preparatory school level. This research took as its starting point these deficiencies and was conducted to research and compare the effectiveness of two different approaches of teaching physics (context-based and traditional learning) on preparatory school students in the 11th grade in terms of their conceptual understanding of pressure (pressure exerted by solids, pressure in stagnant liquids and gases, buoyancy, Bernoulli's Principle), their conceptual achievement. The main question is whether there is significant difference between context-based learning and traditional learning approaches on students' understanding of pressure and buoyancy when pressure and buoyancy concepts pre-test scores are controlled as covariates.

In the literature, it is found that context-based approach has a positive effect on the academic success (Ingram, 2003; Potter & Overton, 2007; Ultay, 2012, 2015; Ultay, Durukan&Ultay, 2015; Yavuz&Kepceoglu, 2011), interest and motivations of the students (Bennett et al., 2005; Holman & PillingIn, 2004; Ramsden, 1997; Rayner, 2005; Tekbiyik&Akdeniz, 2010; Ultay&Kalik, 2011). Besides in the literature, there are many studies supporting the thoughts of the context-based approach is a more catchy learning method since the students can internalize the events that the students encounter in daily life more (Ultay, 2012, 2014; Ultay&Calik, 2012) and it positively contributes to associating the physics knowledge with daily life (King & Ritchie, 2007). In the studies mentioned above, in the literature it is stated that science and physics lessons should be assessed in accordance with the context-based approach (Akpinar, 2012) and daily life examples should be in order to develop the problem solving abilities of the students (Park & Lee, 2004; Taasoobshirazi& Carr, 2008). During learning process, problems are said to have the function of directing the students and monitoring their development, facilitating classroom management, ensuring the interaction between the individuals in learning environment, increasing motivation and developing problem-solving abilities (Kurnaz, 2013). So, in science lessons, the problems acquiring students to make analysis, synthesis and evaluation should be preferred to develop students' problem-solving abilities (Knecht, 1971). So, in this case it will be possible to deepen the conceptual learning and to gain the deeper understanding. In recent years, the importance of science teaching based on the real life and problem solving abilities has been widen by the conducted studies (Campbell, Lubben&Dlamini, 2000; Park & Lee, 2004). Although the effects of the context-based instructions on students' interest, motivation and success are investigated in many studies, very few numbers of studies focused on the context-based assessment (Heller &Hollabaugh, 1992; Kurnaz, 2013; Parl& Lee, 2004)

In designing a context-based instruction, teaching unit should connect relevant context from which questions are derived, and the basic concepts that can be applied to answer questions. Two aspects of context-based teaching of physics arise from the definition stated above. Firstly, the content is central to the teaching of physics concepts. It should emphasize the relevance of the subject to students' lives by including social, economic, environmental, technological industrial applications of physics. Second aspects of the context-based approach is the context provides students a need-to-know basis to extend their knowledge on the subject, that is physics ideas and concepts are introduced when students feel a need to develop further understanding of the future of the context being studied. By using students real world as the starting point for introducing scientific ideas, context-based approaches provide students authentic learning activities to reach this higher-order thinking skills providing a constructivist view. One of the six characteristics of constructivist learning described by different researchers is learning being "situative", which means that "knowledge" acquisition is tied to a specific context and situation.

In a similar way, situated cognition theory defines learning being inherently social in nature by emphasizing the role of the context in which something is learned. In this model of situated cognition, the researcher proposed that learning will be meaningful unless it is isolated from the social and physical context within which it is developed. That is to say, situatedness of knowledge particularly refers being in part of the activity context and culture in which it takes place. In accordance with these one of the instructional models developed based on the situated learning; show similarities to the context-based instruction in terms of immersing students' in real life context engage them in authentic learning practice. Activity theory has a notable point of view for context; it regards the components of the activity; like object, actions and operation, as being the context itself without thinking the learner and the object being studied as separate entities.

Moreover, context is not something isolated from the activities people take part with their own's objects. The reflection of activity theory on classroom practice is cognitive apprenticeship aiming to guide and support learners throughout the problem solving process as it the case in context-based instruction. For the current study, it is important for context-based instruction designed to enable students construct their own knowledge based on their prior knowledge and experience (constructivism) with the guidance of their teachers supporting them throughout the instruction while engaging in a variety of activities in groups emerged within a context. Because the exams include real-life problems, it is important to design the curriculum by considering context-driven problems or topics. To make the curriculum involved in the context-based approaches, the vital element is "teacher factor". Unless teachers follow the reforms in education, it is difficult to expect teachers to apply context-based approaches in their classrooms. In other words, because teachers tend not to use the new approaches and not to give up using traditional approach teachers have to be given in-service education and they should be informed about the reforms, so their professional development should be cared.

Context-based courses have two particular features for enhance the understanding of scientific ideas. The first of these is the motivational aspect that provides students can see what they learn more effectively. The second feature is “drip feed” approach that provides more opportunities for students to develop their scientific understanding by revisiting of ideas at different points in a course (Bennett & Holman, 2003).

Bennett (2003) determined the research findings for students in context-based lesson. These findings are:

1- When pupils use context-based materials or follow context-based courses, students’ interest in science lesson generally increase.
2- Context-based materials help pupils perceive relations between the science and everyday lives for pupils.

Researches on context-based learning (Murphy, 1994; Hennessy, 19993) determine that contexts relate with out-of-school activities increase students’ interests. Students are more successful at problems in everyday life than problems in formal settings, and better deal with everyday problems rather than scientific one (Whitelegg & Parry, 1999). Students are not control problem solving processes in context of school and experiments (Lave, 1998). Students are empowered by choosing accessible context or building on a context suggested by students themselves. Furthermore, students’ social needs may be met and promoted students’ self-esteem and prestige with contexts (Whitelegg & Parry, 1999).

## 2.3 Projects Adopting Context-Based Approaches

Scientific literacy is a major aim in science education, but what approach could be effective at developing scientific literacy? Science educator developed context-based approach to integrate scientific knowledge and real life events, and they designed curriculums according to the new approach. Context-based approach is presented within projects and studies. Some of the projects are:

- The Salters Approach and SLIP (Supported Learning in Physics Project),
- Piko (PhysikimKontext) in Germany,
- ROSE (The Relevance of Science Education) in Finland,
- STEMS (Science, Technology Environment in Modern Society) in Israel,
- PLON (Dutch Physics Curriculum Development Project and NiNa) in the Netherlands

There are researchers investigate the effects of the context-based learning on students' conceptions and attitudes towards physics (Bennett et al. ,2003 &Lubben et al. 2005). Both reviews focused on the same research questions: "What evidence is there that teaching approaches which emphasize placing science in context and promote links between science, technology and society improve the understanding of science and the attitudes towards science of 11 to 18-year-old pupils, and what are the implications of the evidence for initial teacher training courses?". There is obviously a need to undertake a thematic review of context-based studies in physics education focusing on their needs, aims, methodologies, findings, general knowledge claims and implications. Such a review should show what has been accomplished so far, what the practical recommendations they suggested are, and what the effects of context-based approach on teaching and learning are. The main purpose of this study is to evaluate context-based physics instruction approach by using a previously constructed matrix (Calik et al., 2005; Unal et al,2006; Kurnaz&Calik; Ultay&Calik, 2011).

### 2.3.1 The Educational Needs of Context-Based Physics Studies

Most of the studies are done to provide recognizable contexts which are interesting for students. Recognizable contexts help students to relate the scientific knowledge with everyday phenomenon. Therefore, students could learn the subject better because they could find the context interesting (Whitlegg& Parry, Ng & Nguyen, 2006; Kaltakci&Eryilmaz, 2011) and they could be more motivated. Because these contexts also provide a need-to-know basis and facilitate meaningful learning, it is important to identify more clearly what constitutes a contextual approach to teaching. In order to do this, a pedagogical model for the contextual approach should be proposed for educators to apply it in their classes (Wilkinson, 1999b).

Although context-based approach is increasingly popular, there has been little research on the impact of the context-based approach on either teacher' practices or students' experiences of physics (Wilkinson,1999a;Lye, Fry & Hart, 2002 ; Vignouli, Hart & Fry, 2002; Enghang, Gustafsson&Jonsson, 2007; Tekbiyik, 2010). In addition to students' experiences of context-based physics classes, it is also important to take physics teachers' views who are the real implementers of the new approach (Parc& Lee, 2004; Ayvaci, 2010; Balta&Eryilmaz, 2011)

### 2.3.2 The Aims of Context-Based Physics Studies

Many studies are mostly done to develop teaching materials about physics topics based on the context-based approach suitable for the new physics program and evaluate its effectiveness in students' success. It is important because this type of studies present example materials for the new teachers. In addition, studies are also done to determine physics teachers' views and perceptions, and also discover how they integrate contexts into the topics. Because teachers' roles in the context-based approach are different from the traditional approach, they are mentors from now on, it is worthy to clean their views and perceptions about context-based approach. And also for new teachers it is considerably important to give information about the context-based approach and this makes the approach clear, understandable and applicable. There are some studies having an aim of comparing context-based multiple choice tests with traditional multiple choice tests for measuring students' achievement. Because of the low scores in PISA (Program for International Student Assessment) and TIMMS (Trends in International Mathematics and Science Studies) examinations, countries pay more attention to get higher scores. Getting higher scores in PISA and TIMMS exams is possible with solving real-life problems, so context-based assessment tools are important to practice real-life problems.

The studies in the review can be grouped as theoretical and empirical studies. Theoretical studies introduce or illustrate model teaching designs by arguing for their advantages to explain and discuss the researchers' views on the context-based approach. Lubben et al. (2005) used "theoretical studies" for non-empirical papers, thereby, teachers or curriculum developers may subsequently adopt them in practice. Scenario-based studies introduce theoretical ideas and the basic philosophy of the context-based curriculum based on previous empirical backgrounds.

But their prior aim is not presenting findings but making comments and giving information by considering the previous empirical researches. Empirical research studies attempt to answer their research questions through findings-based evidence and argue the advantages or disadvantages of the context-based approach by using these findings.

### 2.3.3 Data Collection Methods of Context-Based Physics Studies

In the literature, data collection tools, data collection techniques, implementers, implementation time, sample groups and the selection of samples are included. Data collection tools are identified according to what the researchers used in their studies. In this way, interviews, observations, questionnaires, portfolios, open-ended and multiple choice questions tools: researcher or standard. The implementer is identified as a teacher or a researcher. In addition, the selection of sample is grouped as purposely, randomly, volunteered and unspecified for the studies not mentioning the sample selection. Most studies used high school students and physic teachers as samples. It is remarkable because high school students are important in terms of evaluating achievement, and physics teachers are important in terms of taking opinions as implementers of the approach. However, university students or prospective teachers are also important because it shows whether they learn the approach; in the effectiveness of the approach and whether they will use the approach in their classes in the future.

## 2.4 Research findings of context-based physics studies

### 2.4.1 Effects of research findings on students

Several students were quite skeptical at the beginning of their involvement in the context-based approach. However, they were much more positive at the end. Students generally found the context approach more accessible, interesting and memorable than their previous experiences of physics learning (Whitelegg& Edwards 2001). The students have been very successful, both in terms of students' perceptions of the course and also in the depth and relevance of learning outcomes. The level of motivation and students' satisfaction with their achievement are also high. The outcomes, both informally and through questionnaires have been very positive regarding relevance and the value of what students learn (Rayner, 2005).

Contextual teaching and learning approach is an attempt to make the delivery of education to be more natural, how the students learn and work in real life by letting students actively participate (Yam, 2005). It is revealed that teachers' views of teaching and learning are fairly in accordance with constructivist ideas but that their self-assessed instructional activities are still rather traditional. However, students' estimation of instruction in one of the sets shows that there is a development of instruction towards inquiry-oriented. The piko program leads to a change in instructional practice towards providing better opportunities for students to think and work independently (Duit et ai., 2007).

It has been found in the study that students' personal everyday life experience develops into reasoning skills in physics during group talk. The educational purpose of using CRPs to encourage the students to discuss physics for understanding is confirmed by this study. The students used their time very efficiently and they went from everyday life experiences towards physics talk (Enghag, Gustafsson&Jonsson, 2007). The satisfaction level of students and the enthusiasm of teachers about the course were positively correlated to each other. We could see a gradual improvement in the students' ability to deal with those problems. A guided inquiry-based course "Physics by photography" could motivate students to learn and increase their ability to solve real-life problems (Basir, Alinaghizadeh&Mohammadpour, 2008).

There is a statistical difference between pre and post tests of the achievement test and the attitude test. Context-based materials increased students' learning and affected students' attitudes positively. Anatolian high school students are the most successful group (Tekbiyik, 2010). There is a statistical difference between pre and post tests of the achievement test and the attitude test. Students' conceptual learning is increased by the context-based materials. Also, students' attitudes are affected positively at the end of the intervention (Yayla, 2010). It is revealed that orienteering and formula force and motion tests are statistically different from traditional force and motion test. Students' achievement is found higher in context-based questions Akpinar& Tan, 2011)

### 2.4.2 Effects of research findings on physics teachers

Not all teachers have a clear understanding of what is meant by a “context” with many thinking it simply refers to the teaching of physics concepts with application and everyday examples. A number of teachers have difficulty teaching with a context, and many seem to follow their traditional ways (Wilkinson, 1999a). Contextual approach involves using the context rather than the content (or concepts) to derive the teaching. Teaching contextually is therefore different from teaching concepts first and discussing applications second (Wilkinson, 1999b).

Physics in Context is useful to foster the development of teachers’ content-specific pedagogical knowledge as well as the development of a new culture of teaching and learning that provides better opportunities for students’ learning and that fosters students’ interest towards physics (Duit et al., 2007). Teachers complained about the absence of necessary materials to perform the context-based teaching activities. Teachers, students and even parents do not understand and adopt the new teaching approach (Degermenci, 2009). It shows how difficult it is to change the habitual ways of doing things and bring the contexts of science and engineering into the educational process in an integrated way (Jamison &Mejlgaar

# CHAPTER THREE

# 3. Methodology

## 3.1 Research design

The research was carried out with two groups, one experimental group and one control group. In the experimental group (Context-Based Learning Group-CBLG) the physics topics to be taught were introduced by using context-based approach to the activities and examples in the physics 11$^{th}$ grade text book. In the control group (Traditional Learning Group-TLG) the topics were taught using traditional teaching methods (plain narrative, questions and answers).

The duration of the research was a total of three weeks. In the two groups, a Pressure Conceptual Text (PCT) pre-test and post-test was administered before and after the implementation. The research experiment was initiated immediately after the pre-test.

### 3.1.1 Research group

The two 11$^{th}$ grade classes of the school where the research took place were grouped into experimental and control groups. Gender distribution in the groups is shown in Table 3.1.

**Table 3.1: Distribution of students by gender and group**

| Gender | TLG | CBLG | Total |
|---|---|---|---|
| Female | 16 | 12 | 28 |
| Male | 13 | 19 | 32 |
| Total | 29 | 31 | 60 |

### 3.1.2 Research measuring instrument

Before the three weeks class is started, the pre-test is prepared and given for the two groups to measure their past knowledge learnt from lower grade level on the subject of pressure and buoyancy. Finally, the two-tier Pressure Conceptual Text (PCT) that was prepared on the subjects of pressure and buoyancy was developed to measure their conceptual achievements. Treagust and Chandrasegaran (2007) have stated that student' conceptions of topic could be studied in depth if the second tier of the two- tier test was composed of open-ended questions. In developing the PCT, care was taken to maintain content validity in line with the concepts recommended by the Ethiopian Federal Ministry of Education for the high school 11$^{th}$ grade physics instruction program.

Two tiered test enter to education environment with the Treagust's (1988) study entitled "the development and use of diagnostic instruments to evaluate students' misconceptions in science". Two-tiered tests are separated from multiple choices tests with at least one dimension having a second phase in which the reasons for the marked choices of the first phases are required to be stated. According to the related literature, two-tiered tests could be prepared in three ways;

i) Two phases of the test could be prepared as multiple choices,

ii) Two phases could be prepared as multiple choice then one more phase could be added for students to write their own ideas as" the other" open ended form

iii) First phase of a test could be prepared as multiple choices and the second one could be open-ended. In this way, students have chance to write their own ideas.

This phase is important to measure students' reasoning abilities and to determine if there are more alternative conceptions different from the related literature. When the two- tiered tests in the literature is examined, it has seen that, often in the first phase of testing, two or three choices are not standard. These choices most often include choices like "yes-no", "increased-decreased-stable", instead of the situations including students' possible alternative conceptions. In the second stage of the tests, students' alternative situations are limited in choices with the data from the literature. When the studies in the literature were examined, it has not been met any- two tiered tests including "floating", "sinking", "buoyancy force of liquids and gases", "solid pressure, liquid pressure and gas pressure". When all of this data are taken into consideration, developing a two tiered test to determine students' alternative conceptions and providing differentiation in their conceptual structure about the concepts in the "force and motion" unit may contribute to the national and international literature in this field.

The first version of the test prepared by the researcher 16 of four-choices (one right answer and three destructors) and in the second version of the set 16 four-choices (one right answer and three destructors) test items and a justification section. To test the content and face validity, the tests was reviewed by three physics teachers with more than 10 years of experiences. The assessment criteria used in the analysis of the test are described in detail in the data analysis section.

### 3.1.3 Intervention instruments

After the texts were prepared, two physics instructors with more than 10 years of professional experience to offer their views. In line with the opinions of the teachers', it was established that the prepared texts were appropriate to the academic level of the students and their knowledge.

Physics 11 Textbook

The $11^{th}$ grade Physics Curriculum emphasizes that students should be active learners if what is taught is to be meaningful and retained. The reason the Physics 11 Textbook, prepared on the basis of the Curriculum, was made the center of the activity is so that students could be prompted into active participation in class. In one of the groups in the research, instruction was carried out with a context-based teaching approach. The goal was to have students learn by experiencing and the result of the teaching was reviewed in terms of effectiveness.

The Physics 11 Textbook contains 10 activities on the topics of pressure and buoyancy. The tools and equipments used in these activities are easily found and usable. In the experimental group (CBLG) in the research, each activity is conducted when the related topic was first brought up. In addition, the students were asked to read the texts in the unit and to discuss the activities in class, providing an opportunity for effective participation. In the controlled group (TLG), the researchers allowed the students in class only to benefit from the theoretical narratives in the textbook on the physics topics being taught.

## 3.2 Procedure

The research was conducted in the first semester and involved the unit of “Matter and its Properties” in the $11^{th}$ grade physics course. The duration of the research was a total of three weeks. In the two groups, a pre-test and post-test was administered before and after the implementation. The research experiment was initiated immediately after the pre-testing. The same researcher (the first researcher), a teacher that was experienced in upper- secondary school physics, taught both of the groups instruct the students. Both groups were instructed for an equal length of time. At the end of every topic, the sample questions prepared by the researcher were answered together with the two groups.

*Treatment in the context-based learning group*

In the Context-Based Learning Group, the first lesson started out with an intriguing text taken from the Physics $11^{th}$ grade Textbook. All of the questions for discussion in the textbook were discussed in the classroom as an introduction to the lesson. In this, the goal was to incite the curiosity and motivation of the students. In this group, the teaching remained loyal to what was offered in the Physics 11 Textbook. The students carried out the activities under the guidance of their teacher. The students were each asked to write down the measurement results in their books. The discussion in the “Let’s conclude” section at the end of the activities were again carried out in a discussion involving the whole class and each student was encouraged to participate actively.

*Treatment in the traditional learning group*

In the control group, before each class started, the students were asked a question to motivate them. The researcher conducted the lessons here in this group, but only by using the method of lecturing. It was the teacher who played an active role over the course of the session.

### 3.2.1 Two-tiered test

Development of a two tiered test for determining differentiation in conceptual structure related to “Floating-Sinking, Buoyancy and Pressure” concepts by using conceptual questions. Two tiered tests were not only used to determine the level of differentiation of the students’ conceptual frameworks but also for the main cause underlying on students’ thinking. At the same time by the two tiered tests, whether or not the student is aware of his/her own knowledge can also be determined. Moreover, two-tiered tests can also contribute to the building relationships between the cause and the result of the knowledge. Similarly, two-tiered tests for the different sub-topics could also be prepared and applied for determining students' conceptual structure in different concepts.

*Pre-test Question*

*Instruction: Questions below have one correct answer and choose the correct answer for each question from the given four choices.*

1. A boy weighs 500N and the soles of his feet have an area of $0.05m^2$. The pressure he exerts when he stands on the ground is_____________.

   A*. 10kPa B. 1kPa C. 100kPa D. $100N/m^2$

2. A book rests on a desk. Its covers measures 20cm by 25cm. It exerts a pressure of 100. The mass of the book is___________.

   A. 2kg B. 1kg C*. 0.5kg D. 0.25kg

3. A rectangular wooden block of mass 2kg is 20 cm thick, by 10 cm wide by 30 cm tall. The maximum pressure this block could exert on a surface is_____________.

   A*. $10^3N/m^2$ B. $10^4N/m^2$ C. $10^2N/m^2$ D. $10^5N/m^2$

4. What is the value of the pressure in Pa if the reading from a barometer is 820mm of Hg? A. $2.04x10^5$Pa B. $1x10^5$Pa C*. $1.08x10^5$Pa D. $3.06x10^5$Pa

5. Which one of the following is correct?

   A. Pressure is defined as the force acting multiplied by the unit area.

   B. As your altitude increases the atmospheric pressure also increases.

   C. 1atm is equal to760cm of Hg

   D*. If the atmospheric pressure drops so does the boiling point.

6. What is the pressure exerted by the water at the bottom of a swimming pool 6m deep?

   A. $6x10^3N/m^2$ B*. $6x10^4N/m^2$ C. $6x10^5N/m^2$ D. $6x10^2N/m^2$

7. The pressure acting on a diver 20 m below the surface is___________.

   A. $2x10^4N/m^2$ B. $2x10^5N/m^2$ C. $3x10^4N/m^2$ D*. $3x10^5N/m^2$

8. A toy submarine has a weight of 6N in air. When immersed in water it has a weight of 4.6N. What is the buoyant force and the weight of water displaced?

   A. 6N & 10.6N B. 10.6N & 1.4N C*.1.4N & 1.4N D.4.6N & 1.4N

9. A floating wooden block has a volume of $0.4m^3$ and displaces $0.3m^3$ of water. What is the density of the block?

   A*.$750kg/m^3$ B. $1225kg/m^3$ C. $1525kg/m^3$ D. $150kg/m^3$

10. Which one of the following is not correct?

    A. Gases may compressed but liquids are incompressible.

B. In fluids the pressure increases with depth and is the same in all directions.

C*. Gauge pressure is the sum of absolute pressure and atmospheric pressure.

C. The apparent weight of a body is equal to the weight of the object minus the buoyant force.

11. An elephant has a mass of 3200kg. Each of his feet covers an area equal to $0.08m^2$. What is the pressure from each foot?

A*.$10,000N/m^2$   B. $100,000N/m^2$   C. $1,000N/m^2$   D. $500N/m^2$

12. How deep under water would you need to be in order to be at double atmospheric pressure?

A.1m   B. 20m   C. 50m   D*. 10m

13. The weight of an object is measured in air to be 7N. The object is then immersed in water and its apparent weight is measured to be 4N. What is the buoyant force and state whether or not the object floats?

A. 11N   B*. 3N   C. 4N   D. 7N

14. A metal cube weighs 1N in air and 0.8N in when totally immersed in water. What is the density of the cube?

A. $5kg/m^3$   B*. $5x10^{-3}kg/m^3$   C.$5x10^{-2}kg/m^3$   D. $5x10^{-4}kg/m^3$

15. If the column of oil 100m high is balanced by column of mercury 6cm is high, what is the density of the oil?

A. $870kg/m^3$   B. $680kg/m^3$   C $960kg/m^3$   D*. $780kg/m^3$

16. A stone weighs 50N in air and displaces 18N of pure water when suspended in it. What is the apparent weight of the stone in this water?

A. 50N   B. 18N   C. 68N   D*. 32N

**, It represents the correct answer of the questions.*

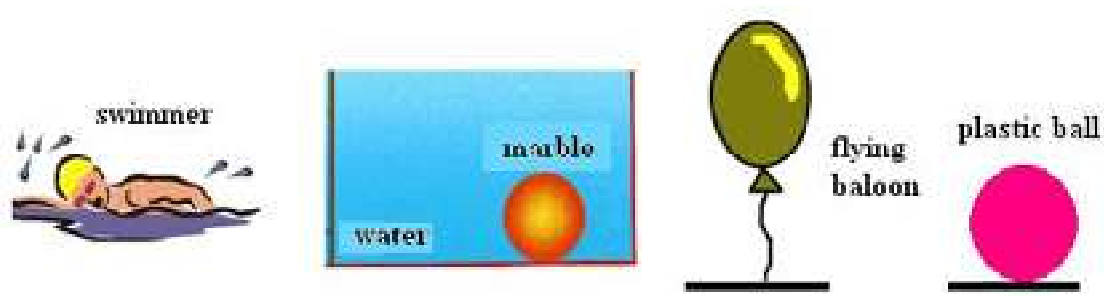
*Two-Tiered Tests for Determining Differentiation in Conceptual Structure (Adapted from Journal of TURKISH SCIENCE EDUCATION)*

The following two-tiered tests are used to differentiate the academic achievement of the Context-Based Learning Group in this study.

Post-test questions:

*Instruction: Questions, below include two phases. At the first phase, you should mark the correct answer of the question from the choices. In the second phase, write why you think that your choice is true into the area starting with "Because".*

**Question 1:**




Which one or ones of the above pictures is affected by the buoyancy force? (Flying balloon and plastic ball are in the same environment).

a) Swimmer
b) Swimmer and flying balloon
c) Swimmer and marble
d) Swimmer, marble, flying balloon and plastic ball*

**Because:**……………………………………………………………………………………………
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**Question 2:** In the picture, a monkey has gone to see to catch fish. Which of the following statements can be said about the liquid pressure that see has applied to monkeys' boat, big fish, small fish and fish feed?


a) The liquid pressure affects all equal.

b) The liquid pressure affects the big fish and fish feed equal.

c) The liquid pressure acting on monkey’s boat is the largest.

d) The fluid pressure acting on the small fish is the largest one.*

**Because**:……………………………………………………………………………………………
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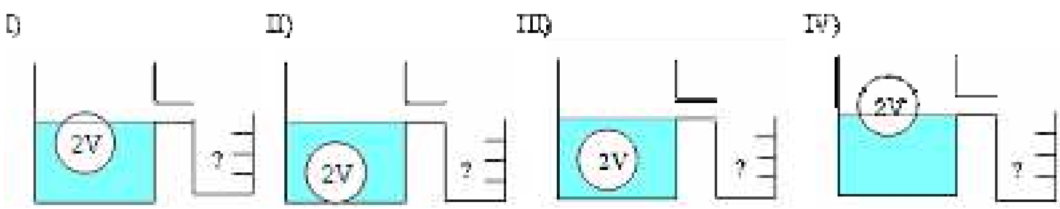
**Question 3:**In the pictures below, substances with the same volume are left into the barrels filled with water. Which one of these substances will cause to overflow equal amounts of water from the barrels?

a) II and IV

b) II and III*

c) III and IV

d) I and IV




Because:……………………………………………………………………………………………
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**Question 4:**

I. A marble with 50g mass

II. A tray with 1000g mass

III. A square shaped bell jar with 100g mass

If we put the above substances into water, which one of the following is absolutely true about floating and sinking situations of these substances in the water?

a) Tray with 1000g mass sinks.

b) Square shaped bell jar with 100g mass floats.

c) Marble with 50g mass floats.

d) Nothing can be said about floating and sinking situation of substances in water.*

**Because:**…………………………………………………………………………………………

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**Question 5:** When a student put an egg into water, it sinks. What the student should do for the egg to float in the water?

a) He should add water into the container.

b) He should solve a very big amount of salt in water.*

c) He should add olive oil into the water.

d) He should vaporize somewhat water.

**Because:**…………………………………………………………………………………………

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**Question 6:** In the figure, objects numbered 1, 2, 3 & 4 are in a balance in water. Accordingly which statements given below are correct?

**I.** Just the object numbered 4 is floating in water.

**II**. Objects numbered 1, 2, & 3 are sinking in water.

**III**. Objects numbered 2, 3 & 4 are floating in water.

a) Only **I** b) **I** and **II** c) Only **III***d**) I, II** and **III**

**Because:**……………………………………………………………………………………………
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**Question 7:** A boy in different situations;

In case **I**, he is standing on of his leg;

In case **II**, he is standing on two of his legs;

In case **III**, he is sitting.

Which one of the following is true about the pressure exerted by the boy on the ground?

a) He applies more pressure to the ground when he is standing on one leg.*

b) He applies more pressure to the ground when he is standing on his two legs.

c) He applies more pressure to the ground when he is sitting.

d) Pressure that he applies to the ground in all three cases is equal.

**Because:**……………………………………………………………………………………………
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**Question 8:**

I- Exploration of the flying balloon after some time rising in atmosphere

II- A woodpecker blowing an inflated balloon with its beak

III- Crimpling of a balloon attached to the bottom of an empty pool by adding water on it

Which one or ones of the situations given above occur with effect of the pressure?

a) Only I b) I & II c) Only III d) I, II & III*

**Because:**.................................................................................................

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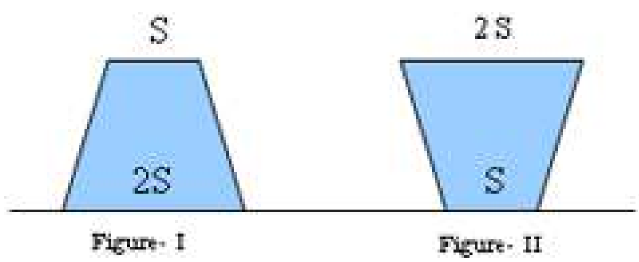
**Question 9:** Two closed boxes filled with water in the figure below. Which one or ones of the following are true for both of the figures?




a) Pressure both boxes applied to the ground are equal.

b) Weight of the water applied to the bottom of the boxes increased.

c) Liquid pressures of the water applied to the bottom of the boxes are equal.*

d) Compressive force that the box applied to the ground in figure 1 is bigger.

**Because:**.................................................................................................

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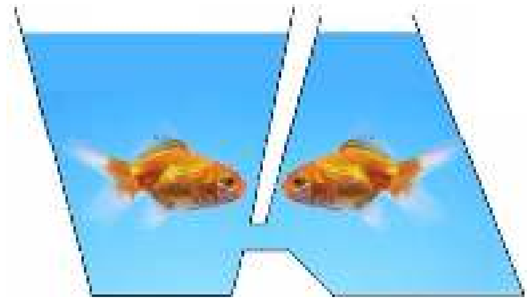
**Question 10:** There are two fishes at the same depth in different places in the aquarium in the figure below. Which of the statements said about the effect of liquid pressure on fish is true?



a) Liquid pressure effect on fish in both sides is equal.*
b) Liquid pressure affects more on the fish in the first side.
c) Liquid pressure affects more on the fish in the second side.
d) Nothing can be said about the liquid pressure effect on fishes.

**Because:**……………………………………………………………………………………………
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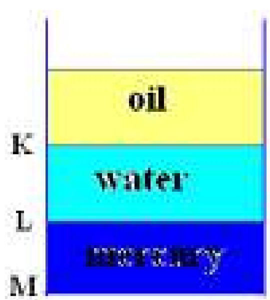
**Question 11:** Different liquids are found at the same height in the figure below. Accordingly, which of the following is correct sequence of the liquid pressure in points K, L & M such as $P_K$, $P_L$ & $P_M$ ($d_{water}$= 1g/cm$^3$; $d_{mercury}$= 13.6g/cm$^3$; $d_{oil}$= 0.8g/cm$^3$)




a) $P_K=P_L=P_M$
b) $P_L>P_M>P_K$
c) $P_K>P_L>P_M$
d) $P_M>P_L>P_K$*

**Because:**……………………………………………………………………………………

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**Question 12:** Which one or ones of the following pictures having gas pressure?
(Flying bird, flying bear, and standing cat are all in the same place)


a) I & II b) IV & V c) I, II, IV & V d) I, II, III, IV & V*

**Because:**……………………………………………………………………………………

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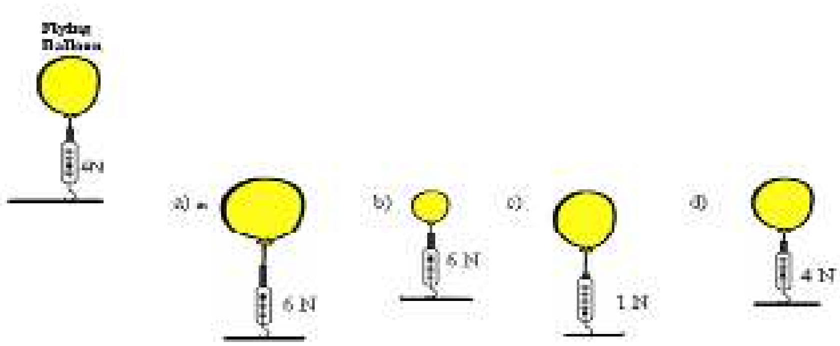
**Question 13:** When Abi tied the flying balloon to the ground at home with the dynamometer, dynamometer distended like in the figure. Abi measured the tension as 4N. If Abi tied his flying balloon to the mountain, which one of the above does he measure in the dynamometer?




**Because:**……………………………………………………………………………………

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**Question 14:** Which conclusion does a student could not reach who is observing the progress of a balloon flying upwards?

a) Increase in the total mass of the balloon*

b) Increase in the volume of the balloon and the balloon become inflated

c) Increase of the buoyancy force of the air applied to the balloon

d) Decrease of the density of the balloon

**Because:**……………………………………………………………………………………………

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**Question 15:** Which of the following reason stated is different from the others?

a) While a player has his leg back to hit the ball, having cramp in his leg*

b) Blockage of the ear during the trip to the plateau

c) One’s nose bleeding during the journey with a flying balloon in the atmosphere

d) Occlusion of person’s ear when he/she went closer to seaside from the plateau

**Because:**……………………………………………………………………………………………

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**Question 16:** Which of the following choices could be applied for increasing of solid pressure?

a) The tank wheels are made with large surfaces.

b) The number of wheels of the train is very much.

c) The edges of the ships are made sharp*

d) To make the furniture and feet of the armchairs larger.

**Because:**……………………………………………………………………………………………

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**It represents the correct answer of the question*

## 3.3 Data analysis

The classification of categories set in Table 3.2 is used to analyze the data obtained from the test questions. The scoring of the text was achieved by the evaluation of the data in both the first and second.

**Table3.2 : The criteria for the classification of students' responses in the test questions.**

| Level of understanding | Criteria for the classification of students response | Criteria for analyzing the two-tier test items | Categories Marks |
|---|---|---|---|
| Sound understanding | Responses that include all components of the scientifically accepted ideas | True response-True reason (T-T) | 3 |
| Partial Understanding | Responses that include at least one of the components of the acceptable ideas and that show understanding of concepts but that may also contain a kind of misconception | True response-No reason (T-N)/False response-True reason (F-T) | 2 |
| Specific misconception | Responses that include descriptive, incorrect or illogical information | True response-False reason (T-F) | 1 |
| No understanding | Repeats a part of, or full questions; irrelevant or uncodableresponses. "I don't understand" | False response-False reason (F-F)/False response-No reason (F-N) | 0 |
| No response | No answer; "I don't know", "I have no idea" | No response-No reason (N-N) | 0 |

For two-tier test items, since each question and reason had one correct answer and the others contain alternative conceptions, students' responses also were analyzed in order to define their conceptions based on pre-test and post-test.

The one-way ANCOVA statistical method was selected for the split-plot design measurements before and after the experiment in the two different treatment groups (context-based learning and traditional learning). ANCOVA is used to test the main and interaction effects of the factors, while controlling for the effects of the covariate(s).

# CHAPTER FOUR

## 4.1 Results of Research

**Table 4.1: Descriptive statistics for the conceptual achievement scores on the pre-test, by groups.**

| Group | n | M | SD |
|---|---|---|---|
| Traditional-Learning Group (TLG) | 30 | 8.92 | 7.4 |
| Context-Based-Group Learning (CBLG) | 30 | 9.33 | 7.8 |

Note, M=Mean; SD=Standard Deviation

As can be seen in the table, the mean scores of the groups on the pre-test have little difference. The difference between the students' pre-test mean scores was very small and it is not that much significant difference between them.

**Table 4.2 : Descriptive statistics of post-test scores by groups.**

| Group | n | M | $M_a$ | SD |
|---|---|---|---|---|
| TLG | 30 | 28.63 | 28.89 | 1.65 |
| CBLG | 30 | 34.60 | 34.60 | 1.60 |

Note, $M_a$=Adjusted Mean; SD=Standard Deviation

Table 4.2 shows that the descriptive statistics of post-test scores with respect to the groups as a result the Bonferroni Test were reviewed to understand which group was the source of the difference. In terms of the adjusted post-test scores, in the Bonferroni Test, the adjusted post-test mean scores of the Context-Based Group Learning ($M_a$=34.60) were significantly higher than the Traditional Learning Group ($M_a$=28.89).

It was found that the context-based instruction is increased the level of academic achievements of the students. Pre-test and post-test scores have a significant difference. Daily life context in materials about the topic of "pressure and buoyancy" based on the context-based approach have a positive effect on the students' achievement. For this reason, these contexts remind easily concepts.

Two open- ended questions, categories and students numbers are in below:

1) How did the new method implemented in physics subject affect your learning? Explain your answer.
    - raising retention of learning – 6 students
    - making learning and understanding easy – 7 students
    - making the physics subject interesting – 3 students
    - active participation to lesson – 5 students
2) Did the content "physics and buoyancy" make contribution to you?
    - no contribution 2- students
    - it only helped me to score good result in the examination – 12 students
    - it contributed to obtain information about the topics – 4 students
    - it helped me to know the application of the concept – 6 students

The purpose of this study was to investigate the effects of context-based approaches in students' achievement on pressure and buoyancy. After the context-based instruction method is applied significant changes occurred in students' achievement. This result shows that students' knowledge about pressure and buoyancy increased by context-based approach in post test.

### 4.2 Discussion

At the end of the research, it was found that in the test results according to adjusted post-test mean scores indicate that, the conceptual achievement scores of the context-based learning groups' were higher than the traditional learning group. This outcome shows that the use of context-based approach is more effective than traditional approach. In the results of studies show that teaching according to the context-based learning approach has a positive effect on conceptual understanding and the method is also successful in eliminating the misconceptions the students' learning problem.

From the conclusion drawn from the problem of the research, it was seen that teaching based on the context-based learning approach is more effective on conceptual achievement than traditional approach. The result stresses the effectiveness of context-based learning on student achievement has stated that the reason context-based teaching is superior to traditional approach is that students are motivated to work in the context-based learning environment.

The reason why the scores of context-based approach were higher than traditional approach could be that students were involved in activities that helped them activate their prior knowledge and struggle with their misconceptions. These activities also provide evidence that students' initial conceptions are insufficient. The important part of this approach (context-based) was the intensive teacher-student interaction. Such a student centered environment provides opportunities for greater involvement, thereby giving students more chance to gain insights and self-efficacy, and students are allowed to focus on learning and understanding. Therefore, the scores of this group could have been higher than traditional learning group.

## 4.3 Conclusions and Recommendations

### 4.3.1 Conclusion

The purpose of this study was to investigate the effectiveness of context-based approaches in students' achievement pressure and buoyancy concepts. The final result showed that students' knowledge about pressure and buoyancy increased by context-based approaches in post-test. Physics in contexts are connected with daily life of students' and facilitated physics learning for students. Furthermore, team work and discussions provide to structure knowledge correctly.

### 4.3.2 Recommendations

As a result of these findings, it may be advised to use of context materials in physics lesson. Because increasing understanding for learning physics is the reason for using this approach, appropriate contexts for students should be selected. Physics should be presented to the students not only as a body of knowledge, but also its influence on the students' personal life and the society in which he/she lives.

Teachers preparing their lesson contents to associate their knowledge with everyday students' life and include context-based learning approaches. In order to use context-based approaches in schools, teachers should prepare lots of context lessons and educational materials which can assist with performing activities based on context-based instruction. Schools also should be supported with kind of experiment materials and lesson equipments.

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