



THE EFFECTIVENESS OF CONCEPTUAL CHANGE TEXTS AND CONTEXT-BASED LEARNING ON STUDENTS' CONCEPTUAL ACHIEVEMENT

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Introduction

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 mislearning information that leads them away from scientific fact and 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 (McDermott, 1991; Khan & Ahmad, 2014).

The focus of this research is to explore the effectiveness on conceptual understanding of innovative approaches as an alternative to traditional approach, specifically with respect to conceptual change and context-based learning.

Concepts are very important in physics. Students' daily lives and experiences, their systems of belief and learning environments, their efforts to grasp concepts using their as yet immature mental skills and other factors, conflict with the nature of science itself as well as with the process of how scientific knowledge emerges. In this process, students may attach incorrect meanings to a scientific fact. Misconceptions obstruct the assimilation of acquired knowledge (Erçan et al., 2010). To eliminate misconceptions and achieve meaningful learning, the accuracy of existing knowledge must be reviewed and misinformation must be changed in order to pave the way for new knowledge. This is called the conceptual change process (Smith et al., 1993).

The Conceptual Change Approach developed by Posner et al., (1982) is based on four conditions: (1) Dissatisfaction: The student must be dissatisfied with the concept he knows; that is, he must realize that it is inadequate, (2) Intelligibility: The new concept must be understandable enough for the student, (3) Plausibility: The student must find the new view/concept logical

Abstract. *The topic of pressure and buoyancy is one that encompasses both invisible and abstract conceptions and about which students have misconceptions. The purpose of this research was to research the effectiveness of three different methods of teaching physics (conceptual change-based, real life context-based and traditional learning on upper-secondary physics students in the 11th grade in terms of conceptual achievement about the pressure and buoyancy topics. In this research, pre-test/post-test quasi-experimental design with non-equivalent control group, involving a 3 (group) × 2 (time) factorial design was used. Experimental 1 Group was given the conceptual change texts on the mentioned subjects, the Experimental 2 Group was offered a learning approach based on real life context-based learning, whereas the control group was given the traditional learning. Data for the research were collected with the "Pressure Conceptual Test". When the results of the research were examined, it was found that the conceptual change text group's conceptual understanding scores were significantly higher than those of the context-based learning group and the traditional learning group. The context-based learning group's conceptual understanding scores were significantly higher than those of the traditional learning group.*

Key words: *conceptual change texts, conceptual achievement, real life context-based learning.*

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and be able to picture it in his/her mind and (4) Fruitfulness: The new notion/concept must be efficient; in other words, the student must be able to solve similar problems with this new concept.

Many studies have been conducted to examine the effectiveness of the conceptual change approach in terms of teaching students to understand concepts (e.g. Chambers & Andre 1997; Hynd et al., 1997; Hynd, 2001; Duit & Treagust, 2003; Ayvaci, 2013; Sendur & Toprak, 2013). These studies have led to the conclusion that a conceptual change approach is in fact effective in eliminating students' misconceptions.

This research has concentrated on the conceptual change approach of conceptual change texts and using these in the teaching environment. Texts that are used to introduce theories that will convince students that they have misconceptions about certain scientific facts for the purpose of making these misconceptions conform to scientific concepts are called "conceptual change texts" (Hynd, 2001). According to Guzzetti et al., (1997), conceptual change texts are texts that enlighten students about alternative concepts and the reasons behind them, explaining at the same time, with examples, that their misconceptions are inadequate.

Studies on the use of conceptual change texts in physics show that these types of texts have a positive impact on students' understanding of concepts when they are used as teaching materials in the classroom (e.g., Chambers & Andre, 1997; Diakidoy et al., 2003; Özkan & Sezgin Selçuk, 2013).

Another approach that has been introduced as an alternative to traditional learning in recent years has been context-based learning (Taasoobshirazi & Carr, 2008). This approach, whose theoretical framework is based on constructivist learning theory, is student-centred. 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.

A few works of research 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 and 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 for more and better designed studies.

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 misconceptions (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 & Heywood, 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 a liquid" and "there is no such thing as atmospheric pressure."

Furthermore, it can be seen that these studies are more concentrated on the lower-secondary level and there has been no research on topics of pressure on the upper-secondary school level. It is for this reason that this research has found a need to approach the subject of pressure as a part of the upper-secondary school level physics course.

Purpose of Research

There has been no research encountered in the literature that examines and compares the effectiveness of context-based teaching on the conceptual learning. Although the use of conceptual change texts in science education (one of the strategies of the conceptual change approach) is very popular (e.g. Tsai, 1999; Palmer, 2003; Coştu et al., 2007), its use in physics education (Hynd et al., 1994; Chambers & Andre, 1997; Guzzetti et al., 1997; Hynd et al., 1997; Diakidoy et al., 2003) has as yet not been adequately reviewed. In particular, there has been no research encountered about the effect of this learning style on the permanence of conceptual learning.



Furthermore, it can be seen that in the literature is more focused on the elementary school level and there has been no research on topics of pressure on the upper-secondary school level.

This research took as its starting point these deficiencies and was conducted to research and compare the effectiveness of three different approaches of teaching physics (conceptual change-based, context-based and traditional learning) on upper-secondary school physics 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 are significant differences among the effects of conceptual change text, context-based learning and traditional learning approach on students' understanding of pressure and buoyancy when pressure and buoyancy concepts pre-test scores are controlled as covariates.

Methodology of Research

Research Design

This research used the pre-test/post-test quasi-experimental design with a non-equivalent control group, involving a 3 (group) \times 2 (time) factorial design. The research was carried out with three groups-two experimental groups and one control group. In the Experimental 1 Group, the Conceptual Change Text Group - CCTG, the physics topics to be taught were introduced by using conceptual change texts; Experimental Group 2, the Context-based Learning Group - CBLG were taught the same topics in the manner recommended by the Turkish Ministry of National Education (2007), implementing the context-based learning approach to the activities and examples in the Physics 11 textbook. In the control group (Traditional Learning Group - TLG, the topics were taught using traditional teaching methods (plain narrative, questions and answers).

The research was conducted in the fall semester of the 2012-2013 academic year and involved the unit of "Matter and its Properties" in the 11th grade physics course. The duration of the research was a total of seven weeks. In all three 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.

Research Group

The research was conducted in three different 11th grade physics classes in an Anatolian High School located in the province of Izmir, Turkey. The three 11th grade classes of the school where the research took place were grouped into experimental and control groups without prejudice. Gender distribution in the groups is shown in Table 1.

Table 1. Distribution of students by gender and group.

Gender	CCTG	TLG	CBLG	Total
Female	16	15	8	39
Male	14	15	22	51
Total	30	30	30	90

Dependent Measure Instrument

Pressure Conceptual Text (PCT)

The two-tier Pressure Conceptual Text (PCT) that was prepared on the subjects of pressure and buoyancy was developed to measure their conceptual achievement. Treagust and Chandrasegaran (2007) have stated that students' conceptions of topics 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 Turkish Ministry of Education (2007) for the High School 11th grade physics instruction program. The first



version of the test prepared by the researchers consisted of 30 five-choice (one right answer and four distractors) test items and a justification section. To test the content and face validity, the test was reviewed by three physics teachers from two different upper-secondary schools (with more than 10 years of experience) and three faculty members specialized in physics education. In line with the opinions of the specialists, a sixth choice of "Other (state, if any)" was added to the two-tier test that was developed. There was only one right answer to each question on the test. Also, before testing for validity and reliability, a pilot run was implemented with 50 students to see whether there was anything the students could not understand.

The 30-item test was tested for reliability in the spring semester of the 2011-2012 academic year in İzmir, Turkey, at two Anatolian high school 11th grade classes, encompassing a total of 169 students. The analysis of the two-tier Pressure Conceptual Text was completed in two phases. The assessment criteria used in the analysis of the test are described in detail in the data analysis section.

As part of the reliability research for the PCT, the instrument's Cronbach Alpha coefficient was calculated to define internal consistency. The reliability coefficient for the entire test is 0.79. At the end of the calculations, the number of items on the test was brought down to 19. The score range possible on the two-tier test is 0 - 57.

The question below is an example from the PCT (Table 2):

Table 2. Example of a test item on the two-tier PCT.

Q.1. Which answer or answers refer to the reason you need wide-soled shoes in order to be able to walk without falling on the ground covered with snow?
I. To use the wide sole to reduce friction.
II. To reduce the pressure as a result of a widened surface.
III. To stop from sinking by reducing the weight carried.
A. I only
B. II only
C. I and II
D. II and III
E. I, II and III
F. Other.....
Please explain the reason for your answer
.....
.....

Intervention Instruments

Conceptual Change Texts (CCTs)

The conceptual change texts, which were developed by the researcher, were devised to suit the 11th grade level and the curriculum. Texts were developed according to the conceptual change approach introduced by Posner et al. (1982) that is based on the conditions of dissatisfaction, intelligibility, plausibility and fruitfulness.

After the texts were prepared, two physics instructors with more than 10 years of professional experience and two faculty members specialized in physics education were enlisted to offer their views. In line with the opinions of the specialists, it was established that the prepared texts were appropriate to the academic level of the students and their knowledge. A pilot research was then launched.

Physics 11 Textbook

The 11th 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 centre 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 in a way that complied with the activities recommended by the Turkish Ministry of National Education (2007). 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 equipment used in these activities are easily found and usable. In the Experimental 2 group in the research (CBLG), each activity was 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 control group, the researchers allowed the students in class only to benefit from the theoretical narratives in the textbook on the physics topics being taught.

Procedure

The research was conducted in the fall semester of the 2012-2013 academic year and involved the unit of "Matter and its Properties" in the 11th grade physics course. The duration of the research was a total of seven weeks. In all three 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 pretesting. The same researcher (the first researcher), a teacher that was experienced in upper-secondary school physics, taught both of the groups. 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 three groups.

Treatment in the conceptual change group

Once the worksheets were distributed, the students were told that they were to follow the instructions on the sheets. After each student received a sheet, a volunteer was called upon to read the text out loud. The objective of this was to encourage the participation of the students in the class. The researcher acted as a guide throughout the process and, instead of correcting the students' mistakes, led the students to finding the right answers by themselves.

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 Textbook. All of the questions for discussions 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 discussions 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.

Data Analysis

The classification of categories set forth by Coştu and Ayas (2005) in Table 3 were used to analyse the data obtained from the Pressure Conceptual Text. The scoring of the text was achieved by the evaluation of the data in both the first and second tiers.



Table 3. The criteria for the classification of students' responses in the test question.

Level of understanding	Criteria for the classification of student response	Criteria for analysing 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 question; irrelevant or uncodable responses. '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 analysed 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 three different treatment groups (conceptual change text, 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). ANCOVA has four assumptions: Normality, equality of variances, homogeneity of slopes, and dependency of scores on the dependent variable. In a Single Factor Analysis of Covariance (ANCOVA), while determining the effectiveness of experimental method, if pre-tests scores of both groups (experimental and control groups) are not equal to each other, pre test scores are controlled as covariate. If there is a significant difference between groups, Bonferroni post hoc test is applied to see the source of the difference (Büyükoztürk, 2010).

Results of Research

To resolve the problem of the research, a Single Factor Analysis of Covariance (ANCOVA) model of statistics was chosen for the split-plot design encompassing the pre- and post-experiment measurements. The results obtained from the application of the Pressure Conceptual Text as a pre-test are given in Table 4.

Table 4. Descriptive statistics for the conceptual achievement scores on the pre-test, by groups.

Group	n	M	SD
Conceptual Change Text Group (CCTG)	30	11.87	6.08
Traditional Learning Group (TLG)	30	6.83	1.86
Context-Based Learning Group (CBLG)	30	9.33	7.80

Note. M = Mean; SD = Standard Deviation

As can be seen in the table, the mean scores of the groups on the pre-test are all different. To determine whether the difference between the students' pre-test mean scores was significant, the one-way analysis of variance (ANOVA) was used.



Table 5. Results of the ANOVA for the pre-test scores of the groups.

Source of Variance	Sum of Squares	df	Mean Square	F	p
Between groups	380.022	2	190.011	5.634	0.05
Within groups	2934.300	87	33.728		
Total	3314.322	89			

The results of the analysis showed that there were significant differences between the achievement scores of the groups on the pre-test ($F_{(2,87)}=5.634, p<0.05$). To reveal the source of the differences, Tamhane's T2 test was selected from among the post-hoc tests (tests used when group variances are unequal). It was determined from the result of Tamhane's T2 Test that the conceptual achievement mean scores on the pre-test of the Conceptual Change Text Group were significantly higher than the mean scores of the Traditional Learning Group.

In the covariance analysis performed, the post-test scores on the Pressure Conceptual Text was the dependent variable, the pre-test scores the control variable and the particular treatment (group) was used as an independent variable. All of ANCOVA's assumptions were tested. Since all of ANCOVA's assumptions were proved, the ANCOVA was used to test whether the groups' post-test scores, adjusted according to the pre-test scores, showed any significant differences. The analysis results are shown in Table 6.

Table 6. ANCOVA results for post-test achievement scores adjusted according to pre-test achievement by group.

Source of Variance	Sum of Squares	df	Mean Square	F	p	η_p^2
Pre-test	31.240	1	31.240	0.406	.526	.005
Group	3386.399	2	1693.199	21.984	.000	.338
Error	6623.627	86	77.019			
Corrected Total	127646.00	90				

According to the ANCOVA results, no significant difference was found between the post-test scores of the groups adjusted according to the pre-test scores [$F_{(2,86)}=21.984, p<.05$]. It was thus seen that there was an association between the conceptual achievement of the students and the teaching method that had been applied.

To determine the effect size of applied learning approach on the significant difference between experimental and control groups' conceptual achievement scores, partial eta squared (η_p^2) value was examined. The value changes between 0 and 1. It is acceptable that the scores around .01 is low, .06 is medium and .14 is high impact (Büyüköztürk, 2010: 44). The partial eta-squared value found in this research ($\eta_p^2=.338$) indicates that the teaching method used had a significant effect on the mean PCT scores of the research and control groups.

Due to the fact that there are more than two groups, Bonferonni test, which is a kind of post hoc tests, was used for adjusted post-test means. Table 7 shows that the descriptive statistics of post-test scores with respect to the groups and Table 8 indicates that Bonferonni test results according to the adjusted post test scores.

Table 7. Descriptive statistics of post-test scores by groups.

Group	n	M	M_a	SD
CCTG	30	44.90	44.64	1.65
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 8: Bonferroni Test results according to adjusted post-test scores.

(I) Group	(J) Group	M_a (I-J)	SD	p
CCTG	TLG	15.75*	2.41	.000
	CBLG	10.04*	2.30	.000
TLG	CCTG	-15.75*	2.41	.000
	CBLG	-5.71*	2.30	.015
CBLG	CCTG	-10.04*	2.30	.000
	TLG	5.71*	2.30	.015

Note. * $p \leq (.05/3)$

The results of the Bonferroni test were reviewed to understand which groups 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 Conceptual Change Text Group ($M_a=44.64$) were significantly higher than those of both the Context-Based Learning Group ($M_a=34.60$) and the Traditional Learning Group ($M_a=28.89$). By the same token, the post-test scores of the Context-Based Learning Group were significantly higher than the scores of the Traditional Learning Group.

Discussion

At the end of the research, it was found that in all three groups, the students' conceptual achievement scores increased from the pre-test to the post-test. The increase in the students' scores from the pre-test to the post-test was an expected outcome of the research. All three groups experienced the application of a particular teaching method. The increases in scores from prior to the instruction to after the instruction were statistically significant for all three groups. The partial eta-squared value found in this research indicates that the teaching method used had a significant effect on the mean PCT scores of the experimental and control groups. Bonferroni test results according to adjusted post-test mean scores indicate that, the conceptual achievement scores of the Conceptual Change Text Group were higher than those of the Context-Based Learning and Traditional Learning Groups. The conceptual achievement scores of the Context-Based Learning Group were higher than those of the Traditional Learning Group. This outcome shows that the use of conceptual change texts in teaching concepts related to the topic at hand is a more effective approach than traditional and context-based approach. Similarly, it can also be seen that the context-based learning approach is more effective than traditional approach.

When the literature was reviewed, studies were encountered in which it was reported that the use of conceptual change texts had effectiveness on the learning of concepts (e.g., Chambers & Andre, 1997; Guzzetti, 2000; Diakidoy et al., 2003; Coştu et al., 2007).

When the effect of the conceptual change approach on conceptual change is compared with traditional learning methods, it has been found in many studies that this approach has more of a positive effectiveness (e.g., Coştu et al., 2007; Chambers & Andre, 1997; Duit & Treagust, 2003; Şendur & Toprak, 2013).

In the literature, 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 have (e.g. Bennett et al., 2007; Değirmencioğlu, 2008; Kistak, 2014).

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 literature stresses the effectiveness of context-based learning on student achievement (e.g. Wilkinson, 1997; Campbell & Lubben, 2000; Glynn & Koballa, 2005; Murphy & Whitelegg, 2006). Wilkinson (1997) has stated that the reason context-based teaching is superior to traditional approach is that students are more motivated to work in the context-based learning environment. When compared with the traditional learning environment, it may be said that students participate more actively in the activities presented to them in the context-based learning atmosphere and therefore their conceptual learning is positively affected.

The reason why the scores of conceptual change approach and context based learning 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 in these approaches (conceptual change and context based) was the intensive teacher-student interaction. Such a student centred environment provides opportunities for greater involvement, thereby giving students more chances to gain insights and self-efficacy, and students are allowed to focus on learning and understanding (Balci, Cakiroglu & Tekkaya, 2006).

It can be said that the researcher observed that context based learning group had more motivation and interest in the activities. Similarly, Glynn & Koballa (2005) reported that when compared to traditional instruction, context-based instruction is more effective in improving the motivation of students. This approach may have helped to understand physics irrelevant to everyday life. Therefore, the scores of this group could have been higher than traditional learning group.

The reason why conceptual change approach scores were higher than context based learning approach could be that in the conceptual change approach, students became dissatisfied with their existing conceptions. They could have accepted the new concept in an easier way when they experienced dissatisfaction about their existing concept. Moreover, in the conceptual change approach, students can use what they learn from the texts in new situations they face, which is different from context based approach. This could have led students understand the concepts meaningfully. This way, the scores of the groups could have been higher.

Conclusions and Implications

When the results of the research were examined, significant differences were discovered among the three groups in terms of their conceptual achievement according to ANCOVA and post-hoc test results. The conceptual change group's conceptual achievement scores were significantly higher than those of the context-based learning group and the traditional learning group. The context-based learning group's conceptual achievement scores were significantly higher than those of the traditional learning group. It was found that both conceptual change approach and context based learning approach are much more effective than traditional learning approach. Furthermore, the former one is the most effective than the others.

Based on the findings of this research, it might be recommended that before starting to teach any subject, it should first be determined whether students have preconceptions or misconceptions about the subject and teaching activities should proceed on the basis of this information (to eliminate existing misconceptions). In the light of these results, the use of conceptual change texts in teaching may be used as an alternative teaching method.

The conceptual change texts prepared in this research on the subjects of pressure and buoyancy and the context-based learning approach activities were developed in line with the 11th grade syllabus on matter and its properties. In this context, the results obtained are limited to the mentioned topics in one particular unit. Conceptual change texts and the context-based learning approach may be attempted at various academic levels and on different subjects in science/physics education to examine the effect on the same variables. The effects of conceptual change and context-based learning approaches on learning should be researched at length.

The following recommendations can be made with regard to the teaching materials: researchers should comply with the four conditions (dissatisfaction, intelligibility, plausibility and fruitfulness) as it applied in this study, in order to make these conceptual change texts effective teaching tools. In addition, considering that there may be some students in class who have difficulty in understanding what they read, the use of the material should definitely accompany classroom discussions.

In this study, the ready activities supporting context based learning in the text book of The Ministry of National Education were utilized while context based learning approach was being implemented. In the future studies, the new activities including cheap instruments, taking attention to students and encouraging student based learning can be improved. Improving activities in other subjects of physics and science would contribute to the field.

If it is considered that the educational system today is transitioning from traditional teaching to contemporary teaching methods, more room should be made for these modern methods in the organization of teaching and education efforts. In this context, teachers should give up their accustomed traditional teaching techniques and lean towards teaching activities that are based on these new methods.

In future studies, the same learning approach effectiveness on different learning outputs (attitude towards the course, learning motivation and learning retention etc.) can be examined.

The results of this research provided further evidence to support the findings in a growing body of literature indicating that students hold alternative conceptions on a variety of pressure and buoyancy concepts. Teachers should be informed about the usage and importance of conceptual change texts and context based learning



environments, and they can plan the instructional activities accordingly. In short, when favourable strategies are used, it is highly probable that these cause a significantly better acquisition of scientific conception.

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