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Is case-based instruction effective in enhancing high school students' motivation toward chemistry?

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Abstract

The aim of this study was to investigate the effectiveness of case-based learning (CBL) over traditionally designed chemistry instruction (TDCI) on 10th grade students' perceived motivation about chemistry as a school subject. Two classes were randomly selected from a high school. One class was assigned to be an experimental group and the other was assigned as a control group. A total of 45 high school students from 10th grade were the participants of the study (25 experimental and 20 control group students). Students in the experimental group were taught by case-based instruction while the control group students received traditional instruction. Motivated Strategies for Learning Questionnaire (MSLQ) was administered to both groups of students as pre- and post-tests to measure their perceived motivation. The results of one-way MANOVA based on gain scores revealed that CBL was an effective method for promoting students' motivation towards chemistry.

Keywords: Case-Based Learning, Motivation, MSLQ

Introduction

Consideration of students' motivational beliefs is important in education. Students engage in tasks due to reasons such as intrinsic interest or enjoyment and task value or utility. These reasons might enhance students' perceived motivation. When students, who are intrinsically motivated, are involved in a presented task, they work harder to overcome the difficulties that they encounter. Enhancement in motivation leads to an increase in attainment of students; therefore, achievement can be thought of as an indirect index of motivation (Pintrich & Schunk, 2002).

Case-based learning provides an environment to enhance students' interest and enjoyment toward learning (Mayo, 2002; Mayo, 2004; Naumes & Naumes, 2006; Wassermann, 1994). The case method of teaching develops students' critical thinking, problem-solving abilities, oral and written communication, and professional decision-making skills offering them practice with real life situations (Jones, 2003). Case-based instruction is also useful for promoting students' attitudes toward chemistry (Çam & Geban, 2011). Cases have a positive influence on students' learning and participation as well as improving their conceptual understanding and motivation (Dori & Herscovitz, 1999; Yadav, Jundeberg, DeSchryver, Dirkin, Schiller, Maier, & Herreid, 2008). This method facilitates social construction of knowledge in a relevant and motivating framework. Thus, case-method of instruction can be a useful teaching strategy for improving students' perceived motivation, yet the existing literature reports only a few empirical researches substantiating the effectiveness of case-based learning on students' perceived motivation.

Although case-based learning is a commonly used teaching method in medical sciences, law and business schools, they have been rarely used in secondary science teaching. In this study, case-based learning with small group format was used and the main purpose was to enhance students' motivation toward chemistry by taking the advantage of daily life nature of case method. Depending on the related literature, we believe that the daily life events or situations would attract students' interest and curiosity to the instructional tasks. Furthermore, in an active learning environment students would find a chance to share and discuss their ideas with friends under teacher guidance. Group work would provide students to recognize the inadequacies of their conceptions, and help to gain different points of view towards the events as well. Chemistry is full of abstract concepts and sometimes these concepts are not easy to learn. In the process of learning, students' interest to learn chemistry may be reduced or even completely lost. In this study, cases generally associated with daily life situations would be used in order to make the concepts more concrete and understandable. There are some studies showing that this method increases students' interest and attitude towards the course but we expect that this study would provide evidence that case-based instruction can also be useful for enhancing students' motivation.

Literature Review

Cases are the educational materials including information and data such as psychological, sociological, scientific, anthropological, historical, observational, and technical material. Though they are based on a particular subject area such as history, law, business, education, they are interdisciplinary by their nature. Cases can vary from a paragraph or two to a dozen pages, but long cases are suggested to be distributed and read before the class to prevent students from becoming confused and lost in the details. In some cases, learners can create their own cases, but newspapers, magazines, journals, personal experiences or experiences of others can contribute to the content for cases (Tomey, 2003).

Cases are composed of two main parts: (1) the case situation for the study and (2) the questions related to the case situation. Cases might be developed first and then the questions can be asked, or questions might be asked before and then cases are developed in order to answer these questions. At the end of each case, some study questions related to cases help students to evaluate the outcomes, concepts, and subjects of the case. The purpose of the study questions is to direct students to facilitate their understanding, rather than simply asking for the names, dates, or labels in analyzing the data and suggesting solutions. The study questions followed by the cases facilitate class discussion. Learners solve the presented problem using their background knowledge (DeYoung, 2003). Learners usually read the given case, analyze, and identify the problems of the real or hypothetical situation and then they take part in a group discussion. Case-based teaching provides opportunities for students to study in small groups and discuss their responses related to given cases and study questions (Wassermann, 1994). According to Bennett (2010), case analysis task increases learners' awareness and discussion and reflection have important roles in developing their comprehension.

Attitude and motivation are the important constructs of the affective domain that have an effect on students' science learning and achievement. They are often regarded as the predictors of students‟ decisions about science (e.g., attending class, reading textbook assignments, and completing homework). Pintrich, Marx, and Boyle (1993) expressed attitudinal and motivational constructs as moderators of conceptual change. Another view is that "affective dimension is not just a simple catalyst, but a necessary condition for the learning to occur" (Perrier & Nsengiyumva, 2003, p.1124). Moreover, Cavas (2011) reported the effect of students' motivational levels on their science achievement. It was found that students with highest motivation level had the highest science achievement scores. This finding is also supported by Sevinç, Özmen and Yiğit (2011)'s study indicated that students with high academic success were also found to have a high motivation level. Despite the fact that affective dimensions have been regarded as important, researchers did not give more attention to these constructs than they did to the cognitive dimensions, though they are aware of the importance of these issues in science education. Though changes in students' attitudes and motivation about science appear difficult to achieve, change can be possible. Students' attitudes toward science and their motivation to learn science can be improved with effective science instruction. The research of Mamlok-Naaman (2011) with high school students indicated that students' interest in science may increase with the integration of historical and social views in science curriculum. An additional conclusion was that students' familiarity with the concepts has positive influence on their motivation and success. In addition, hands-on science activities, laboratory work, field study, and inquiry-oriented lessons can be used to attain these goals (Koballa & Glynn, 2007). In the present study, the effectiveness of case-based instruction on promoting students' motivation was evaluated.

Motivation

Motivation is defined as the "process whereby goal-directed activity is instigated and sustained." (Pintrich & Schunk, 2002, p.5.). As understood from this definition, motivation is a process rather than a product. Therefore, motivation cannot be observed directly, but rather can be deduced from such behaviors as "choice of tasks, effort, persistence, and verbalizations (e.g., "I really want to work on this")" (Pintrich & Schunk, 2002, p.5.).

Recent developments in motivational literature suggest that motivational factors play an important role on students' learning and transfer of problem solving strategies (Bereby-Meyer & Kaplan, 2005). Results from Urdan and Schoenfelder's (2006) study indicated that specifying strong mastery goals in classrooms or schools improve students' motivation and behavior. Other research findings point to a positive and strong effect of motivation and attitude on academic time and achievement in mathematics and science (Singh, Granville & Dika, 2002). There are still other studies emphasizing the role of motivational beliefs on students' conceptual change process (Duit & Treagust, 1998; Lee, 1989; Lee & Brophy, 1996; Pintrich, Marx, & Boyle, 1993; Strike & Posner, 1992; West & Pines, 1983).

Educational researchers have revealed a number of motivational factors that include Intrinsic Goal Orientation, Extrinsic Goal Orientation, Task Value, Control of Learning Beliefs, Self-Efficacy for Learning, and Performance and Test Anxiety. Intrinsic goal orientation is a goal orientation toward an academic task, indicating that students' participation in the task is not as a means to an end such as a grade or reward but instead relates to challenge, curiosity, or mastery. Extrinsic Goal Orientation refers to the degree to which students perceive themselves to be taking part in a task for reasons such as grades, rewards, performance, evaluation by others, and competition. Task Value refers to students' assessment of the task about its usefulness, significance and interestingness. High task value encourages students to participate more in the learning issues. Control of Learning Beliefs refers to students' belief that their attempts to learn will get positive outcomes. These positive outcomes are dependent on an individual's own effort rather than external factors such as a teacher. If students feel that they can control their academic performance, they are more likely to make an effort to effect the desired changes. Self-efficacy for learning and performance includes two features of expectancy: expectancy for success and self-efficacy. Expectancy for success denotes performance expectations, and pertains specifically to task performance. Self-efficacy is an individual's assessment of his or her capability to both master a task and confidence in having the skills essential to carry out that task. Test anxiety is a sign of worry and concern stated by students regarding exams. Students' expectations and their academic performance are found adversely associated with each other. Test anxiety has two major components; (1) a worry or cognitive component and (2) an emotionality component. The worry component is about students' pessimistic ideas that disturb their performance. On the other hand, the emotionality component means the affective and physiological arousal features of anxiety (Pintrich et al., 1991).

Motivation and Case-Based Learning

The literature presents a few studies related to the relationship between case-based learning and motivation. Dori and Herscovitz (1999) stated that case-based learning enhances students' motivation by displaying the significance of issue about real life situations. In general, case-based learning increases students' interest and enjoyment toward learning (Mayo, 2002, 2004; Naumes & Naumes, 2006; Wassermann, 1994). Intrinsic interest or enjoyment and task value or usefulness are important reasons both for students being a part of the task and for enhancing their motivation. If students are interested and enjoy learning, it is more possible for students to be motivated and to be involved in learning a task (Pintrich & Schunk, 2002). Similarly, Rannikmäe, Teppo and Holbrook (2010) state that students' intrinsic motivation can be enhanced by making science lessons interesting and relevant for them.

Case-based instruction has been considered as an effective way of learning in psychology and education in terms of promoting critical thinking and connecting theoretical and applied knowledge. Students taught with case-based learning participate actively in classroom interaction, formulate solutions to real-world problems, and construct self-knowledge through integrating theoretical constructs with personal experiences. Mayo (2004) used case narratives based on the lives of real characters in order to make connections to real-life. Mayo's (2002) previous investigation indicated that students identified case-based instruction as realistic, challenging, interesting, enjoyable, creatively stimulating, and helpful toward learning. In addition, materials used in case-based instruction provide students with opportunities to experience real life situations (Mayo, 2002; Naumes & Naumes, 2006; Rybarczyk et al., 2007; Wassermann, 1994). Teachers also state that students are more engaged in learning when using cases (Yadav et al., 2008). Students take part actively in realistic problem situations and reflect their personal experiences through case-based learning. Hoskin (1998) supports case study as an effective means of learning by engaging learners, as a group, with real-world problems.

In brief, motivational beliefs are as important as the cognitive concepts in education. Literature findings indicated that students actively engage in case-based learning environments. They enjoy classes while learning and find the assigned tasks interesting, which are also related to components of motivation and an indicator of academic achievement. Therefore, it is important to uncover the effectiveness of this new teaching method on different subjects, grade levels and cognitive and motivational variables to have implications in classes. Consequently, the current study will provide empirical data on whether case-based learning increases students' perceived motivation toward chemistry as a school subject. The related research question is: What is the effect of case-based learning on tenth grade students' perceived motivation toward chemistry?

Methodology

Participants
Forty-five 10th grade students (22 boys and 23 girls) from an Anatolian high school in the capital city of Turkey participated in this study. Experimental and control groups instructed by the same chemistry teachers were randomly selected. While there were 25 students instructed by CBL in experimental group (14 female and 11 male students), there were 20 students instructed by TDCI in control group (9 female and 11 male students). The ages of participants were between 15 and 16. There are different high school types in Turkey, one of which is the Anatolian high schools. At the end of elementary education, students enter a nationwide multiple-choice exam and students are placed in high schools based on their scores. Students with lower exam scores are placed in public high schools, whereas students with higher scores compared to those in public schools are placed in Anatolian high schools. Though these schools follow the same National Curriculum and are mostly similar in terms of school facilities and the way content is taught, they differ in terms of student profile. For the present study, Anatolian high school was selected due to its convenient location and willingness of the chemistry teacher in that school. Therefore, convenience sampling was used for this reason.

Instrument

Motivated Strategies for Learning Questionnaire (MSLQ)
The MSLQ is a self-report questionnaire developed for a college course to evaluate the students' motivational orientations and their use of different learning strategies (Pintrich, Smith, Garcia, & McKeachie, 1991). The MSLQ is a 7-point Likert scale from "not at all true of me" to "very true of me," thereby measuring students' motivational and learning strategies constructs. Basically there are two main sections in MSLQ, a motivation section and a learning-strategies section. In the current study, only the motivation section of MSLQ was used to determine the change of students' perceived motivation for both experimental and control group students. In the motivation section, students' goals and value beliefs for a course, their beliefs about their skill to succeed, and their anxiety about tests in a course were evaluated by 31 items. The MSLQ contains six sub-headings: (1) intrinsic goal orientation, (2) extrinsic goal orientation, (3) task value, (4) control of learning beliefs, (5) self-efficacy for learning and performance, and (6) test anxiety.

The MSLQ was originally developed in English. A related confirmatory factor analysis for this questionnaire was conducted on a sample of 380 Midwestern college students. (356 from a public four-year university and 24 from a community college). Pintrich et al. (1991) conducted confirmatory factor analysis and calculated fit statistics for MSLQ in terms of $\eta2/df$, GFI, AGFI and RMR. Hayduk (1987) stated that if the $\eta2/df$ ratio is less than 5, it is considered to be indicative of good fit between the observed and reproduced correlation matrices. The confirmatory factor analysis for the English version resulted in a $\eta2/df = 3.49$. When the points of estimate of GFI and AGFI are greater than 0.9 and RMR is 0.05, it shows that the model fits the input data well. The values of GFI=0.77, AGFI=0.73 and RMR=0.07 indicate that they are not in acceptable limits. Alternatively, Pintrich et al. (1991) maintained these indices are tolerable since motivational attitudes may differ depending on course characteristics, teacher characteristics, and characteristics of individual student.

Sungur (2004) adapted and translated MSLQ into Turkish for a biology lesson. Sungur (2004) performed confirmatory factor analysis using LISREL with the participation of 319 tenth and

169 eleventh grade students. The fit statistics for the Turkish version was found as $\eta 2/df$ = 5.3, GFI = 0.77, and RMR = 0.11. Turkish version fit indices are tolerable compared to the English version ($\eta 2/df$ = 2.26; GFI = 0.78; and RMR = 0.08). On the other hand, it is important to mention that both the English and Turkish versions of the MSLQ do not show good fit for the motivation section.

Pintrich et al. (1991) stated that the parts of the MSLQ can be used separately or together according to the needs of the researcher(s). Thus, only the motivation section was used to measure students' motivation. In the current study, the Turkish version of MSLQ translated and adapted with minor changes by Sungur (2004) was used for the chemistry lesson in the current study. This questionnaire was piloted with 324 tenth, eleventh and twelfth grade science students (ages 15-17) at different schools in Ankara, which is the capital city of Turkey. The test was administered to the whole class at one time by emphasizing the purpose and the importance of the study. Confirmatory factor analysis was performed and the related fit statistics were found as $\eta 2/df$ = 2.79, GFI = 0.81, AGFI = 0.77, RMR =0.27. Though the $\eta 2/df$ ratio and RMR values are within an acceptable range for good fit, GFI and AGFI values are below 0.9. In addition, lambda-ksi estimates are similar to the factor loadings in an exploratory factor analysis, and values of 0.8 or higher demonstrate well-defined constructs (Pintrich et al., 1991). Almost all the Lambda-ksi values were reasonable to indicate well-defined constructs. Moreover, reliability coefficients (Cronbach alpha values) were calculated by using SPSS for the current study. Table 1 presents the Cronbach alpha values for English version, Turkish version, and the current version of the questionnaire.

Table 1. Reliability Coefficients

	N(Sample Size)	IGO	EGO	TV	CLB	SELP	TA
ENG	356	0.74	0.62	0.90	0.68	0.93	0.80
TUR (Sungur's)	488	0.73	0.54	0.87	0.62	0.89	0.62
TUR (Current)	324	0.69	0.75	0.64	0.69	0.70	0.77

Caruso (2000) emphasized the importance of sample characteristics on the scores of reliability. Since the reliability is highly dependent on the population in which the sample is selected, it is normal to obtain slight differences in the values of reliability coefficients.

Treatment

This study was conducted in an Anatolian high school during the 2008-2009 academic year for a 12-week period during the teaching of the gas topic. Forty-five 10th grade students participated in the study. In the school, one of the two classes of the same teacher was randomly assigned as experimental and the other class as the control group. All groups of students followed the same National Curriculum, learning the same concepts but in different methods. Both groups of students were administered the MSLQ as a pre- and post-test to determine whether there would be any significant difference between the groups. The classroom period was 45 minutes.

Students in control group were taught by the traditionally designed instruction. In this class, instruction was based on only teacher expressions and textbooks and worksheets prepared by teachers or copied from the textbooks--consisting of many numerical, multiple-choice questions rather than conceptual ones. The main aim of the teacher was to transfer as much information from the teacher to students as possible. Any teaching activities, such as group work, demonstration, or experimentation, were not included in traditional classes. The role of teacher simply was to define and explain the concepts and then solve reinforcing questions. After solving a few arithmetical questions, the teacher asked similar questions and gave a certain time to students to find the solutions. The questions were mainly about the application of the gas formulas and were usually solved by the teacher on the board after receiving the students‟ answers regarding them. Teacher-student and student-student interaction was minimized even during the allocated time for students to solve the problems on their own. If students had questions related to the problems asked or had difficulty in understanding the subjects, they directly asked to the teacher. Students behaved as passive listeners rather than active participants. In brief, they were only motivated by teacher-directed questions and were not encouraged to find the solutions of daily-life problems related to gases.

In experimental group, students were presented cases with small group format considering the study of Flynn and Klein (2001). Their work showed that students instructed with cases like working in small groups more than working individually and furthermore they believed that their learning develops within the group. The mixed groups with four to five students were formed by the chemistry teacher, considering their previous chemistry achievement and attitude toward chemistry. Before treatment, the teacher was trained about the new method of teaching and how to implement case-based learning to the gas concepts by discussing the lesson plans prepared by the researchers. Since the teacher assisted in the preparation and checking of the teaching materials, she became familiar with the cases to be used in the course. Prior to instruction, the roles of teacher and the students were explained clearly. The teacher's role was to guide the students and avoid direct answers to the questions asked by students but instead teachers asked open-ended and challenging questions to promote thinking.

The role of the students was to discover answers to the presented situations, working in small groups with four to five students. After distributing the case to the organized groups, the teacher read aloud the presented case to the students. Before sharing their ideas with the whole class, students were given enough time to read and discuss the presented cases in each group and to solve the related study questions. Students wrote the answer(s) of these study questions on the worksheets, which had been distributed to all groups. A whole-class discussion began just after the group discussion. When the solution(s) required drawing, one of the group members drew the group response on the board. A total of fifteen cases about real-life events, experiments, and specific situations were utilized in the context of gas topic (See an example in Appendix I). The whole-class discussion ended when the students reached reasonable or plausible response(s) to the study questions placed at the end of each case. Therefore, the active learning environment was provided by group work, within-group and whole-class discussion. In addition, within group and whole class discussions helped students to gain different perspectives to the presented situations. This learning environment helped to precipitate the emergence of a lack of understanding, along with a chance for students to correct these misconceptions.

During small group discussions, the teacher moved among the groups and assisted them when they needed help in understanding presented cases or related questions. The group and whole class discussion continued until intelligible and plausible answer(s) were found by the students to the case questions. Therefore, students constructed their own knowledge. After all groups explained their answers to the questions, the teacher summarized the correct answers. If students still had questions, the teacher clarified them. A verification checklist, designed by the Yalçınkaya (2010) in order to control whether the case-based learning was implemented suitably, was filled out by one of the researchers and PhD chemistry-education students. The checklist included two sections: the former one contained “yes” or “no” type items and the latter one was a 5-point Likert-type scale with anchors at “always” and “never” (See

Appendix II). Seventy-five percent of the items marked as "yes" and "usually" pointed out that this method of learning was applied appropriately to the intention of the study. Therefore, treatment verification was maintained by means of the treatment verification checklist.

Analysis of Data

One-way MANOVA based on gain scores was run to evaluate whether there was a statistically significant mean difference between EG and CG students with respect to the students' motivation-based dependent variables: Intrinsic Goal Orientation (IGO), Extrinsic Goal Orientation (EGO), Task Value (TV), Control of Learning Beliefs (CLB), Self-Efficacy for Learning and Performance (SELP) and Test Anxiety (TA). For this purpose, gain values (posttest-pretest) were calculated for each motivational dependent variable for the analysis of posttest scores. Treatment was used as an independent variable. Students' collective dependent variables of IGO, EGO, TV, CLB, SELP, and TA based on gain scores were used as dependent variables.

Results

Table 2 indicates descriptive statistics with respect to IGO, EGO, TV, CLB, SELP and TA across the experimental and control groups. To determine the effect of treatment on students' perceived motivation, before carrying out one-way MANOVA based on gain scores, its assumptions were tested. For the normality assumption, as seen from Table 2, most of the skewness and kurtosis values were tolerable, satisfying the multivatiate normality assumption for all dependent variables except for the deviation of kurtosis value of GainTV and GainEGO in EG; therefore,the univariate normality assumption was met. Moreover, the other assumptions, the homogeneity of variance-covariance matrices, the independence of observations and Levene's Test of Equality of Error Variances were also tested in order to continue the analysis. A significant result of Box's M test assessing the homogeneity of variance-covariance matrices resulted in the violation of this assumption; thereby Pillai's trace was selected for the interpretation of MANOVA results.

As seen from Table 3, MANOVA analysis indicated the significant effect of treatment on students' perceived motivation (Pillai's trace = 0.377, $F(6, 38) = 3.839$, $p = 0.004$). The partial eta squared value of 0.37 showed a large effect of treatment on students' perceived motivation. That is to say, 37% of multivariance of the perceived motivation was associated with the treatment effect. The power value was found to be 0.94, indicating that the difference between the groups arose from the treatment effect, which had practical value (Gay & Airasian, 2000).

As a follow-up to MANOVA, univariate ANOVAs based on gain scores were performed in order to find the effect of treatment on each dependent variable. As Table 4 showed, ANOVA analysis revealed a statistically significant effect of treatment on 10th grade students' extrinsic goal orientation ($F(1,43) = 4.961$, $p<0.05$, $\eta^2 = 0.103$), task value ($F(1,43) = 8.768$, $p<0.05$, $\eta^2 = 0.169$) control of learning beliefs ($F(1,43)=9.149$, $p<0.05$, $\eta^2 = 0.175$), self-efficacy for learning and performance ($F(1,43)=,22.782$, $p<0.05$, $\eta^2 = 0.346$) whereas no statistically significant differences were found between control and experimental group students in terms of intrinsic goal orientation ($F(1,43) = 2.867$, $p>0.05$) and test anxiety ($F(1,43) = 0.429$, $p>0.05$). Partial-eta squared values (η^2) ranging from 0.17 to 0.35, indicate that treatment had a large effect on students' task value, control of learning beliefs and self efficacy for learning and performance while case-based instruction had a moderate effect ($\eta^2=0.10$) on students' extrinsic goal orientation (Green, Salkind, & Akey, 2000).

Table 2. Descriptive Statistics with respect to IGO, EGO, TV, CLB, SELP and TA across the Groups

	N		Pretest		Posttest		Gain (Posttest-pretest)		Skewness		Kurtosis		Standard Deviation	
	CG	EG	CG	EG	CG	EG	CG	EG	CG	EG	CG	EG	CG	EG
GainIGO	20	25	17.40	19.08	18.00	21.72	0.600	2.636	0.179	0.072	0.767	-0.483	4.109	3.925
GainEGO	20	25	20.47	20.04	18.35	21.28	-2.125	1.240	-0.081	1.811	-1.370	5.382	4.103	5.666
GainTV	20	25	29.25	29.66	26.35	33.00	-2.900	3.336	-0.380	0.101	1.214	3.073	9.706	3.702
GainCLB	20	25	21.32	21.54	20.35	24.04	-0.975	2.500	-0.042	0.701	-0.188	1.665	3.514	4.062
GainSELP	20	25	40.15	36.83	36.30	43.64	-3.850	6.808	0.220	0.434	-1.557	-0.149	7.693	7.239
GainTA	20	25	17.60	18.46	21.25	20.84	3.650	2.380	1.319	0.188	1.941	-0.255	4.373	7.726

Table 3. MANOVA Results with respect to Dependent Variables of IGO, EGO, TV, CLB, SELP, TA

Source	Pillai's trace	*F*	Hypothesis Df	Error Df	Significance (*p*)	Eta Squared μ^2)	Power
Treatment	0.377	3.839	6.000	38	0.004	0.377	0.935

Table 4. Follow-up Univariate ANOVAS

Source	Dependent Variable	Df	*F*	Sig.(*p*)	Eta-Squared	Observed Power
Treatment	IGO	1	2.867	0.098	0.063	0.381
	EGO	1	4.961	0.031	0.103	0.586
	TV	1	8.768	0.005	0.169	0.825
	CLB	1	9.149	0.004	0.175	0.840
	SELP	1	22.782	0.000	0.346	0.997
	TA	1	0.429	0.516	0.010	0.098

As seen from Table 2, experimental group students taught with case-based instruction gained more in each motivational dependent variable (except test anxiety) than the control group students did. On the other hand, students' extrinsic goal orientation, task value, control of learning beliefs and self efficacy for learning and performance decreased after receiving traditional instruction for the gas unit (Refer to Table 2).

Discussion

The main purpose of the current study was to investigate the effectiveness of case-based instruction on 10th grade students' perceived motivation (intrinsic goal orientation, extrinsic goal orientation, task value, control of learning beliefs, self-efficacy for learning and performance, test anxiety). It was found that case-based instruction had a significant effect on students' extrinsic goal orientation, task value, control of learning beliefs, and self-efficacy for learning and performance, while there was no significant effect of treatment on students' intrinsic goal orientation and test anxiety.

In the present study, students' gain values of control of learning beliefs (CLB) increased significantly in favor of experimental group students. In other words, students' perceptions of control over their academic performance and their attempts to learn will lead to positive outcomes developed with case-based instruction. This finding is consistent with those obtained by Pintrich et al. (1991). Moreover, the experimental group students' gain scores of extrinsic goal orientation, task value, and self-efficacy for learning and performance were significantly higher than the control group students. In other words, experimental group students took part in a task for reasons such as grades, rewards, performance, evaluation by others, and competition. In addition, a significant increase in task value of students instructed with cases indicated that students were engaged in tasks because these tasks are valuable to them. Individuals may value the tasks according to their own needs and values (Eccles, 2005). According to Wigfield and Tonks (2002), students may find the tasks useful due to some extrinsic reasons. For instance, students may not have much intrinsic interest to chemistry, but in order to become pharmacist, the course of chemistry has a high utility for them. Students, especially in high school, may find the tasks valuable for different reasons. However, if students think that tasks are useful or valuable, they are more interested and involved in these tasks and will study harder and more effectively on them (Wigfield & Tonks, 2002). Therefore, it can be concluded that the experimental group students' perceived task value was higher because they found the tasks valuable, interesting, or enjoyable. Moreover, different extrinsic reasons as stated above may have been influential.

Additionally, students' self-efficacy for learning and performance increased significantly following the case instruction (i.e., they became more confident in having the skills essential to carry out the task after case-based teaching). The reason for the increase in students' self-efficacy may be due to the contemporary teaching method used in their classes. These teaching methods are likely to enhance students' motivation and promote learning. Courtney, Courtney, and Nicholson (1992) stated that a student's self-efficacy enhances by experiencing success of specific tasks repeatedly. Students' motivation is increased if they see progress in their learning. Students become more skillful as they work or practice on tasks and sustain a sense of self-efficacy for performing well (Schunk, 1989).

The present study also indicated that there was not a significant mean difference between experimental and control group students in terms of treatment effect with respect to the students' gain values of intrinsic goal orientation and test anxiety. One of the reasons for this finding can be the implementation period, because only 12 weeks for implementation of case-based learning might not be enough to change students' intrinsic goal orientation. In other words, the limited teaching period of instruction might not be sufficient for students to participate in a task for the reasons such as challenge, curiosity, and mastery, and not for being a means to an end such as a grade or reward. In terms of test anxiety, experimental group students' test anxiety increased following case-based instruction, though this difference was not found as statistically significant. This increase may be due to the fact that case-based learning is a novel and student-centered approach to which students are not accustomed. Therefore, students may have concerns about their performance on the tests, which causes an increase in their text anxiety. According to Hill and Wigfield (1984), students' unfamiliarity with tests or the degree of difficulty of tests can cause anxiety in students.

It is also interesting to note that students' extrinsic goal orientation, task value, control of learning beliefs, and self-efficacy for learning and performance decreased after receiving traditional instruction for the gas unit (See Table 2). This decrease may result from the way content is delivered. Instruction that leads to memorization and gives less freedom for students to practice and control their learning would result in the decrease of students' motivation. These learning outcomes reflect the characteristics of traditional instruction. Moreover, content difficulty is another factor influencing motivation. Content perceived as being difficult to achieve would decrease students' motivation (Pintrich & Schunk, 2002). The gas topic was reported as one of the more difficult topics in chemistry. Stavy (1988) stated that students in all levels face with problems in understanding of the behavior of gas because of the invisible nature of it.

In sum, this study provides evidence of the effectiveness of case-based instruction in enhancing students' extrinsic goal orientation, task value, control of learning beliefs, and self efficacy in chemistry classes. This may be due to the nature of case-based instruction, because it allows students to participate in learning processes via discussing their opinions in order to solve real life situations. As Pintrich and Schunk (2002) discussed, tasks that require students' active participation, student-student interaction, and the linkage of subject matter with daily lives would cause an increase in students' motivation. Considering the influence of motivational beliefs on students' achievement, it can be recommended that teachers should implement case-based instruction in their classes. However, the results of the study need to be cross-validated with a larger number of students from different grade levels as well as different subject matters in order to be able to generalize the results. Also, as stated above, there are different types of high schools in Turkey. This study was conducted in a high school where student characteristics such as achievement and efficacy may be different from students in other types of schools. Therefore, for further generalization, the findings should be validated with students from other school types. Finally, future studies may extend the understanding of the impact of case-based teaching on students' motivation as well as other variables such as attitude, interest, epistemological beliefs etc.

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Appendix I

Airbag

Ayşe and her family were traveling in their car to visit their relatives. However they experienced a car accident and fortunately due to airbag they were not injured at all. Like this accident, many lives of the people are saved due to the airbags in the cars therefore it can be said that airbags are one of the biggest innovations in the car industry. What may be the working principle of airbags? Please discuss.

What may be the properties of a good airbag?

What should the properties of the gas in the airbag be?

Does the gas in the airbag exert the same pressure on everywhere of the airbag? Why or why not?

Appendix II

Treatment Verification Checklist

Explanation: This scale includes fifteen items related to the implementation of case-based learning. For the first two items select "YES" or "NO". For the rest of the items (3 to 15), the alternatives of "Rarely", "Never", "Frequently", "Usually", and "Always" are given. After reading the items carefully, mark the option you think is correct.

Question No		YES	NO
1	Students work in small groups.	O	O
2	The groups are heterogeneous in terms of gender, chemistry achievement and attitude.	O	O

		Rarely	Never	Frequently	Usually	Always
3	Teacher hands out the case activities at the appropriate times.	O	O	O	O	O
4	Students generate ideas about given case scenarios and the related questions.	O	O	O	O	O
5	Each of the group participants joins a learning activity and makes a contribution.	O	O	O	O	O
6	Students respect the others ideas/opinions and listen each other while declaring.	O	O	O	O	O
7	Students share the information and help each other to understand during a group activity.	O	O	O	O	O
8	Teacher establishes a relaxing, comfortable environment.	O	O	O	O	O
9	Teacher ensures equal participation.	O	O	O	O	O
10	Teacher asks discrepant questions to create a dilemma by moving around the groups in the class.	O	O	O	O	O
11	Teacher encourages the students to think critically about the given case scenario.	O	O	O	O	O
12	Teacher makes directive explanations to keep the group focus on the goal.	O	O	O	O	O
13	Teacher asks open-ended and non-directive questions.	O	O	O	O	O
14	Teacher gives feedback to students about the case-based activities.	O	O	O	O	O
15	The students presenting the group ideas or answers are selected randomly by the teacher.	O	O	O	O	O