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Investigating Teachers' Fidelity to Constructivist Chemistry Curriculum in Turkey: Congruence between Intended, Perceived and Observed Curriculum in Turkey

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Abstract

This study aimed to evaluate chemistry teachers' curriculum fidelity in Turkey. Therefore, it was investigated how intended constructivist principles in the 9th grade chemistry curriculum in 2007, have been perceived and implemented into the practice by the chemistry teachers in Turkey. A qualitative evaluative case study guided this research study, which was carried out with 23 chemistry teachers, working in the high schools in Erzurum city center and selected by convenient sampling method. The data was collected through semi-structured interviews under the guidance of the "Teacher Interview Form (TIF)" and classroom observations using the "Chemistry Class Constructivist Environment Observation Form (CCCEOF)" developed by the researchers. The interview and observation data were subjected to content analysis. The findings showed that the constructivist principles intended in the chemistry curriculum are not adequately perceived by the teachers and are put into practice in a traditional way.

Keywords

Constructivism, curriculum evaluation, curriculum fidelity, secondary school chemistry curriculum

Introduction

Across the world, science education is a vital component for a country's advancement. Part of the effort to improve the quality of science education is achieved through curriculum development (Ayas, 1995, 2013). The chemistry curricula began its development from 1930 and then periodically changed from 1934 to 2013 (Ayas, 2013; Yörük & Seçken, 2011) in Turkey. However, none of these changes, except for those in 2007 and 2013, went further than determining topics, listing the content together with the time to be allocated (Ayas, 2013). Furthermore, in the context of Turkey, curriculum development studies to date can be divided into four major phases that have affected by events, studies, social and political issues in the West and Çalık and Ayas (2008) summarized these phases and their effects as follows: the first phase of curriculum reform from 1932 to the late 1940s mostly focused on translating science textbooks from other languages into Turkish. The second phase started in the 1950s and there was little progress apart from developing a few scientific experiments. The 1980s marked the beginning of the third phase, in which curricula from the United States was launched into secondary schools financially supported by the Ford Foundation and this attempt was unsuccessful because the implementation process was not clear and poorly executed. The fourth phase consisted of the attempts in 1992, 2000 and 2005 to change the science curricula to focus on student-centered learning. In 2004, the Ministry of National Education [MoNE] began to make radical changes to the primary curricula and then secondary curricula in 2007 and incorporated a constructivist approach.

According to constructivism and the new shifted paradigm in chemistry curriculum in Turkey, students are at the center of learning. Students participate reflective conversation and discussions and ask critical questions in order to be active in learning teaching process (Bay, 2008; Brooks & Brooks, 1993; Fosnot, 2007; Gönen & Andaç, 2009; Hançer, 2006; MoNE, 2005; 2007; Özmen, 2004; Şimşek, 2004). From a constructivist perspective, learning occurs when students are actively involved in the process of constructing their own knowledge about the real world using their physical experience and social interactions (Kimble, Yager, & Yager, 2006). Teachers need to facilitate student-centered methods and techniques to encourage student participation and involvement in the learning process such as letting students start or initiate their own questions, problems and cases, draft their own ways of finding answers to those questions and problems, conduct their own research and experiments and share their findings, answers and solutions with their peers and teachers (Kimble, Yager & Yager, 2006) Teachers query students' prior knowledge and searches students' understanding about concepts before share her or his own ideas (Bay, 2008; Brooks & Brooks, 1993; Fosnot, 2007; Gönen & Andaç, 2009; Hançer, 2006; MoNE, 2005; 2007; Özmen, 2004; Şimşek, 2004). Constructivist classrooms must be arranged to allow opportunity for authentic learning and real-life tasks, examples and events should be included (Bay, 2008; Brooks & Brooks, 1993; Fosnot, 2007; Gönen & Andaç, 2009; Hançer, 2006; MoNE, 2005; 2007; Özmen, 2004; Şimşek, 2004). In Turkey, since 2007, the emphasis in the chemistry curriculum is on alternative assessment and evaluation approaches, which should both help pupils to be a part of the learning process and link educational content to daily life conditions and problems (MoNE, 2007; Sozbilir & Neacşu, 2014).Assessment and measurement is conducted in order to determine the success of the students, to determine their deficiency and to provide feedback about the progress of the student in the learning-teaching process (MoNE, 2007).

The purpose of this study was to evaluate chemistry teachers' curriculum fidelity in Turkey. Therefore, it was investigated how intended constructivist principles in the 9th grade chemistry

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curriculum in 2007, have been perceived and implemented into the practice by the chemistry teachers in Turkey. This is a case and 9th grade is taken an example. In this study, it is aimed to establish an evaluation process for chemistry curricula and the study is not limited to 2007 only. Also, considering that the curriculum development and evaluation process is intertwined, it is in relation to both previous curricula and later post-2013 curricula of chemistry. Thus, the relationship between the chemistry curricula was established and continuity was provided in evaluation. According to the research purpose it was sought to answers of the following research questions:

1. How is perceived the principles based on constructivist approach highlighted in the 9th chemistry curriculum, by the teachers?
2. How is put into practice the principles based on constructivist approach in the 9th chemistry curriculum, by the teachers?
3. What is the congruence between intended, perceived and observed (implemented) chemistry curriculum?

Background

Although there have been frequent changes to the curricula, the literature indicates that the majority of these revisions are not based on scientific evidence. For example, Sözbilir, Kutu, and Yaşar (2012) suggests that only 3.8% of science education research cover curriculum fidelity and studies in Turkey. All the implemented chemistry curricula are rather superficially evaluated in Turkey. Kalkan, Savcı, Şahin, and Özkaya (1994) commented on the inadequate physical conditions, laboratories, equipment and materials. Aydın (2007) found that the chemistry curriculum could not be effectively put into practice by the teachers and that it was not related to daily life issues and problems. Ercan (2011) investigated teachers' views concerning the implementation of the 2007 chemistry curriculum and found that teachers had lack of knowledge about assessment and they commented on the intensity of the curriculum. Kurt and Yıldırım (2010), Üce and Sayıçayır (2013) and Yadigaroğlu and Demircioğlu (2011) undertook semi-structured interviews with chemistry teachers and found that these teachers reported that the curriculum was overloaded further and they did not know the methods and techniques that should be used in chemistry classes (Kurt & Yıldırım, 2010; Yadigaroğlu and Demircioğlu 2011). Teachers referred to assessment approaches, which were not in keeping with Turkish National University Entrance Examination system and also the lack of in-service training concerning the chemistry curriculum (Kurt & Yıldırım, 2010). In response to the problems reported, the secondary chemistry curriculum revised in 2013 (MoNE, 2013). Demircioğlu, Aslan and Yadigaroğlu (2015) evaluated this latest chemistry curriculum by interviewing chemistry teachers. According to the results, the teachers considered that the curriculum is lacking in providing students with science process skills. One particular problem was the 9th grade chemistry syllabus being more intensive than that for the 10th grade. Furthermore, the teachers stated that a guidebook is missing.

Effectiveness of curricula has been studied in different countries throughout the world. Similar findings have been reported by three studies on curriculum evaluation conducted in Uganda (Altinyelken Kosar, 2010), South Africa (Bantwini, 2010) and Botswana (Rowell & Prophet, 1990). While Altinyelken Kosar report challenges to successful applications of the curriculum such as the intensity of the content, overcrowded classes, lack of teaching learning materials, insufficient in-service training programs and teachers' lack of knowledge about assessment, Bantwini's findings indicates that teachers' insufficient knowledge or perceptions about curriculum innovations is a barrier to the effective implementation of curriculum innovations. On the other hand, Rowell and Prophet determined the exam system as the main barrier for the effective implementation of practical activity-based secondary school curriculum rather than the sole focus on academic content. Regarding the importance of teachers' beliefs in curriculum implementation, Roehrig, Kruse and Kern, (2007) and Roehrig and Kruse (2005) investigated the implementation of a reform-based chemistry curriculum in the US. Their findings show that there is a strong relationship between teachers' beliefs and implementations. Thus, they concluded that teachers must be supported and assisted in the implementation of the intent of the curriculum standards. Similar results are reported by Park and Sung (2013). They examined teachers' perceptions of curriculum reform in terms of their implementation and the support needed to actively and effectively implement curriculum reforms in Korea. The findings showed that teachers have negative feelings about curriculum reform, which impact their engagement to implement the reforms.

In Scotland, Wallace and Priestley (2011) investigated how teachers' beliefs about teaching, learning influenced teachers' mediation of a reform policy in their classrooms and the point of resonance or tension between teacher's beliefs and the local educational authorities' philosophy towards and management of policy implementation. The findings indicate that congruence between teachers' beliefs and the philosophy of the curriculum initiative is a key factor in the teachers' enactment of innovation in their classroom. There are conflicting results from two different curriculum reform studies carried out in Taiwan. Klainin (1984) investigated the effectiveness of a laboratory/discovery-based chemistry curriculum and found that it had a positive effect on students' scientific process skills such as observing, formulating hypothesis, designing and executing investigations, recording data, analyzing and interpreting data, forming conclusions as well as the acquisition of the content matter of the subjects. However, Chiu, and Whitebread (2011) investigated teachers' perception and implementation of the constructivist mathematics curriculum and their findings indicated that none of the teachers fully implemented the cognitive and affective requirements according to the constructivist mathematics curriculum. Regarding the implementation of a new science curriculum, there are two reports from two different countries. Lowe and Appleton (2014) examined teachers' implementation of the new science curriculum in Australia. Their findings show that although teachers spent 2 years getting to know the new science curriculum through meetings, training, and exploring the new Australian curriculum documents, there were still shortcomings. The main problematic issues for schools and teachers were the lack of time to read and comprehend the curriculum documents and content expectations as well as the time for training and to effectively modify the current processes. Rayder, Banner, and Homer (2014) analyzed teachers' experiences of the reform of the science curriculum in England. They claim that reforms offer teachers the flexibility to allow them to adopt innovations appropriately to local context. Thus, policy makers should not only consider professional development activities as a promoting curriculum reform but also take into account offering teachers support in gaining a perspective on curriculum policy directives.

Theoretical Framework

It is seen, as stated in the preceding paragraphs, there has been several educational reforms and investigations in the success of implementation of these reform movements both in Turkey and in the World. Innovations in curriculum studies pose the one of the most important issue in these educational reforms. Determining the success of the curriculum implementation is expressed by the term of "curriculum fidelity", "implementation fidelity" or "implementation of fidelity" according to the literature (Bümen, Çakar, & Yıldız, 2014; Dusenbury, Brannigan, Falco, & Hansen, 2003; Furtak et al., 2008; Mihalic, 2004). Curriculum fidelity defined as a determination of the, how well a curriculum is being appliedin comparison with the designed curriculum (Mihalic, 2004), way of finding out the congruence between the implemented and original designed curriculum (Furtak et al., 2008)or "degree to which teachers or stakeholders abide by curriculum's original design when implementing it" (Bümen et al.,, 2014, p. 220). Thus, in order for educational and curriculum reform efforts to be successful it is crucial that evaluation of curriculum fidelity takes place. Data needs to be gathered and reviewed in order that curriculum developers can revise, compare, maintain or discontinue their actions and programs (Oliva, 2001; Ornstein & Hunkins, 1998). Curriculum evaluation not only needs to be concerned with questions about what should be taught but also with finding out what happens in the classroom, the activities that occur both outside the classroom and in hidden curriculum (McCormick & James, 1990,p.1). In Turkey, although there have been many reforms in education and school curricula since the 1920s an effective process of evaluation and determination of curriculum fidelity has not been constructed up to date (Bümen et al., 2014). Thus, this study focuses on gathering evidence-based results to effectively evaluate the fidelity of the chemistry curriculum in secondary schools in Turkey. To achieve this, the following three models were utilized; McCormick and James (1990)'s curriculum evaluation model, Stake's Congruence-Contingency model and Eisner's Connoisseurship Evaluation model (Orntein & Hunkins, 1998). This study focused on the perception and implementation of constructivist principles in the 9th grade chemistry curriculum by selected chemistry teachers. The current study is one of the first to analyze the chemistry teachers' perceptions in depth and their implementations of constructivism and reveals the case sample of chemistry teachers' curriculum fidelity in Turkey.

Method and Sample

This is a qualitative evaluative case study. This type of study requires detailed descriptions, interpretations and a certain decision and judgment with holistic, naturalistic and realistic data (Meriam, 1998). In this study, the researchers conducted direct interviews with the teachers who participated in the study and made non-participatory observations in the chemistry classes during the research process. In this way, researchers could collect realistic, detailed and illustrative data about the subject studied and investigated. As explained above, three models were used and combined to create the curriculum evaluation model as shown in **Figure 1** that fits the evaluative case study design.

This study was conducted in three stages according to the evaluation model. As seen from the Figure 1, the first stage is about the intended chemistry curriculum. The intended antecedents, intended transaction and intended outcomes (McCormick & James, 1990; Ornstein & Hunkins, 1998) are accepted as the intended curriculum in this study. Environmental factors, school procedure, pupils' interests, pupils' interactions with each other and teachers, educational materials, and outcomes that exist may influence the successful implementation of a curriculum.

As mentioned above, the Turkish high school chemistry curricula is based on constructivism and the constructivist principles were determined from the literature through document analysis and are named the "intended curriculum" in this study. As summarized in **Figure 1**, it is determined students' roles as 11 items in the first column of **Table 3**, teachers' roles as 9 items in the first column of the **Table 4**, learning-teaching environment principles as 12 items in the first column of the **Table 5** and assessment principles as 7 items in the first column of the **Table 6** according to the national and international literature and Turkish chemistry curriculum for intended curriculum (Bay, 2008; Brooks & Brooks, 1993; Fosnot, 2007; Gönen & Andaç, 2009; Hançer, 2006; MoNE, 2005; 2007; Özmen, 2004; Şimşek, 2004).

As seen from the **Figure 1**, the second stage is about the perceived chemistry curriculum. The "perceived curriculum" pertains to the teachers' perceptions or knowledge of constructivism that was elicited through interviews. As summarized in the **Figure 1**, it is defined that teachers' perceptions related to constructivist students' role as 5 items in the second column of **Table 3**, teachers' role as 5 items in the second column of **Table 4**, learning-teaching environment principles as 16 items in the second column of the **Table 5** and assessment principles as 7 items in the second column of **Table 6**.

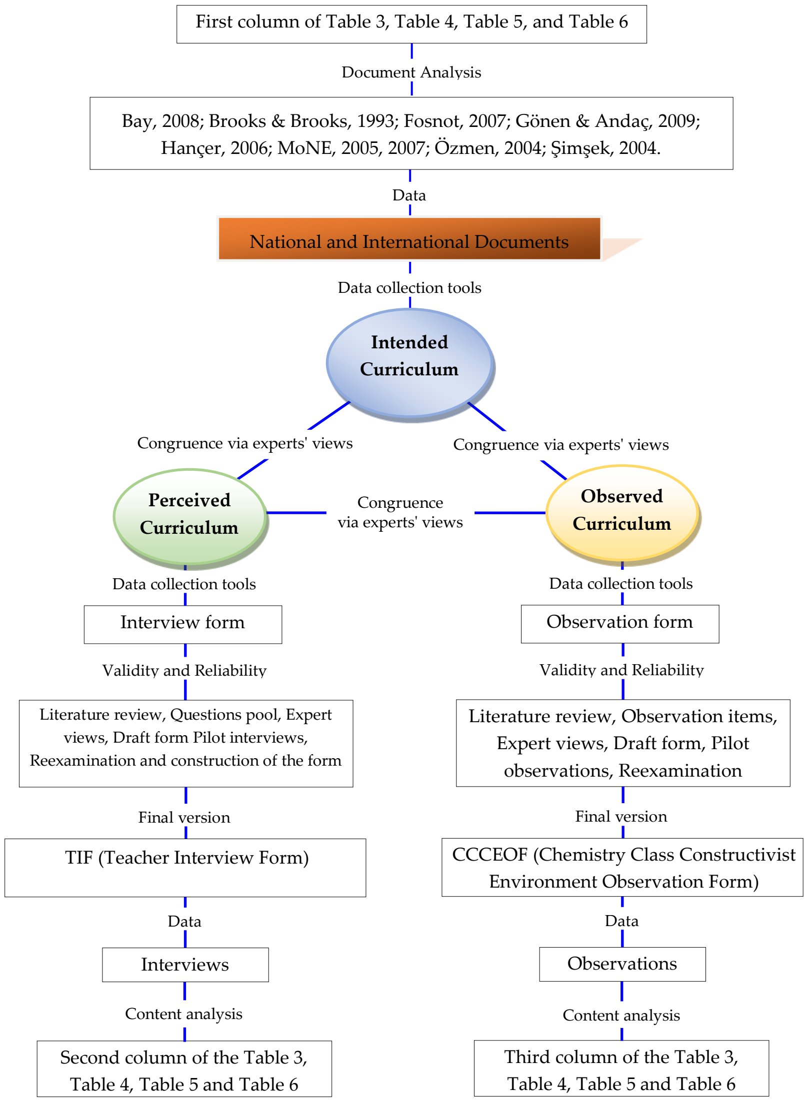

Figure 1. Evaluation model used in this study

As seen in **Figure 1**, the third and last stage is about the observed chemistry curriculum. As summarized in the **Figure 1**, it is determined the efficacy of the implementation of the chemistry curriculum and observed constructivist students' roles as 11 items in the third column of **Table 3**, teachers' roles as 9 items in the third column of the **Table 4**, learning-teaching environment principles as 12 items in the third column of **Table 5** and assessment as 7 items in the third column of **Table 6**, in chemistry classes. Furthermore, the congruence and relationships between the teachers' perceptions and implementations of the constructivism, is determined with making comparison the items defined in the first and third column of **Table 3**, **Table 4**, **Table 5** and **Table 6** based on literature and chemistry curriculum, as mentioned above paragraphs, by the authors' views who are experts in curriculum evaluation process.

Participants, Data Collection Tools and Process

The participants in the study were 23 chemistry teachers working in different high schools in Erzurum, a relatively large city in eastern Turkey. This study was carried out with teachers and theirs pupils taking permission from Erzurum National Education Management. All 42 chemistry teachers working in high schools in Erzurum city center were asked if they wanted to participate in the study; 23 teachers agreed to participate. Thus, participates were determined according to the convenience sampling method (McMillan & Schumacher, 2010). The data were collected from document analysis, semi-structured interviews and focus group interviews guided by the "Teacher Interview Form (TIF)" and classroom observations using the "Chemistry Class Constructivist Environment Observation Form (CCCEOF)" developed by the researchers (Yaşar, 2012).The similarities and differences of study sample in the term of age, gender, teaching experience, teaching chemistry experiences, graduate faculty, graduate degree, administrative duties and types of high school are indicated and summarized in **Table 1**.

During the development of TIF, first the literature related to constructivism and its properties as well as the connections that chemistry curricula have with constructivism were analyzed and the type of questions that should be posed to the teachers were determined. Second, a pool of questions was outlined. These questions were reexamined and discussed among the authors and departmental colleagues. Once the final questions were determined, three pilot interviews were held with a chemistry teacher and two academics in chemistry education department at Ataturk University. Following these interviews, the questions were reexamined and the final version of the TIF was constructed. TIF is semi-structured and contains three components. The first part contains a short presentation about the research and purpose of the study; the second part elicits the teacher's demographic characteristics, age, gender, teaching experiences, graduated faculty, graduated degree, current administrative tasks undertaken and the type of high school in which they work; the third part consisted of 13 open-ended questions. The first three questions aim to obtain general information related to the chemistry curriculum such as the basic properties, content and changes that were made; the fourth question concerned constructivism and its properties; the fifth and sixth questions were related to the learning-teaching environment in terms of the techniques, methods and materials that should be used in chemistry classes; the seventh question focused on the roles and responsibilities of teachers; the teacher's views on the pupils' roles, responsibilities in relation to the curriculum and constructivism was elicited in eighth question; and the ninth question was related to the assessment approaches according to the intended curriculum. The final four questions concerned general information consisting of the conditions necessary for effective implementations; whether the teachers had attended in-service courses and the effectiveness of this training; the type of problems encountered during the curriculum implementation and teachers' recommendations to the curriculum developer.

Table 1. Demographic properties of the chemistry teachers participating in the study

Age				
20-25	26-30	31-35	36-40	41 and over
-	-	$T_{3,9.12.16,D,17}$	$T_{2,5.6.7,C,19}$	$T_{1,4.8.10,11,13,14,15,A,B,18}$
Gender				
Female		Male		
$T_{8,9,A,C,D,18,19}$		$T_{1,2.3.4.5.6.7.10.11,12,13,14,15,16,B,17}$		
Teaching Experiences				
1-5	6-9	10-15	16-20	21 and over
T_9	T_3	$T_{6,12,16,C,D,17}$	$T_{2,4.5.7.10,14,A,B,19}$	$T_{1,8.11.13,15,18}$
Teaching " Chemistry" Experiences*				
1-5	5-9	10-15	16-20	21 and over
$T_{9,12,16}$	$T_{3,6,17}$	$T_{C,D}$	$T_{2,4.5.7.10,14,A.B,19}$	$T_{1,8.11.13,15,18}$
Graduated Faculty				
Chemistry Teacher Training Program		Chemistry Department		
$T_{1,2.4.5.6.11,12,13,14,15,16,D,17,19}$		$T_{3,7.8.9.10,A,B,C,18}$		
Graduated Degree				
BSc	MSc	PhD		
$T_{1,2.4.3.6.7.8.10.11,13,14,15,A,B,C,D,18,19}$	$T_{5,12,16}$	$T_{9,17}$		
Administrative Duties				
School Principal	Deputy School Principal	No		
-	$T_{11,14.15.16}$	$T_{1,2.3.4.5.6.7.8.9.10,12,13,A,B,C,D,17.18.19}$		
Types of High Schools				
General high school	Anatolian high school	Anatolian teacher training high school	Science high school	Vocational high school
$T_{2,7,10}$	$T_{3,6.8.9,12,17,18}$	$T_{1,4}$	$T_{5,11,19}$	$T_{13,14.15.16,A,B,C,D}$

*Although graduating as chemistry teachers, some of the participants were initially appointed as classroom teachers due to the demand for these teachers in earlier times. Later, they up positions as chemistry teachers.

T: Teacher, T1, 2, etc.: first teacher, second teacher…etc. TA, B, C, and D: Teachers are interviewed in a focus group. TG: Focus group interview conducted with TA, TB, TC and TD.

The majority of interviews (19 out of 23) with the teachers were conducted individually while 4 teachers were interviewed in a focus group. The focus group interview was held because the participants worked in the same school and recognized each other. Focus group teachers were coded as TA, B, C and D while teachers interviewed individually coded as T1, 2,…, 19. All interviews were carried out in the teachers' rooms and lasted about 45 to 60 minutes. The interviews were audio recorded with the permission of the participants and schools. All interview data were transcribed verbatim and subject to content analysis.

Once the interview data analysis were completed, for the final stage of the study, 6 of the 23 interviewed teachers, from different schools and on voluntary basis according to the convenience sampling method, were selected for the observations of in the classroom settings to determine how they implement the 9th grade chemistry curriculum. The observations were guided by CCCEOF. The development stages of the CCCEOF are described below. An extended account of the development and validation process of both instruments can be found in Yaşar (2012). Descriptive data for observation stage is summarized in **Table 2** as showed below.

Table 2. Descriptive data for observation stage.

Observed teachers	Observed chemistry units and topics	Pilot Observations	Main Observations	Total
T_1	Mixtures, Chemistry in our life	7	9	16
T_2	Mixtures, Chemistry in our life	1	9	10
T_7	Mixtures, Chemistry in our life	5	15	20
T_{10}	Mixtures	10	-	10
T_{11}	Mixtures, Chemistry in our life	1	16	17
T_{12}	Chemical changes, Mixtures, Chemistry in our life	1	19	20
Total observation		25	68	93

$T_{1,\ 7\ etc...}$: First teacher, second teacher etc…

In developing CCCEOF, first the interview results and related literature were examined. The items and principles that should be observed were identified and discussed among the authors. Initially, a structured draft observation form was created, tested and piloted. The deficiencies of the observation form were discussed among the authors and external expert help was sought. The result of the discussion was the creation of a semi-structured observation form since it allowed the observer to define the way in which a particular behavior took place in a different classroom environment or situations. The pilot observations were performed initially with the selected six chemistry teachers' classes over a total of 25 hours (45 minutes each class) as shown in Table 2. In addition to the development of the observation form, during this pilot phase, the first author was able to improve his observation skills, adapt to the class environment and develop his interactions with teachers and students. The final version of the semi-structured CCCEOF consists of six components. The first part of the form contains a short presentation about the researcher and purpose of the study and teachers' demographic characteristics, age, gender, teaching experiences, graduated faculty, graduated degree, administrative tasks and worked in which type of high school. The second part of the form is related to physical conditions of class and school including the number of pupils, class size, ventilation, light and term, cleanliness, seating arrangements and technological equipment. The pupils' role and responsibilities were determined (see the third column of Table 3 in the third part; the learning-teaching environment principles were identified in the fourth part (see the third column of Table 5); the fifth part of the form concerns the teacher's roles and responsibilities (see the third column of Table 4) and the last part of the form is related to assessment approaches (see the third column of Table 6). Once the development of the observation form and observation skills training of the researcher has been completed, the observations began for the data collections to determine how constructivist principles were applied in the chemistry curriculum. As shown in Table 2, a total of additional 68 class hours (45 minutes each class) observation were undertaken. The observations were video recorded with the permission of the teachers and the schools. Furthermore, in addition to the observation form, field notes were taken.

Data Analysis

All the interview and observation data was read, patterns were identified and the first categorization was undertaken by each author individually with a sample data representing 10% of the whole data. Similar categories and codes were combined. Disagreements and small differences between authors were discussed and the final categorization was decided. The remainder of the data was coded by the first author and the frequencies were calculated. The codes and acronyms used to describe the interview data are as follows "**C**onstructivist **P**erception (**CP**)", "**P**artial **C**onstructivist **P**erception (**PCP**)" and "**N**o-**P**erception/**N**o-**K**nowledge (**NP/NK**)". The observation data was coded as follows "**f⓪**→ defined behavior is not observed", "**f①**→defined behavior is observed but in a traditional way", "**f②**→defined behavior is attempted according to constructivist principles but not successfully implemented" and "**f③**→defined behavior is undertaken in line with constructivist principles". The total of the code frequencies is coded as "**f_T⓪**→ Total of defined behavior is not observed", "**f_T①**→ Total of defined behavior is observed but in a traditional way", "**f_T②**→ Total of defined behavior is attempted according to constructivist principles but not successfully implemented" and "**f_T③**→ Total of defined behavior is undertaken in line with constructivist principles".

Results and Discussions

This section presents the qualitative data obtained through content analysis of interviews and observations. The results are presented in **Tables 3** to **6** each consisting of three columns to provide an in-depth comparison and congruence between the intended, perceived and observed curriculum as explained above in the research methodology.

The intended constructivist learners' roles were identified with eleven codes in the first column in **Table 3**. The teachers' perception related to the constructivist learners' roles are identified with five codes in the second column. Two of these codes are that students *"should take responsibilities for their own learning*, (f=1; T_1)" and *"should be active in the learning process* (*f*=17; $T_{1, 2, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, G, 19}$)". These were coded as partial constructivist perception (PCP). The other three codes are that students should *"have studied and prepared before coming to class,* (*f*=2; $T_{17, 18}$)" and "*practice what they have learned in school at home,* (*f*=1; T_{17})" and *"only listen to teachers* (*f*=2; $T_{3, 18}$)" coded as no-perception or no-knowledge (NP/NK). **Table 3** shows that no teachers have perceived constructivist principles for students' roles or responsibilities consistent with constructivism. Among the chemistry teachers, 17 have partial understanding and 3 have no idea about constructivist principles in terms of students' roles. Therefore, there is weak congruence between the intended and perceived curriculum.

The most frequent response from the teachers is "*Student should be active in learning process"* however, the chemistry teachers were unable to describe their ideas about learners' roles in a constructivist learning environment. Learners' practices in the chemistry courses are summarized with eleven codes in the third column in **Table 3** labeled as the observed curriculum. A total of 68 hours of observation were undertaken. There were 11 behaviors determined in relation to the constructivist learner roles. This stands for 68*11=748 behaviors assigned in total. Frequencies and percentages are calculated based on these 748 behaviors. As seen in the third column, all of the students' behaviors were not consistent with constructivist criteria. Students' practices are determined as f_T⓪= 418 and f_T①= 330, which means that most of the defined behaviors are either not observed (56 %) or coded as traditional (44 %) in the classroom. Therefore, the inconsistency between the intended and observed curriculum can be clearly seen from these figures. Most of the teachers partially perceived student's role as constructivist and enacted traditional applications in their chemistry teaching.

In **Table 4**, the intended constructivist teachers' roles were identified with the nine codes given in the first column and the teachers' perception related to their constructivist roles was identified with the five codes presented in the second column. **Table 4** shows that of the 20 chemistry teachers, 5 perceived constructivist principles; 11 partially perceived them and 4 did not perceive their roles or responsibilities in a constructivist learning environment. The first 5 teachers detailed their ideas about teachers' roles and mostly mentioned the following codes that teachers should *"follow research, working hard and renew themselves (f=3, $T_{1, 6, 12}$)";"collaborate with others (f=1, T_1)"*; *"design a learning environment that help students learn by themselves and to facilitate learning (f=4, $T_{1, 6, 8, 17}$)"* and *"include and actively involve students in the learning process (f=3, $T_{8, 12, 17}$)"*. The 11 chemistry teachers sometimes gave similar responses such as *"design a learning environment that help students learn by themselves and to facilitate learning (f=9, $T_{2, 4, 5, 7, 10, 13, 14, 16, G}$)* and *"include and actively involve students in the learning process (f=2, $T_{9, 11}$)"*. The remaining, 4 teachers did not perceive the teacher's role in a constructivist learning environment and they only gave the following responses; *"teachers should follow latest research, working hard and develop themselves (f=2, $T_{15, 18}$)"* and "*teachers only lecture the students (f=2, , $T_{3, 19}$)"*.

Table 3. Congruence between the intended, perceived and observed curriculum in terms of the students' role

Intended Curriculum-students role		Perceived Curriculum		Observed Curriculum-student roles
1- Participates in reflective conversation and discussions/asks critical and constructive questions in order to be active in the learning-teaching process. 2- Explains the issues and concepts using their knowledge of chemistry and tries to establish cause-effect relationship between events. 3- Recognizes and tries to use materials, instruments and devices in the classroom activities (observation, experiments, demonstrations etc.). 4- Plans, implements, reviews classroom activities and reports the results with the other students. 5- Tries to recognize, interpret and use in communicate chemical concepts, symbols, classifications and coding systems.	**Weak fidelity**	The curriculum requires that students should: 1- Take responsibility for self-learning. [f=1; PCP] 2- Be active in learning process. [f=17; PCP]	**Weak fidelity as a traditional way**	1- Participates in reflective conversation and discussions/asks critical and constructive questions in order to be active in the learning-teaching process. [f⓪→51; f①→17] 2- Explains the issues and concepts with using their knowledge of chemistry and tries to establish cause-effect relationship between events.[f⓪→55; f①→13]. 3- Recognizes and tries to use materials, instruments and devices in the classroom activities (observation, experiments, demonstrations etc.). [f⓪→65; f①→3]. 4- Plans, implements, reviews classroom activities and reports the results with the other students. [f⓪→63; f①→5]. 5- Tries to recognize, interpret and use in communicate chemical concepts, symbols, classifications and coding systems. [f⓪→5; f①→63].
		→Infidelity→		
6- Uses the knowledge that learned in the chemistry courses, to solve problems encountered in everyday life/ to explain physical-chemical events. 7- Queries the positive and negative effects of chemistry on the environment. 8- Communicates with other students and teachers in the classroom. 9- Listens and tries to understand other students and teachers' explanations and states his/her own opinions when necessary. 10- Willing to learn and take responsible for self-learning. 11- Undertakes activities inside and outside class such as presentations, creating posters and exhibitions.	**Weak fidelity**	3- Have studied and prepared before coming to the classroom. [f=2; NP/NK] 4- Study content again at home after the course. [f=1; NP/NK] 5- Only listen to teachers. [f=2; NP/NK]	**Weak fidelity as a traditional way**	6- Uses the knowledge that learned in the chemistry courses, to solve problems encountered in everyday life/ to explain physical-chemical events. [f⓪→51; f①→17]. 7- Queries the positive and negative effects of chemistry on the environment. [f⓪→58; f①→10]. 8- Communicates with other students and teachers in the classroom. [f⓪→2; f①→66]. 9- Listens and tries to understand other students and teachers' explanations and states his/her own opinions when necessary.[f⓪→2; f①→66]. 10- Willing to learn and take responsible for self-learning. [f⓪→2; f①→66]. 11- Undertakes activities inside and outside class such as presentations, creating posters, exhibitions.[f⓪→64; f①→4].

Although most of the teachers seem to be aware that they need to change their roles and adopt different responsibilities, the results show that there is semi-congruence between the intended and perceived constructivist teachers' roles and responsibilities. Teachers' practices in the chemistry courses are summarized in nine codes in the third column in Table 4 as the observed curriculum. Over the 68 hours of observation, 9 behaviors were determined as revealing constructivist teachers' roles. This stands for 68*9=612 behaviors were assigned in total. Frequencies and percentages calculated based on these 612 total behaviors. As seen in the third column, all of the teachers' behaviors were not consistent with constructivist criteria. Teachers' practices are determined as f_T⓪= 358; f_T①= 224 and f_T②=30. Most of the defined behaviors are not undertaken (58 %) or implemented in a traditional way (37 %) and some of the teachers' behavior was an attempt to be carried out according to constructivist principles but was not successful (5 %). This shows an inconsistency between the intended and observed curriculum. Most of the teachers only partially perceived their constructivist roles and enacted traditional applications in the classroom.

The first column in **Table 5** shows the 12 codes that identify the intended constructivist learning-teaching environment criteria. The 16 codes in the second column refer to the teachers' perceptions related to a constructivist learning-teaching environment. **Table 5** shows that 3 chemistry teachers have a perceived constructivist level; 16 have a partially perceived level and 1 teacher has no perception or have no idea about the constructivist learning-teaching environment. Detailing their ideas about the constructivist learning-teaching environment, 3 chemistry teachers (T1, 14, 17) mostly mentioned that the curriculum expects that "an essential environment and infrastructures exits for classroom activities (*f*=3, T1, 14, 17)"; "there is a democratic learning-teaching environment (*f*=1, T1)"; "technological or visual equipment are included (*f*=3, T1, 14, 17)";"chemistry knowledge should be related to daily life and problems(*f*=2, T14, 17)"; "Practice in writing articles will be undertaken (*f*=1, T1)"; "Multi-branched diagnostic tree model should be used (*f*=1, T1)"; "Question-answer method or technique should be used (*f*=1, T1)"; "Brainstorming should be used (*f*=2, T1, 17)"; "Lectures must be given with the activities and examples based on the laboratory method (*f*=1, T17)"; "Demonstration technique will be used (*f*=1, T14)"; "A field trip observation method should be used (*f*=1, T17)"; "students are at the center of the lectures (*f*=1, T14)" and "smart-boards are utilized (*f*=1, T14)". Although 16 chemistry teachers sometimes expressed the same ideas and were accorded with similar codes, they were not able to explain their ideas in detail. These teachers also referred to the constructivist learning-teaching environment using the codes; "teaching materials are developed and used (*f*=1, T5)" and "textbooks are used (*f*=2, T7, 9)".

Table 4. Congruence between the intended, perceived and observed curriculum in terms of the teachers' role

Intended Curriculum-teachers role		Perceived Curriculum		Observed Curriculum-teachers role
1- Queries students' prior knowledge and searches students' understanding about concepts before share his/her own ideas. 2- Keeps alive students' curiosity with the learning cycle as outlined discovery, recognition and enforcement. 3- Helps students to run activities (design experiments, write report, grasping and interpret charts etc.) which enhance students' cognitive, affective and psychomotor skills. 4- Provides opportunities for students using new conceptions in different situations	**Weak fidelity**	The curriculum expects the teachers to: 1- Follow the latest research, work hard and develop themselves. [f=3; CP] 2- Collaborate with others. [f=1; CP]	**Partial fidelity as a traditional way**	1- Queries students' prior knowledge and searches students' understanding about concepts before share his/her own ideas. [f⓪→46; f①→14;f②→8] 2- Keeps alive students' curiosity with the learning cycle as outlined discovery, recognition and enforcement. [f⓪→4; f①→59; f②→5]. 3- Helps students to run activities (design experiments, write reports, graphing and interpret charts etc.) which enhance students' cognitive, affective and psychomotor skills. [f⓪→51; f①→17]. 4- Provides opportunities for students using new conceptions in different situations. [f⓪→37; f①→31].
		→Infidelity→		
5- Guides students during knowledge discovery or learning process. 6- Lets students produce and compare concepts/ideas by creating an environment for discussion. 7- Encourages students to undertake research and participate in class by asking open-ended and engrossing questions. 8- Encourages students to use and benefit from information-communication technologies that develop students' skills and knowledge. 9- Incorporates students into the planning of learning-teaching process.	**Weak fidelity**	3- Design a learning environment that helps students learn by themselves and to facilitate learning. [f=4; CP and f=9; PCP] 4- Include and actively involve students in the learning process [f=3; CP and f=2; PCP] 5- Only give lecture to students [f=2; NP/NK].	**Partial fidelity as a traditional way**	5- Guides students during knowledge discovery or learning process. [f⓪→32; f①→33; f②→3]. 6- Lets students produce and compare concepts/ideas by creating an environment for discussion. [f⓪→58; f①→5; f②→5]. 7- Encourages students to undertake research and participate in class by asking open-ended and engrossing questions. [f⓪→5; f①→54; f②→9]. 8- Encourages student to use and benefit from information-communication technologies that develop students' skills and knowledge. [f⓪→57; f①→11]. 9- Incorporates students into the planning of learning-teaching process. [f⓪→68].

Table 5. Congruence between the intended, perceived and observed curriculum in terms of constructivist learning-teaching environment principles

Intended Curriculum		Perceived Curriculum		Observed Curriculum
1- Constructivist classrooms must be arranged to allow opportunity for authentic learning. Real-life tasks, examples and events should be included. 2- Learners should form knowledge in democratic classroom environment that can be used throughout their lives to solve daily-life problems. 3- Focuses on basic concepts, theories, and coding systems in the learning-teaching process. 4- Knowledge is not static instead its dynamic and variable features must come to the fore. 5- Different types of teaching-learning materials are included / primary sources and students' handmade materials come to the fore. 6- Focuses on learners' interest, responding to questions and problems.	**Weak fidelity**	The curriculum expects that : 1- An essential environment and infrastructures exists for classroom activities. [f=3; CP and f=14; PCP] 2- There is a democratic learning-teaching environment. [f=1; CP and f=1; PCP] 3- Technological or visual equipment (computer, projections for the preparation/presentation of slides or presentations) are included. [f=3; CP and f=13; PCP] 4- Chemistry should be related to daily life and problems. [f=2; CP]. 5- Practice in writing articles will be undertaken. [f=1; CP] 6- Multi-branched diagnostic trees model should be used. [f=1; CP] 7- Question-answer method or technique should be used. [f=1; CP and f=5; PCP] 8- Brainstorming should be used. [f=2; CP and f=3; PCP]	**Partial fidelity as a traditional way**	1- Focuses on real-life problems / real-life tasks, examples and events are given in the learning-teaching process. [f⓪→15; f①→15; f②→8] 2- Focuses on basic concepts, theories, and coding systems in the learning-teaching process. [f⓪→2; f①→58; f②→8]. 3- Interrelates topics to others subjects, units and fields. [f⓪→19; f①→49]. 4- Uses different and alternative learning methods and techniques in the learning-teaching process. [f⓪→2; f①→66].
		→Infidelity →		
7- Learning is interactive. There is an intense relationship between student-student and student-teacher. 8- Different and alternative learning methods and techniques should be used. 9- Interdisciplinary /spiral relationships are established. 10- The focus is on collaborative activities rather than individual learning. 11- Special environment or class should be created for chemistry courses. 12- The classroom environment should be technologically enhanced.	**Weak fidelity**	9- Lectures must be given with the activities and examples based on the laboratory method. [f=1; CP and f=12; PCP] 10- Demonstrations technique will be used. [f=1; CP and f=1; PCP]. 11- Field trips observation method should be used [f=1; CP and f=1; PCP] 12- Students are at the center of the lectures. [f=1; CP and f=2; PCP] 13- Smart-boards are utilized. [f=1; CP and f=1; PCP] 14- Teaching materials are developed and used. [f=1; PCP] 15- Textbooks are used. [f=2 PCP] 16- There will be no new ideas.[f=1; NP/NK].	**Partial fidelity as a traditional way**	5- There is an intense relationship between students and student and teacher. [f⓪→2; f①→65; f②→1]. 6- Focuses on learning activities rather than teaching activities in the learning-teaching process. [f⓪→2; f①→66]. 7- Different types of teaching-learning materials such as primary sources and students' handmade materials are used in the learning-teaching process. [f⓪→3; f①→65].

Thus, it can be inferred that teachers are aware that there is a need for change in the learning environments. However, they only have partly perceived the properties of a constructivist learning environment. The constructivist learning-teaching practices in the chemistry courses are summarized in seven codes in the third column labeled the observed curriculum in **Table 5**. 68 hours of observation were undertaken. The 7 behaviors determined as constructivist learning-teaching criteria are given in the third column. So in total, 68*7=476 behaviors were assigned. Frequencies and percentages were calculated from these 476 behaviors. The third column shows that practice or behaviors within the learning-teaching environment do not conform to constructivist criteria. Practices and behaviors in learning-teaching environment in chemistry courses are determined as f_T⓪= 45; f_T①= 414 and f_T②=17. Some activities are attempted to be carried out according to constructivist principles but are not successfully (3.6 %); however, most of the defined in-class and out-class activities and implementations related to constructivist principles are not undertaken (9.4 %) or implemented in a traditional way (87 %). Therefore, there is an inconsistency between the intended and observed curriculum. Despite being aware of the need to change their behavior, they only partly perceived the properties of a constructivist learning environment, and chemistry was mostly taught in a traditional way.

The intended constructivist assessment approaches were identified with seven codes as shown in the first column in **Table 6** and the approaches of teachers' perception related to constructivist assessment were categorized in seven codes in the second column. Table 6 shows that none of the chemistry teachers had a perception of constructivist assessment approaches. Partial perception was identified in 7 teachers (T2, 3, 8, 10, 11, 12, 17). These teachers did not detail their ideas and sometimes reported conflicting opinions and mostly lacked depth in their responses; for example the curriculum encourages; "Process assessment is recommended rather than product assessment (f=7, T2, 3, 8, 10, 11, 12, 17)"; "Use of concept maps in assessment (f=1, T12)" and "Use of essay type questions is encouraged (f=1, T3)". Over half the chemistry teachers (13) (T1, 4, 5, 6, 7, 9, 13, 14, 15, 16, G, 18, 19) did not perceive or have any ideas about constructivist assessment approaches. Their responses were that curriculum encourages "the use of different kind of question types in the assessment (f=8, T1, 4, 6, 14, 15, 16, G, 19)"; "Use of essay type questions (f=5, T5, 9, 14, 15, 18)"; "Use of conceptual questions rather than algorithmic problem solving (f=2, T7, 14)"; "the expansion of test technique in the assessment process (f=2, T5, 9)" and "Not any new practices (f=1, T13)". Teachers' practices of constructivist assessment approaches in the chemistry courses are summarized with seven codes in the third column in Table 6 as the observed curriculum. Out of 68 hours of observation made seven behaviors identified and coded for alternative or constructivist assessment approaches. This makes 68*7=476 behaviors in total. Frequencies and percentages were calculated based on these 476 behaviors. The seven codes that were determined as alternative or constructivist assessment behaviors did not apply to all of the teachers as expected. As seen in the third column of **Table 6**, the teachers' practices in assessment approaches were not consistent with constructivist criteria. The teachers' practices were determined as f_T⓪= 465; f_T①= 10; f_T②=0 and f_T③=1. Most of the defined constructivist assessment approaches were not applied (98.1 %) or were implemented in a traditional way (1.7 %) and only 0.2 % of the behaviors were carried out according to constructivist criteria. According to constructivist principles, the teachers mostly assess students' achievement using traditional methods.

Table 6. Congruence between the intended, perceived and observed curriculum in terms of assessment approaches in a constructivist chemistry curriculum.

Intended Curriculum		Perceived Curriculum		Observed Curriculum
1- Learners should be encouraged to engage in self-assessment. 2- Learners should be given performance tasks and their classroom performance should be taken into account. 3- Learners should be given projects that include out of school activities or tasks and these activities and tasks must be added in the assessment process. 4- An individual portfolio should be created that includes all of the learners' applications, efforts and products.	**Infidelity**	The curriculum encourages: 1- Process assessment rather than product assessment. [f=7; PCP] 2- The use of concept maps in the assessment. [f=1; PCP] 3- The use of different kinds of question types in the assessment (Puzzle, Diagnostic Tools, Open-ended, short answer, multiple choices… etc.) [f=8; NP/NK]. 4- Use of essay type questions [f=1; PCP and f=5; NP/NK].	**Partial fidelity as a traditional way**	1- Learners should be encouraged to engage in self-assessment. [f⓪→68] 2- Learners should be given performance tasks and their classroom performance should be taken into account. [f⓪→65; f①→3]. 3- Learners should be given projects that include out of school activities or tasks and these activities and tasks must be added in the assessment process. [f⓪→68]. 4- An individual portfolio should be created that includes all of the learners' applications, efforts and products. [f⓪→68].
		→Infidelity →		
5- Learners should undertake peer assessments based on pre-determined criteria. 6- Learners should be given homework that encourages them to carry out research and applying higher order thinking. 7- Performance assessments and rubrics should be used.	**Infidelity**	5- Use of conceptual questions rather than algorithmic problem solving [f=1; PCP]. 6- The expansion of test techniques (multiple choices) in the assessment process. [f=2; NP/NK]. 7- The curriculum does not encourage new practices [f=1; NP/NK].	**Partial fidelity as a traditional**	5- Learners should undertake peer-assessments based on pre-determined criteria. [f⓪→68]. 6- Learners should be given home work that encourages them to carry out research and applying higher order thinking. [f⓪→60; f①→7; f②→1]. 7- Performance assessments and rubrics should be used [f⓪→68].

Conclusions

The findings from the current study suggest chemistry teachers' curriculum fidelity is very low. Therefore, there is an inconsistency between the intended, perceived and observed chemistry curriculum by the Turkish chemistry teachers. Although the majority of the teachers appear to be aware that in a constructivist classroom, the teachers' and students' roles and responsibilities need to be changed; most of the teachers only had displayed partial perception of constructivist principles and were not able to successfully implement them in classroom settings using acceptable methods, techniques and materials. Most of the time, the teachers dominated the learning process and the students were seen as passive receivers of the knowledge imparted by the educators. Furthermore, the findings showed that most of the teachers did not have an acceptable perception of constructivist assessment approaches, thus, no change in the assessment process was observed. Teachers used assessment as a summative process rather than extending it to cover formative purposes. Assessment was used to determine whether the target objectives had been achieved not to evaluate the student's learning process.

As a result chemistry teachers' curriculum fidelity is weak and most of the teachers did not abide by designed curriculum and its properties. The reasons for this weak fidelity and infidelity were due to several issues. Among them, a major problem is the lack of sufficient support and training offered to the teachers following the launch of the new curriculum. Since the Turkish education system is centralized, MoNE plans and implements the curriculum at the same time. However, teacher training is undertaken gradually after the implementation of the curriculum and these results in much confusion amongst teachers. Furthermore, the national educational system not being compatible with the basic structure and philosophy of chemistry curricula may influence this unsuccessful implementation. In addition to the dearth of in-service training for teachers there are other barriers to the successful implementation of the new curriculum including; inadequate physical conditions, visual-audio and laboratory materials and technological enhancement of learning-teaching environment and the ineffective use of laboratories by chemistry teachers.

In Turkey, another issue is the inconsistency in assessment. The constructivist curricula emphasize the importance of formative assessment while the centralized exam system in Turkey forces teachers to focus on presenting the knowledge that the students required to pass exams. A major problem caused by the centralized exams was the part of the curriculum that was omitted by the teachers. The constructive curriculum emphasizes a balanced development in as cognitive, affective and psychomotor skills. However, the teachers only focus on the cognitive dimension as it is tested in the centralized exams.

When the results of this study compared with previous studies similar findings were found. But, there are few studies about teachers' curriculum fidelity and perception or beliefs and their practices of constructivist chemistry curriculum or in chemistry education. Findings of this study is in compliance with the finding of the Uzuntiryaki, Boz, Kirbulut, & Bektas (2010) explored pre-service chemistry teachers' beliefs about constructivism and the influence of their beliefs in their practice. This study identified that majority of pre-service teachers did not have a strong conception of constructivism; instead they had moderate or weak conception of constructivism and the relationship between the pre-service teachers' beliefs and their practice was not clear. Findings of present study also parallel with Bantwini (2010) who analyzed that meaning that primary school teacher attaches to the new curriculum and found that teachers did not know or perceive the new curriculum and its components. And there have been a few studies about implementation of chemistry curriculum in Turkey (Aydın, 2007; Dönmez Usta, Ceng, Kaslı, & Ayas, 2009; Ercan, 2011; Kalkan, Savcı, Şahin, & Özkaya, 1994; Kurt & Yıldırım, 2010; Seçken & Kunduz, 2013; Yadigaroğlu & Demircioğlu, 2011) and other field of international studies about curriculum evaluation studies (Altinyelken Kosar, 2010; Chiu & Whitebread, 2011; Rowell & Prophet, 1990). These studies revealed that chemistry and others curricula and its components were not implemented into practice as desired or intended and several problems were specified. Lack of teachers' knowledge or perception about curriculum and its components such as targets or skills in curriculum, alternative assessment approaches, learning methods and techniques; focus on cognitive issues rather than affective ones; insufficient in-service courses about curriculum; lack of teaching and learning materials and teachers' guide book; crowded classes and insufficient curriculum evaluation researches were mostly mentioned by the teachers among these problems.

It is not realistic to think of the factors that influence curriculum fidelity independently, it has seen that the most important factors affecting implementation fidelity of chemistry curricula in Turkey, are teacher characteristics, organizational characteristics, regional-social-economic-cultural characteristics, centralized education system, high-stake tests and student characteristics. Developed curricula should be in harmony with the social, economic and cultural structure of the society and country. The centralized management system in Turkey, leads to formation of a centralized education and examination system that determines the fate of students throughout the country. Central examination systems, is a traditional one, also constitute a traditional student profile. This situation obviously reduces the effectiveness of the chemistry curriculum in practice. Moreover, it has been seen that chemistry teachers' perceptions and knowledge about constructivism and its properties in curriculum, is insufficient. This is point to the existence of traditional teacher characteristics and results in the fact that chemistry teachers have not adopted the curriculum adequately in Turkey. Teacher characteristics and competences need to be increased in parallel with the developed curricula. This is possible by the design and implementation of effective and practical in-service programs for chemistry teachers and teacher training programs for chemistry teacher candidates. Chemistry teacher candidates also need to graduate from the teacher-trainings programs with adequate qualifications. The link between theory and practice should be established and emphasis should be given to practical works in teacher-training programs. As a result, all these related factors have affected the implementation fidelity of chemistry curriculum in Turkey. Finally, in the present study, most of the constructivist principles in chemistry curriculum were not perceived or understood and put in to the practice adequately or correctly by the teachers. So, it can be said that there is an inconsistency between intended, perceived and observed chemistry curriculum.

Recommendations

Within the framework of the findings, the following suggestions were made in order to apply the chemistry curriculum in the desired manner in accordance with the constructivist approach. In order for chemistry curriculum success in the implementation:

1. Formative assessment approaches or activities to both chemistry teachers and teacher candidates need to be designed, implemented and evaluated. Chemistry teachers training programs should be reorganized according to these new developments or trends. In addition, chemistry curricula should be prepared in parallel with the education and examination systems of the country.
2. A large amount of chemistry teachers should be utilized in curriculum development studies and teachers should be included in this process.
3. Different chemistry curricula should be developed for different types of schools and regions. As it is known that different applications exist in different types of schools and region in Turkey. Developed more flexible curriculum leads more successful implementations in chemistry classes in Turkey.
4. Theoretical, practical, effectively and long term in-service training courses should be organized for chemistry teachers.

Limitations of the Research

The results of the research were obtained with in the following limitations:

1. This study is limited to the academic year of 2010-2011 spring-2011-2012 fall semester.
2. This study is a case conducted with the 9th grade chemistry classes.
3. This study is limited to the observation of five 9th grade chemistry teachers' classes.
4. This study is limited to interviews with 23 chemistry teachers.

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