A Research on the Generative Learning Model Supported by Context-Based Learning

Fatma Merve Ulusoy & Aysem Seda Onen
Hacettepe University, TURKEY

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This study is based on the generative learning model which involves context-based learning. Using the generative learning model, we taught the topic of Halogens. This topic is covered in the grade 10 chemistry curriculum using activities which are designed in accordance with the generative learning model supported by context-based learning. The purpose of this study was to ascertain the effects of the activities on students’ motivation towards context-based chemistry learning, their attitudes towards chemistry lessons and their level of success in understanding the halogen concepts that were taught. The sample of the study consisted of 60 grade 10 students in a high school in Ankara, Turkey. The study was conducted using a pretest – posttest design with a control group of 30 students and a treatment group of 30 students. The Context-Based Chemistry Motivation Scale, the Attitudes towards Chemistry Scale and the Halogens Achievement Test were used as data collection tools in the study. The study concluded that the context-based learning activities improved students’ motivation in learning chemistry and their attitudes towards the chemistry course as well as increasing their achievement levels in the test.

Keywords: Context-based learning, generative learning model, context-based chemistry motivation, attitudes towards chemistry.

INTRODUCTION

Gaining understanding of students’ experiences in daily life is closely related to the teaching and learning of chemistry in present times. Attempting to teach students the intensive theoretical knowledge of chemistry courses results in students perceiving the subject to be dry and abstract. As a result, there have been changes in the motivation and attitudes of students towards chemistry courses as well as in their in chemistry (Becker, 1983; Gräber, 1992; Osborne & Collins, 2001; Pekdaş, 2010; Todt, 1985; Wanjek, 2000). Therefore, awareness of the need to bridge the gap between students’ daily life experiences and the content of chemistry courses has resulted in interpreting chemistry topics around students’ daily life events (Huntemann, Paschmann, Parchmann & Ralle 1999; Koçak, 2012). Introducing chemistry topics by relating them to daily life events and increasing the quality of education has highlighted the utilization of the context-based approach in chemistry teaching (Acar & Yaman, 2011; Bennett & Lubben, 2006; Demircioğlu, Demircioğlu, Çalkı, 2009; Huntemann, Haarmann & Parchmann, 2000; King & Ritchie, 2013; Ramsden, 1997; Schwartz, 2006; Van Driel, Bulte & Verloop, 2005; Vos, Taconis, Jochems & Pilot, 2011). In the context-based approach contexts are used as the starting points for developing scientific thoughts (Bennett, Lubben & Hogarth, 2006; Ramsden, 1997). The main aim of the context-based approach is to present scientific concepts to students through selected daily life events, and as a result anticipating an increase in their motivation as well as their willingness to learn chemistry (Barker & Millar, 1999; Koşe &
**State of the literature**

- Recently, greater importance has been given to the relevance of chemistry education in the events that we face in our daily lives.
- Context-based learning has been supported simultaneously with a model, method and technique in research projects.
- Current researches show that context-based learning generally positively affects students’ interests, attitudes, motivation and success in the field of science.

**Contribution of this paper to the literature**

- In this research, it is aimed to find out the effects of context-based learning on a specified science topic (Halogen). The topic has been taught by relating students’ daily life experiences to their chemistry background knowledge.
- Studies conducted related to context-based chemistry teaching in terms of motivation was accomplished using qualitative methods. In this respect, the Context-Based Chemistry Motivation Scale designed to assess context-based chemistry motivation is the first data collection tool that has been documented in the literature.
- It is expected that meeting students’ needs and desires to learn a subject using context-based learning activities will make a positive contribution to the research literature in this field.

Tosun, (2011). In this way, it is aimed to positively influence the interests and attitudes of students towards science. Additionally, raising awareness of the relationship between real life issues and science would foster the development of science process skills (Sözbilir, Sadi, Kutu & Yıldırım, 2007). The context-based approach focuses directly on the daily life events and relates these events to chemistry concepts or topics in the form of contexts. Selection of appropriate contexts and teaching through these contexts would help to maintain the students’ attention in the lessons (Ünal, 2008).

The integration of the context-based approach into the chemistry course is referred to in the literature as “context-based chemistry”. (Huntemann et al., 1999; Parchmann et.al, 2006). The aims of context-based chemistry are to avoid the implementation of a heavy curriculum and to establish a teaching program of events that are connected to the daily life experiences of students. In this way, the chemistry course is related to the daily life events of students with the help of contexts. During the establishment of links and contexts, students’ experiments involving materials that are commonly available are utilized (Gilbert, 2006; Karagölge & Ceyhun, 2002; Palmer, 1997). According to the context-based approach, teaching environments are expected to facilitate students’ learning through extracts from daily life events and experiences. This would require students to attain skills to perform activities using daily life tools along with their theoretical or experimental knowledge. For instance, starch, hydrochloric acid, tincture of iodine and such substances could be used in determining the iodine content in table salt (Böcher, 2005), alcohol and cough pastilles could be burned to release CO_2 gas (Ledwig & Nick, 2009), the chloride content could be determined in cleaning agents such as bleach or hydrochloric acid (Böcher, 2005), and chocolate could be decomposed using acetone (Wörn, Melle & Bader, 1999). These types of experiments are in line with context-based chemistry and they have positive influences on students’ experimental skills and course achievement levels.

The importance of context-based learning is highly emphasized by the constructivist and sociocultural learning theorists. It is suggested that the context-based learning is quite effective in students’ constructing, transferring and implementing knowledge through their own experiences (Andrée, 2003; Gilbert, 2006). Therefore, presenting course contents involving context-based chemistry activities according to the methods, models and techniques in line with the constructive approach in learning resulted in positive effects favoring the achievement of context-based chemistry teaching (Choi & Johnson, 2005; Coştu, 2009; Kerber & Akhtar, 1996; Kutu & Sözbilir, 2011; Toroslu, 2011; Ültay & Ültay, 2013). One of these models is the generative learning model (Ayas, 1995; Çalık, 2006; Karplus, 1960, as cited in Ayas, 1995; Osborne & Wittrock, 1983). The generative learning model was first suggested by Osborne and Wittrock in 1983 (Kyle, Abell & Shymansky, 1989) and was translated into Turkish by Ayas (1995). It is defined as the combination of previous knowledge with new knowledge and it consists of four stages, Preliminary, Focus, Challenge and Application. The model requires the active participation of students in their own learning. Having understanding of this model, teachers could plan their own lessons using their students’ existing knowledge and the school facilities that are available (Ayas, 1995).

The need and willingness of students towards learning a topic in chemistry education should be considered from two aspects, namely the teacher and the student. Therefore, it is very important to determine the extent to which the generative learning model supported with context-based learning addresses the requirements of the model. In the light of this view, this study aims to determine the effects of teaching Halogens to 10th Grade students using activities in line with the generative learning model supported with context-based activities on students’ motivation to learn
chemistry together with their attitudes towards chemistry and their achievement in chemistry courses.

METHODOLOGY

This study was conducted using the pre-posttest design involving a control group and a treatment group. The Context-Based Chemistry Motivation Scale (CBCMS) and the Halogens Achievement Test (HAT) developed by the researcher along with the Attitudes Towards Chemistry Scale (ATCS) developed by Kan & Akbaş (2005) were used in the study. All three data collection tools were administered to the control and treatment groups as pre- and posttests. The researcher taught the Halogens topic to the treatment group using the generative learning model supported with the context-based learning activities. The worksheets that were used in the stages of the model consisted of context-based stories, context-based chemistry experiments, and puzzles – matching questions and open-ended questions. The same topic was taught to the control group using a traditional lecture method, PowerPoint presentations and with questions and answers.

Course of Teaching in the Treatment Group

At the beginning of the lesson, general information on Halogens was briefly described. This group was taught according to the generative learning model within the frameworks of determined context. The model consists of four phases. The generative learning model allows for the integration of laboratory practice to the course (Ayas, 1995; Hand & Treagust, 1991); therefore, context-based experiments were conducted with the students.

Preliminary Phase

Students in the treatment group were handed out worksheets on the topic of the day. A passage from the first part of the worksheet about a daily life event was read along with the students. Relevant contexts were given to students to arouse their curiosity. Students then participated in a discussion where questions about the reasons for the event were asked.

Focus Phase

In the focus phase of the generative learning model, experiments were performed to concretize the perceptions of students that were acquired in at the preliminary phase. Later on, the observations of students during the experiment and their conclusions were discussed. Following the experiments, students’ theoretical knowledge about the periodic characteristics of Halogens, their molecular structures and certain reactions were clarified.

Challenge Phase

In the challenge phase of the generative learning model, students completed the activities on the worksheet (puzzles, matching questions, gap filling). They were informed of various examples of the use of Halogens in everyday life. The activities enabled students to achieve their missing knowledge and establish links with their existing knowledge.

Application Phase

In the final phase of the generative learning model, students tried to solve the problems on worksheets selected from daily life events related to Halogens using the knowledge they had attained. A general evaluation together with the students was made about their understanding about halogens. During the evaluation, the main focus was on enabling students to link their existing knowledge with the new knowledge.

Course of Teaching in the Control Group

The control group was taught about Halogens using the traditional learning approach. The topic was introduced according to the lesson plan that was prepared. The researcher made use of traditional instruction, with a question & answer technique and PowerPoint presentations during the lesson.

Data Collection Tools

The Context-based Chemistry Motivation Scale (CBCMS)

A motivation scale was developed for the study to determine the motivation levels of students towards their learning of chemistry using a context-based approach. The reliability and validity of the scale were assessed with 540 high school students. The scale consisted of 20 items within a 3-factor structure. The responses were based on a 5-point Likert-type scale ranging from 1 for ‘strongly disagree’ to 5 for ‘strongly agree’. The overall Cronbach’s alpha reliability coefficient was determined to be 0.91, with values of 0.84, 0.80 and 0.81 for each of the three factors. The Kaiser-Meyer Olkin (KMO) coefficient of the scale was found to be 0.93.

Attitudes towards Chemistry Scale (ATCS)

To determine the effects of the generative learning model supported with context-based learning on
students’ attitudes towards the chemistry course, the ATCS developed by Kan & Akbaş (2005) was used. The scale consisted of 22 items with three factors based on responses with a 5-point Likert-Type ranging from strongly agree (5) to strongly disagree (1) structure with 3 factors. The factors were named by the researchers as Positive Feelings towards Chemistry Course, Negative Feelings towards Chemistry Course and Chemistry Course Related Activities. The Cronbach’s alpha coefficient for the whole scale was 0.92, with values of 0.87, 0.87 and 0.78 for each of the three factors. The structural validity of the scale was assessed through a value of 0.94 for the KMO coefficient.

**Halogens Achievement Test (HAT)**

An achievement test was developed for the study to determine the achievement levels of the 10th Grade students on Halogens. The test consisted of 20 structured questions. As context-based activities were considered in the study, the questions of the achievement test were related to students’ daily life experiences. The pilot study of the test was administered to 491 students and the Cronbach’s alpha value was calculated to be 0.73. The average difficulty of the test was found to be (p) 0.62 and the average distinctiveness was determined to be (r) 0.56. Each question had a score of five points and the total score ranged from 0 to 100.

**The internal and external validity of the study**

Data collection tools were administered to the control and treatment groups for obtaining the internal validity. The researchers evaluated data obtained from each group. A pretest was administered four weeks prior to the beginning of the study while the posttest was administered four weeks after the study was completed. Students in the treatment group were interviewed before the study and informed of the procedure of instruction. As the students were aware that they were a part of the experimental group, to avoid the performance change risk, these students were subject to effective communication and motivation provided by the researchers.

This study was conducted with 10th Grade students from an Anatolian High School in Ankara. The conclusions of this study could be generalized for similar research with other similar groups of students.

**FINDINGS**

Independent samples t-test analyses were conducted using the averages of students’ scores obtained from the ATCS, the CBCMS and the HAT with the aim of determining the any potential significant differences. The results are displayed on Table 1.

Table 1 shows that there was no statistically significant difference between the average pretest scores of the control and treatment group achieved in the ATCS, CBCMS and HAT [t(38) = -0.85; -1.95; -.56, p>.05]. This finding suggests that students of the two groups were at similar levels in terms of their attitudes towards chemistry, motivation and achievement.

Paired samples t-test analyses were conducted using the averages of students’ scores obtained in the ATCS, CBCMS and HAT at the end of instruction with the aim of determining any potential significant differences. The results are displayed on Tables 2, 3 and 4. (Table 2)

Table 2 shows that there is a statistically significant difference between the pre and posttest scores of students in the ATCS [t(29) = -7.03, p<.05]. While the average attitude scores of students before instruction was ( = 2.75), it displayed a significant increased and reached up to ( = 3.43) after instruction. In other words, the generative learning model supported by context-based learning was found to have contributed to the development of positive attitudes towards the chemistry course. No significant increase was observed between the pre and posttest scores of the control group students regarding their attitudes towards chemistry [t(29) = -1.62, p>.05]. (Table 3)

Table 3 indicates that there was a statistically significant difference between the pre and posttest scores of students in the CBCMS [t(29) = -5.59, p<.05]. The average scores of treatment group students in the pretest was ( = 3.41) while it increased to ( = 4.12) in the posttest after instruction. This conclusion shows that the generative learning model supported by context-based learning improved the motivation of students towards their daily life chemistry experiences. Students in the control group did not show any statistically significant differences between their pre and posttest average scores in the CBCMS [t(29) = 0.08, p>.05]. (Table 4)

A statistically significant difference was observed between the pre and posttest HAT averages scores of the treatment group students the [t(29) = -12.10, p<.05]. While the halogens test average scores of the treatment group students before instruction was ( = 63.67), the average increased to ( = 91.17) following instruction. There was also a statistically significant difference between the pre and posttest averages of the students in the control group [t(29) = -3.97, p<.05].

While the achievement test average score of the students was ( = 65.67) in the pretest, it increased to ( = 72.83) following instruction. In other words, the achievement levels of control group students were significantly better than they were before instruction.
After instruction, independent samples t-test analyses were conducted using the average scores obtained from the ATCS, CBCMS and HAT with the aim of determining any potential differences. The results are displayed in Table 5. (Table 5)

Table 5 indicates that there is a statistically significant difference between the average scores obtained by students in the control and treatment groups in the posttest of the ATCS in favour of the treatment group \[ t_{(58)} = 2.38, p<.05 \]. This finding shows that the
The posttest average scores of the control and treatment group students in the CBCMS were significantly different \( t_{58} = 3.41, p<.05 \). The posttest score averages of the treatment group students in the CBCMS (\( \bar{x} = 4.12 \)) was higher than that of the control group, which shows that the generative learning model supported by context-based learning positively affected students’ motivations towards their daily life experiences in chemistry.

The HAT results showed that there was a statistically significant difference between the posttest scores of the control and treatment group students favoring the treatment group \( t_{58} = 7.83, p<.05 \). The posttest score averages of the treatment group students in the HAT (\( \bar{x} = 91.17 \)) was higher than that of the control group (\( \bar{x} = 72.83 \)), which shows that the generative learning model supported by context-based learning increased students’ achievement levels about the halogens.

### CONCLUSION AND DISCUSSION

Context-based learning is an approach depending on the principle that scientific concepts should be presented through certain methods by establishing contexts and relationships selected from students’ daily life events (Barker & Millar, 1999; Gilbert, 2006). In the light of this perspective, it aims to increase students’ motivation and attention towards the lesson, while encouraging them to learn about science and develop positive attitudes towards the courses, which in turn would increase their achievement levels (Barker & Millar, 1999; Gilbert, 2006; Köse & Tosun, 2011; Palmer, 1997; Yaman, 2009). In this study, the topic was introduced within the generative learning model with the selection of appropriate contexts for the students to establish links between the halogens and daily life events. The findings of the study indicate that as a result of the context-based learning activities, students’ context-based chemistry motivation improved along with their attitudes towards the chemistry course, while their achievement levels in the Halogens test increased.

At the beginning of the study, it was assumed that there was no significant difference between the context-based chemistry motivations of students in the control and treatment groups. After the completion of the study, students in the treatment group, who were taught according to the context-based learning methodology, were observed to have increased levels of context-based chemistry motivation, while those of the control group, who received traditional instruction, were identified to have no significant differences in their context-based chemistry motivations. As the topics were not taught within the contexts in the control group, it is an expected result that there were no significant changes in the students’ context-based chemistry motivation. In the treatment group, establishing connections with their daily life experiences using relevant contexts as aimed at creating curiosity among students, which increased their motivation accordingly. There are various studies in the literature indicating that context-based learning increases students’ motivation (İlhan, 2010; Kesner, Hoffstein & Ben-Zvi, 1997; Koçak, 2012; Kutu & Sözbilir, 2011; Lubben, Campbell & Dlamini, 1996; Murphy & Whitelegg, 2006). Peşman and Özdemir (2012) examined the effects of context-based physics teaching on the motivation of students towards physics. The study concluded that no significant change was observed in students’ motivation towards learning physics.

It was assumed that as there were changes in the context-based chemistry motivation of students, their attitudes towards chemistry would also change. The ATCS that was administered to the students in both groups as a pretest prior to the initiation of the study concluded no statistically significant difference in their attitude scores. After the study was completed, the scale

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**Table 5.** T-test results of the posttest scores obtained from the attitudes towards chemistry scale, context-based chemistry motivation scale and halogens achievement test (N = 60).

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>( \bar{x} )</th>
<th>ss</th>
<th>sd</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATCS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Treatment</td>
<td>30</td>
<td>3.43</td>
<td>0.50</td>
<td>58</td>
<td>2.38</td>
<td>.02</td>
</tr>
<tr>
<td>Control</td>
<td>30</td>
<td>3.03</td>
<td>0.77</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>CBCMS</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Treatment</td>
<td>30</td>
<td>4.12</td>
<td>0.45</td>
<td>58</td>
<td>3.41</td>
<td>.001</td>
</tr>
<tr>
<td>Control</td>
<td>30</td>
<td>3.73</td>
<td>0.43</td>
<td></td>
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<tr>
<td>HAT</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Treatment</td>
<td>30</td>
<td>91.17</td>
<td>8.06</td>
<td>58</td>
<td>7.83</td>
<td>.00</td>
</tr>
<tr>
<td>Control</td>
<td>30</td>
<td>72.83</td>
<td>9.97</td>
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</tbody>
</table>
was administered as a posttest and a significant increase was observed in the attitude scores of the students in the treatment group. Meanwhile, no significant changes were observed in the attitude scores of the students in the control group. This conclusion is in line with the outcomes of various studies on context-based learning approaches in the literature (Demircioğlu, 2008; Gurtwill-Wise, 2001; Henderleiter & Pringle, 1999; Ilhan, 2010; Kesner, Hofstein & Ben-Zvi, 1997; King, Belloccchi & Ritchie, 2008; Koçak, 2012). Conclusions of studies on other disciplines other than chemistry also suggest that context-based learning positively affected students’ attitudes towards the courses (Barker & Millar, 1999; Çam, 2008; Hırça, 2012; Kim, Yoon, Rae Ji & Song 2012; Ramsden, 1997; Reid, 2000b). However, there are studies in the literature, which have concluded that context-based learning activities did not have significant effects on students’ attitudes towards the courses (Kutu & Sözbilir, 2011; Sari, 2010; Ünal, 2008).

The HAT that was administered to the students to determine their achievement levels before the study, showed that there were no significant differences between the achievement test averages of the students in both groups. After the study was completed, an increase was observed in the achievement scores of all students in both control and treatment groups. However, the posttest results indicated that the achievement levels of the students in the treatment group were higher than those of the students in the control group. The literature documents various studies that indicate higher achievement levels as a result of context-based learning approaches similar to this study (Toroslu, 2011; Demircioğlu, 2008; Ilhan, 2010; Ramsden, 1997; Steinhoff, 2004; Koçak, 2012; Ünal, 2008).

While society is rapidly changing, individuals should adapt to the developing society and change their attitudes or behaviors, which is one of the most important functions of science education. Additionally, it is very important that the presentation and instruction of course topics should be reasonable, understandable and useful (Ruis, 1988; Yücel, 2007). The context-based chemistry learning approach is recognized as an approach that is in line with the targets of effective chemistry teaching. Accordingly, it could be supported with various methodologies and models that are based on the constructive approach. The study concluded with significant increases in students’ achievement levels along with their attitudes towards chemistry. All these significant findings have been related to and interpreted to improvements in students’ motivation towards context-based learning. The studies for assessing motivation carried out up to now, were conducted with qualitative methods. In this sense, this data collection tool designed to assess motivation has the feature of being the first quantitative tool documented in the literature. The findings of the study indicate that the generative learning model supported with the context-based learning approach would make positive contributions to the teaching process and would be a relevant educational model that relates chemistry teaching to the daily life events of students.

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