THE EFFECT OF HANDS-ON CHEMISTRY EXPERIMENTS ON SELF-DIRECTED LEARNING READINESS

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Abstract

The aim of this research is to examine the effects of daily life-based chemistry experiments on prospective teachers’ views about science experiments of hands-on science and self-directed learning readiness. The sample of the research is the prospective teachers’ who are studying in Hacettepe University, Faculty of Education, and Department of Chemistry Education. The research is designed in a mixed method design. A single group pretest-posttest design was used in the quantitative dimension of the study. In the data analysis, the difference between prospective teachers’ opinion scores on hands-on science experiment and self-directed learning readiness scores. The qualitative dimension of the research was carried out in accordance with the situation pattern, and focus group interviews were conducted with the prospective teachers’ on the methodological methods used and the findings obtained helped explain the quantitative results. The data is collected with views about science of hands-on science experiments scale and self-directed learning readiness scale. In the quantitative findings of the study, it was determined that the prospective teachers’ opinions about the use of hands-on chemistry experiments in their lessons and self-directed learning readiness developed. In qualitative findings, it is emphasized that such experimentation practices still bring chemistry lessons more enjoyable, provide information permanence, reinforce learning and benefit theoretical lectures.

Keywords: hands-on science, self-directed learning, chemistry laboratory, prospective teachers.

1. INTRODUCTION

Since physical sciences and chemistry analyze the relevance in abstract concepts, they are seen hard to grasp by individuals, and therefore the interest in these fields are gradually decreasing (Mete & Yıldırım, 2016). The daily life-based learning approach is a pattern that has been improved in order to increase the diminishing interest in these classes due to the fact that physical sciences, especially chemistry, are perceived to be abstract and detached from life. The daily life-based learning approach provides the connection between an incident in our daily life and a topic in physical sciences. The aim of the daily life-based learning approach is to tell about scientific concepts through the incidents we come across in daily life, and thus increase the interest in physical sciences and other sciences and enable the correlation between the incidents we come across in daily life and physical sciences to be apprehended (Sözbilir, Sadi, Kutu & Yıldırım, 2007). The daily life-based practices have
some positive effects such as increasing the interest of students in science classes, noticing the bonds between
daily life and science classes, and creating an effective learning (Bennett, 2003). The daily life-based learning
provides the establishment of the connection between theoretical and practical information. In physical sciences,
especially in the field of chemistry, there is no time left for practical applications. Instead, theoretical information
is explained in long details and it makes the topic hard for the student to understand. In fact, if the lesson is
structured by the practical applications like the incidents related to physical sciences or chemistry in daily life, it
will both cause to increase the interest of students in physical sciences and cause to have a meaningful learning
(Reid, 2000). The success of daily life-based practices in science education has been demonstrated through the
researchers conducted (Değirmencioğlu, 2008; İllhan, 2010; Kutu & Sözbilir, 2011; Acar & Yaman, 2011; Hırça,

Planning and teaching the chemistry activities with the materials used in daily life will be more meaningful for
students as they need to believe that information has a place in their daily lives in order to accept the newly
taught information. In this context, it stands out that teachers need to associate the information related to the
topics taught with daily life so that students can structure what is taught in a meaningful way. Based on this, this
research aims to analyze the effect of the daily life-based chemistry experiments on the opinions of prospective
chemistry teachers about the hands-on science experiment and self-directed learning readiness.

2. METHODS

The research is designed in a mixed method design. In the quantitative dimension of the study, a single group
pretest-posttest research design was used. The qualitative dimension of the research was carried out in accordance
with the situation pattern, and focus group interviews were conducted with the teacher candidates
on the methodological methods used and the findings obtained helped explain the quantitative results.

2.1. Sampling

The study group of the study is consists of 16 prospective chemistry teachers' who are studying at Hacettepe
University, Faculty of Education. The study was carried out in the General Chemistry Laboratory course during
the spring semester of 2017-2018 academic year.

2.2. Data Collection Tools

2.2.1. Opinions about hands-on science experiments scale

The scale was developed by Uzal, Erdem, Önen & Gürdal (2010). The scale consists of 12 items in 4-point likert
type. The Cronbach alpha reliability coefficient of the scale is .92 for the whole scale. The Cronbach Alpha
reliability coefficient obtained from the sample datas’ is 0.84.

2.2.2. Self-directed learning readiness scale

The scale was developed by Kocaman, Dicle, Üstün & Çimen, (2006) and consist of 40 items in 5-point likert type.
The scale has three sub-scales: self-management, willingness to learn, and self-control. The Cronbach alpha
reliability coefficient of the scale is 0.924 for the whole scale. The Cronbach alpha reliability coefficients of the
subscales are 0.857; 0.847 and 0.830. The Cronbach Alpha reliability coefficient obtained from the sample datas’
is 0.93.

2.3. Data Analysis

Analysis of the quantitative data obtained from the study was performed with the SPSS 15 packet program.
Primarily descriptive statistics were calculated for the variables of opinions about hands-on science experiments
and self-directed learning readiness. Thus, opinions about hands-on science experiment and self-directed
learning readiness levels of the study groups were determined. The difference between pre-test and post-test
scores of prospective teachers’ opinions about hands-on science experiment and self-directed learning readiness
level was examined by Wilcoxon signed rank test.

The qualitative dimension of the study was conducted in accordance with the situation pattern. Focus group
discussions were held on the methodological activities with prospective teachers'. The obtained data were
analyzed and codes related to the opinions about hands-on science experiments and self-directed learning
readiness were determined. Findings have helped explain quantitative results.

3. RESULTS

3.1. Quantitative findings

Descriptive statistics related to pre-test scores of prospective teachers’ opinions about hands-on science
When Table 1 is examined, it has been seen that the prospective teachers' opinions about hands-on science experiments are at the level of medium (X: 3.16) and self-directed learning readiness level is higher (X: 4.11). When the subscales of the self-directed learning readiness scale are examined, it is noteworthy that the highest scores are in the willingness to learn.

Descriptive statistics of the prospective teachers' related to scales after the application are summarized in Table 2.

When Table 2 is examined, it is noteworthy that the increase of prospective teachers' opinions about hands-on science experiments and self-directed learning readiness.

As a result of the application, the difference between pre-test and post-test scores of prospective teachers opinions about hands-on experiments was examined by Wilcoxon signed rank test.

When the table 3 is examined, there is a statistically significant difference between pre-posttest scores of opinions about hands-on science experiments (Z=-2.229, p<0.05).

The difference between pre-test and post-test scores of prospective teachers self-directed learning readiness level was examined by Wilcoxon signed rank test, and the results are seen in table.
Table 4: Wilcoxon signed rank test results of self-directed learning readiness

<table>
<thead>
<tr>
<th></th>
<th>X</th>
<th>sd</th>
<th>Z</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-directed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>learning</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>readiness</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-test</td>
<td>4.11</td>
<td>.48</td>
<td>-2.252</td>
<td>.024*</td>
</tr>
<tr>
<td>Post-test</td>
<td>4.32</td>
<td>.45</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

There is a statistically significant difference between pre-posttest scores of self-directed learning readiness level (Z = -2.252, p < 0.05).

Table 5: Sub-scales analyses of self-directed learning readiness

<table>
<thead>
<tr>
<th>Self-directed learning readiness level</th>
<th>X</th>
<th>sd</th>
<th>Z</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-management</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-test</td>
<td>3.94</td>
<td>.49</td>
<td>-1.789</td>
<td>.074</td>
</tr>
<tr>
<td>Post-test</td>
<td>4.15</td>
<td>.54</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Willingness to learn</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-test</td>
<td>4.25</td>
<td>.57</td>
<td>-1.010</td>
<td>.312</td>
</tr>
<tr>
<td>Post-test</td>
<td>4.35</td>
<td>.57</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-control</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-test</td>
<td>4.14</td>
<td>.56</td>
<td>-2.435</td>
<td>.015*</td>
</tr>
<tr>
<td>Post-test</td>
<td>4.45</td>
<td>.49</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

When the table is examined, it has been seen that there is a statistically significant difference between pre-posttest scores of self-control sub-scales of self-directed learning readiness scale (Z = -2.435, p < 0.05).

3.2. Qualitative findings

3.2.1. Qualitative findings related to opinions about hands-on science experiments

According to the findings obtained from the focus group interviews with the prospective teachers, the codes were determined. The codes and the students who gave their opinions were given in Table.

Table 6: Qualitative findings related to opinions about hands-on science experiments

<table>
<thead>
<tr>
<th>Codes</th>
<th>Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daily life based experiments make laboratory lessons</td>
<td>S4, S6, S12, S13, S15</td>
</tr>
<tr>
<td>enjoyable.</td>
<td></td>
</tr>
<tr>
<td>Daily life based experiments reinforce learning.</td>
<td>S1, S2, S3, S5, S7, S8, S9, S10,</td>
</tr>
<tr>
<td></td>
<td>S11, S14, S16</td>
</tr>
</tbody>
</table>

Example sentences of codes are given below.

**Code 1**
S4: Daily life-based experiments are more fun than classical experiments
S12: Daily life-based experiments offer a funny and safety working environment.
S13: At first, the laboratory seemed to be a problem on its own. Daily life-based experiments have allowed me to get used to the environment and not to be encouraged.

**Code 2**
S1: ... The work done with practical applications of theoretical knowledge in daily life-based experiments is more memorable ...
S2: ... Daily life-based experiments make it easier for the student to re-examine himself ....
S3: I can rethink what I did during the experiment at home, making it easier to understand and work on my one-stop topic.

3.2.2. Qualitative findings related to self-directed learning readiness

According to the findings obtained from the focus group interviews made with the prospective teachers, the students who gave opinions about self-directed learning readiness were given in the table.

Table 7: Qualitative findings related to self-directed learning readiness

<table>
<thead>
<tr>
<th>Codes</th>
<th>Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-management</td>
<td>S6, S8, S11, S14</td>
</tr>
<tr>
<td>Willingness to learn</td>
<td>S1, S2, S3, S5, S9, S10</td>
</tr>
<tr>
<td>Self-control</td>
<td>S4, S7, S12, S13, S15, S16</td>
</tr>
</tbody>
</table>

Example sentences of codes are given below.

**Code 1**
S6: It is much easier to construct the daily life-based experiment phases in the head.
S8: Daily life-based experiments allow me to be aware of my own responsibility and make me feel courageous.

**Code 2**
S5: Experimenting with daily life-based experiments firstly helps me to plan and work on my schedule.
S10: It is more difficult for people to forget what they are doing, and mistakes in an act that they do are more noticeable than the intellectual mistake and learn the truth more easily.

**Code 3**
S7: Daily life-based experiments allow me to understand when I go home that I have learned to repeat it.
S12: Daily life-based experiments combine theoretical knowledge with other information in the mind.

4. DISCUSSION AND CONCLUSION

In this research, the effects of daily life-based chemistry experiments on the self-directed learning readiness, which consists of such features as the increase of the interest in learning and experimentation, the ability to solve the problems encountered in daily life and the ability to use the time well, planning a self-oriented learning, creating self-discipline, generating new ideas, critical thinking, and need for learning something new, have been analyzed.

As a result of the research, it is determined that the daily life-based chemistry experiments have affected the opinions about hands-on science experiments in a positive way, and also have an impact on the level of self-directed learning readiness. It has also emerged with the help of the daily life-based experiments that there has been a significant difference in the extent of self-control involving some readiness such as concentration of prospective teachers on a problem, determination of their own learning goals, taking responsibility, keeping their expectations high, believing in their capabilities, and being aware of their limitations. In the qualitative findings of the study, by analyzing the data acquired from the result of focus group interviews with prospective teachers, it is stated that the daily life-based experiments have made laboratory lessons enjoyable and reinforced learning. Some expressions of prospective teachers support this finding, such as “...at first, laboratory seemed to be a problem itself. The daily life-based experiments have made me accustomed to the environment and encouraged me... and ... The daily life-based experiments make re-examining the topic easy for the student by himself or herself. The contribution of the daily life-based experiments to the self-directed learning readiness emerges from such expressions as “the daily life-based experiments provide me with being aware of my own responsibility and being courageous...”. It is harder for people to forget what they have done and they notice the fault they have done in an action easier than the fault in thinking and learn the truth more easily... and the daily life-based experiments allow me to understand whether I have learned the topic when I go home and regurgitate the topic. The qualitative findings of the study support the quantitative findings.
When literature is reviewed, findings that practices of the daily life-based learning approach motivate students to learn (Dong, 2005; Demircioğlu, Demircioğlu & Ayas, 2006; Stolk, Jong, Bulte & Pilot, 2011), allows to facilitate obtaining information, permanence and meaningful learning (Murphy & Whitelegg, 2006; Sözbilir, Sadi, Kutu & Yıldırım, 2007; Özay Köse & Çam Tosun, 2011; Topuz, Gençer, Bacanak & Karamustafaoğlu, 2013; Korsacılar & Çalışkan, 2015; Gül, Keskin & Özay Köse, 2016; Şensoy & Gökçe, 2017) support the results of the research.

Findings about how the daily life-based practices provide the usage of information in daily life, and the daily life-based learning help students to remember the information they have obtained in their further education lives and facilitate learning following topics (Sadi-Yılmaz, Othan & Cantimur, 2014), at the same time, the daily life-based practices encourage prospective teachers to motivate students for the class and allow to give wide coverage to practices in the class (İlhan, Doğan & Çiçek, 2015) support the qualitative results of the research.

In this research, it is determined that the daily life-based chemistry experiments influence the opinions about hands-on science experiments and prompt them to self-directed learning. We are not aware of the daily life states of the theoretical information that we know. In education system, information should ensure individuals to understand the concrete experiences that they will use in their daily lives. Chemistry and other course contents of classes should be associated with incidents that students encounter in their daily lives. The information learned in this way will be remembered more easily, permanent and internalized. The change and relationship of the daily life-based experiments with other variables apart from self-directed learning can be researched. Also, an analysis can be made with other sample groups and results can be contrasted. The effectiveness of daily life-based learning in different branches except for chemistry can be explored. Thereby, it has been aimed to bring social aspect of the chemistry into the forefront for prospective teachers in a chemistry teaching environment based on real practices.

REFERENCES


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