DETERMINING THE LEVELS OF UNIVERSITY STUDENTS' CHEMISTRY KNOWLEDGE ASSOCIATING WITH THE DAILY LIFE

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ABSTRACT

The aim of this study is to find out how the university students explain the cases in their daily life by using chemistry knowledge. The method of the research is case study. The study group consists of university students who get chemistry education at an university in Middle Blacksea Region attending to Education Faculty and Vocational High School in 2016-2017 academic year. The sample of the study is 160 second grade students attending to science and elementary school teacher training departments of Education Faculty and chemistry first degree Vocational High School program. As a data collection tool, "Chemistry Knowledge Associating Daily Life Questionnaire" was used developed by researcher. In the first part of the questionnaire, the students were asked questions about demographic properties, the sources of knowledge they get in their daily life and the sources they used for solving problems. In the second section, two tailed questions about chemistry were asked. The students said that they use internet and their families to get knowledge and they benefit their experiences and traditions more than scientific knowledge to solve their problems. Most of the students chose the acceptable answers in offered cases but they were insufficient to make explanations. It was seen that the students could not give meaning to the cases they faced in their daily life with the chemistry knowledge they had. It can be suggested that the chemistry knowledge given to the university students should be related to problems they can face in the daily life and how they overcome these cases.

Keywords: *chemistry education, chemical literacy, knowledge association*

INTRODUCTION

Science education is important for an individual regarding to get logical thinking, inquiry, problem solving and participating in decision making processes. It can be determined with the problem solving practices how much they learn and understand while they are attending to the classes. The purpose of the science education all over the world is to train individuals with science literacy. Science literacy needs to read and understand related science articles and to deal with social problems about its validity. An individual with science literacy can describe the scientific problems at decision process and explain academically and technologically (Buxton, 2001).

Science education aims to train students who make inquiry, investigate, think logically, have scientific thinking skills and use it in solving problems. In science education, chemistry education is important for teachers and educators. The revised chemistry curriculum, should mention about basing chemistry concepts, the development process of scientific knowledge as well as nature of science, the importance of chemistry in daily life, the relation of it with technology and using this knowledge to explain in health, environment and life problems (Ministry of National Education [MoNE], 2018). Using the knowledge in daily life is related what a student learns at school with actual events in his environment. When a student observes the concepts learnt at school with the real events that he experiences in his surroundings, meaningful learning realizes when he uses those concepts. Hesse and Anderson (1992) stated that the students educated in schools perceive the concepts in science and technology as luxurious words. The individuals accept these concepts as a second language because they don't use them in their daily life and they lead to prejudice. It is important to relate the knowledge with the daily life (Harlen, 2002;

Andree, 2003; Campbell & Lubben, 2000; Gilbert, 2006; Pınarbaşı, Doymuş, Canpolat & Bayrakçeken, 1998). It is stated that the knowledge related with the daily life is permanent and motivates the students (Kıyıcı & Aydoğdu, 2011; Osborne, Simon & Collins, 2003). The events that the individuals encounter in their daily life can contribute to constitute relations with the concepts make them scientific literacy (Balkan-Kıyıcı, 2008; Enginar, Saka & Sesli, 2002; Yıldırım & Birinci Konur, 2014). Parnell (1996) suggested that the knowledge the students received at school about daily life should be integrated with the practice to become permanent. When science is related with the daily life, the students can explain and solve the problems through scientific realities. Reif and Larkin (1991) states that students have some problems meaning the difference between school science and everyday science. They claimed that these differences cause them to use alternative concepts and ways of thinking which are effective in everyday life, but not in science.

The studies carried on different disciplines of science showed that the students could not relate the knowledge with the daily life. Chemistry subjects generally contain abstract concepts and formulae. Learning the chemistry meaningful for a student means to understand the formulae and concepts and to use them in chemical calculations. Roberts, (2007) defines chemistry literacy as activation of information, skills, achievements and other elements suitable for educational purposes. To make the chemistry knowledge concrete, it is necessary for a student to learn the importance of learning chemistry and to connect it with the life experiences (Gilbert, 2006). Vos et al, (2010) said it is aimed to be aware of the meaning of chemistry learning instead of not teaching them what the chemistry is. The students are successful to solve chemical problems and to learn formulae and symbols at school, but they cannot carry them to their daily life (Haidar & Abraham, 1991; Ayas & Özmen, 1998). The content of chemistry should provide subjects which a student can encounter in his life. Many subjects such as matter, properties of matter, mixtures, gases, solutions, pressure, change of state, boiling, colligative properties can be used to explain the events in our daily life. Events such as foods, medication, paints, soap powders, cells, cooking, digestion should need chemistry knowledge to make them meaningful. Chemistry and chemistry laboratory activities are included into the curriculum at university level. The aim of this study is to find out how the university students attending chemistry courses explain the cases in their daily life by using chemistry knowledge and how much they benefit from scientific knowledge in their daily life.

The research questions are below:

- Which sources do university students who attend chemistry courses use to acquire knowledge in daily life?
- Which sources do students benefit from while solving problems?
- What is the level of the students using their chemistry knowledge to explain the daily life?
- How differs the usage of chemistry knowledge of the university students related to the gender, departments and high school they finished?

METHODOLOGY

Research Model

The research method was case study. Gall, Gall and Borg (2002) described the case study as follows; *" A case study is done to shed light on a phenomenon, which is the processes, events, persons or things of researcher"*. Case study investigates the situation in real-life context or environment (Yin, 2009). In this research, multiple case study method was conducted to investigate the level of correlation of chemistry knowledge with daily life of students from different departments.

Research Sample

The research group consists of university students who get chemistry education at a university in Middle Blacksea Region attending to Education Faculty and Vocational High School in 2016-2017 academic year. The sample of the study is 160 second grade students attending to Science and Elementary School Teacher training departments of Education Faculty and chemistry technologies first cycle Vocational High School program. Purposeful sampling method was used in this research. The criterion includes attending to the chemistry classes or beforehand. The distribution of the sample is given Table1.

Table 1. Demographic properties of sample

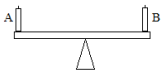
		Science Education		**Elementary School Education**		**Chemistry First Degree Program**		**Total**	
		n	%	n	%	n	%	n	%
Gender	Female	39	75.0	59	76.6	25	80.6	123	76.9
	Male	13	25.0	18	23.4	6	19.4	37	23.1
Type of finished high school	General	18	34.6	12	15.6	4	12.9	34	21.3
	Anatolian	26	50.0	59	76.6	8	25.8	93	58.7
	Vocational	7	13.5	1	1.3	19	61.3	27	16.9
	Others	1	1.9	5	6.5	0	12.9	6	3.8

The sample can be said not to be homogenous. As it results from that the students attending to Education Faculty are mostly female and the number of students attending to vocational school is less. In Turkey general high schools are the schools in which the students who cannot get enough grades from the national exam attend. Anatolian high schools are the ones where the students are taught with foreign language and moreover the students attending Anatolian high school get higher grades than the students attending general high school.

Data Collection Tools

The developed "Chemistry in Daily Life Questionnaire" was used. In the first part of the form, the students were asked questions about their gender, branch, the type of high school they finished, the sources of knowledge they get in their daily life and the sources they used for solving problems. At the acquiring knowledge and problem solving sources step, Balkan-Kıyıcı (2008) were used as a reference. In the second section, two tailed questions about chemistry were asked. Questionnaire form with 35 questions was prepared investigating the curriculums of science education, elementary school education and chemistry first degree. The content validity is provided by taking the opinions of three chemistry, one chemistry education and one physics education professionals. A pilot practice was given to the 40 students who are out of sample group. The misunderstood and unanswered questions were eliminated and the latest status of the form which had 25 questions were determined as summarized in Table 2.

Table 2. Distribution of the question contents

Question Content	Question number	Question Samples
Separation of the mixtures	1	We can distinguish alcohol-water/salt-water solution by evaporation method. Because....
Colligative properties	2, 3	Antifreeze is used in vehicles in snowy/sunny weather. Because....
Boiling, evaporation, condensation, expansion	4,5,8,11,25,22	Making tea takes longer/shorter on the Erciyes mountain than Samsun. Because....
Acids and acidic properties	6,13,18	I boil with carbonated / lemon water to dissolve lime in the kettle. Because...
Gases	9, 20, 21	Cologne/naphthalene is perceived faster in the same room. Because....
Greenhouse effect	10	Using chlorofluorocarbons in deodorants is prohibited due to give harm to ozone layer/increase greenhouse effect. Because....
Dissolution, solutions	12, 16, 24	Adding sugar into the tea proves that the solubility is exothermic/endothermic . Because....
Atom, mass, preservation of mass	14, 15, 17	 There are two non-burning candles in the balanced system When we light A candle, A/B candle comes down. Because....
Metals	7,19,23	Pickles are kept/not kept in metal containers. Because....

Students were asked to read the given statement, underline the wrong one and explain their choice. Sample questions (Question X: Q_x) are below.

Q_2. I am adding salt before/ after cooking. Because….

Q_9. Cologne / naphthalene in the same room is detected faster. Because ...

For the reliability, answered ten questionnaire form chosen randomly are coded by using two independent persons who are chemistry expert. Intercoder reliability was calculated as recommended by Miler and Huberman (1994). The coding reliability of the question form was calculated .92; it proves that the research is reliable.

Data Analysis

Analysis of data was performed by using SPSS 20.0 programme. In descriptive analysis percentage and frequency statics were used. After checking whether the data has a normal distribution or not via Kolmogorov-Smirnov test, analyses were made with parametric tests. Independent sample t-test and oneway ANOVA were used for the group comparisons. The results were determined at the $p= .05$ significance level. The point interval below was used for the scale evaluation. 5-4.2 interval "always", 4.19- 3.40 interval "often", 3.39-2.60 interval "sometimes", 2.59-1.79 interval "rarely" and 1.80-1 interval "never".

The criterion given in the table below was used for evaluation of the chemistry questions. The results were presented related to the coding as Table 3.

Table 3. Rubric for evaluating chemistry questions

Response	Explain	Code	Point
Unanswered	Untreated on the item	a	0
False	Explanation in the first or second section can be false	b	0
First section true	The marking in the first section is correct but not explanation is not given in the second section	c	1
Partially true	The marking in the first section is correct but the explanation is partially true	d	2
True	Scientific explanation is given correctly related to the first section	e	3

Examples about chemistry questions coding (Student 16: S_{16})

Q_2:

S_{80}: I add salt before / ~~after~~ cooking. Because they mix properly. (b, 0 point)

S_{16}: I add salt ~~before~~ / after cooking. Because …. (c, 1 point)

S_{78}: I add salt ~~before~~ / after cooking. Because, it delays the boiling late (d, 2 point)

S_{81}: I add salt ~~before~~ / after cooking. Because, salt increases the boiling degree (e, 3 point)

Q_{12}:

S_{102}: When sugar is added into the tea, cooling shows solubility is exothermic/ ~~endothermic~~. Because ... (b, 0)

S_{103}: When sugar is added into the tea, cooling shows solubility is ~~exothermic~~/ endothermic. Because … I don't know (c ,1)

S_{95}: When sugar is added into the tea, cooling shows solubility is exothermic/ ~~endothermic.~~ Because exothermic releases heat (b, 0)

S_{93}: When sugar is added into the tea, cooling shows solubility is ~~exothermic~~/ endothermic. Because, temperature decreases as it receives heat outside (e, 3)

RESULTS

In the first part of the questionnaire, the students were asked information sources in daily life. Table 4 presents of distribution the sources of knowledge students get in their daily life.

Table 4. The sources of knowledge students get in their daily life

	Always		Often		Sometimes		Rarely		Never		Unanswered		$\bar{X}$
	n	%	n	%	n	%	n	%	n	%	n	%	
School	65	40.5	65	40.6	25	15.6	4	2.5	0	0	1	.6	*4.17*
Family	63	39.4	57	35.6	30	18.8	7	4.4	1	.6	1	.6	*4.08*
TV, pc progr.	5	3.1	38	23.8	87	54.4	28	17.5	0	0	2	1.3	3.09
Radio	3	1.9	9	5.6	13	8.1	70	43.8	63	39.4	2	1.3	1.83
Popular newspaper	5	3.1	19	11.9	56	35.0	58	36.3	19	11.9	3	1.9	2.53
Scientific journals	9	5.6	22	13.8	53	33.1	56	35.0	17	10.6	3	1.9	2.63
Museums	3	1.9	18	11.3	40	25.0	67	41.9	29	18.1	3	1.9	2.31
Zoos	2	1.3	13	8.1	40	25.0	50	31.3	53	33.1	2	1.3	2.09

Science centres	5	3.1	19	11.9	33	20.6	53	33.1	47	29.4	3	1.9	2.21
Technology centres	10	6.3	21	13.1	41	25.6	40	25.0	45	28.1	3	1.9	2.39
Internet	90	56.3	51	31.9	11	6.9	4	2.5	3	1.9	1	.6	*4.36*
Other	11	6.9	17	10.7	5	3.2	8	5.0	1	.6	81	50.6	1.34

The students mostly used internet, academic knowledge and their families to learn. When the mean investigated the internet $\bar{X}$ =4.36 is in always interval between 4-5 whereas school $\bar{X}$=4.17 and family $\bar{X}$=4.08 are in often interval. The students sometimes get knowledge from television programmes and some scientific journals whereas they rarely learn something from popular magazines and newspapers, radio, zoos, science and technology centres. The ones who marked the other option could not explain what their source is.

The sources that the students use while problem solving is given Table 5.

Table 5. The sources they used for solving problems

	Always		**Often**		**Sometimes**		**Rarely**		**Never**		**Unanswered**		$\bar{X}$
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	
My scientific knowledge	36	22.5	*55*	*34.4*	*54*	*33.8*	8	5.0	5	3.1	2	1.3	3.64
Past experiences	47	29.4	*82*	*51.3*	22	13.8	5	3.1	3	1.9	1	.6	**4.01**
Tradition, customs	35	21.9	*51*	*31.9*	48	30.0	21	13.1	4	2.5	1	.6	3.56
What I see my family	48	30.0	*61*	*38.1*	34	21.3	14	8.8	1	.6	2	1.3	3.84
Experts	27	16.9	40	25.0	*53*	*33.1*	30	18.8	9	5.6	1	.6	3.27
Managers' ideas	17	10.6	31	19.4	*52*	*32.5*	25	15.6	23	14.4	12	7.5	2.74
Others	1	.6	3	1.9	5	3.1	8	5	24	15	43	26.9	.78

The students mostly benefit from their own experiences ($\bar{X}$=4.01) and the experiences of their families ($\bar{X} = 3{,}84$). Scientific knowledge is at third level ($\bar{X}$=3.64). The students stated that they consider less the ideas of experts and directors to solve the problems.

The answers given by the students to the "Chemistry in Daily Life Questionnaire" were analysed and displayed in Table 6.

Table 6. Descriptive analysis of questionnaire

Question Content	N	a (n-%)	b (n-%)	c (n-%)	d (n-%)	e (n-%)	X	s
Separation of the mixtures	1	24 (15.0)	48 (30.0)	36 (22.5)	47 (29.4)	5 (3.1)	.90	.93
Colligative properties	2	7(4.4)	77(48.1)	36(22.5)	31(19.4)	9(5.6)	.78	.95
	3	20(12.5)	44(27.5)	41(25.6)	48(30.0)	7(4.4)	.98	.94
State change	4	9(5.6)	75(46.9)	50(31.3)	24(15.0)	2(2.3)	.65	.78
Effect of heat on matter	5	26(16.3)	65(40.6)	33(20.6)	31(19.4)	5(3.1)	.68	.89
	8	30(18.8)	21(13.1)	96(60.0)	8(5.0)	5(3.1)	.79	.67
	11	36(22.5)	47(29.4)	67(41.9)	9(5.6)	1(0.6)	.55	.63
	22	19(11.9)	57(35.6)	66(41.3)	15(9.4)	3(1.9)	.66	.73
	25	23(14.4)	54(33.8)	80(50.0)	3(1.9)	0	.54	.54
Acids and acidic properties	6	22(13.8)	78(48.8)	41(25.6)	12(7.5)	7(4.4)	.54	.81
	13	14(8.8)	26(16.3)	108(67.5)	7(4.4)	5(3.1)	.86	.63
	18	18(11.3)	73(45.6)	47(29.4)	14(8.8)	8(5.0)	.62	.85
Gases	9	13(8.1)	62(38.8)	55(34.4)	29(18.1)	1(0.6)	.73	.77
	20	29(18.1)	72(45.0)	56(35.0)	1(0.6)	2(1.3)	.40	.57
	21	17(10.6)	28(17.5)	109(68.1)	5(3.1)	1(0.6)	.76	.53
Greenhouse effect	10	25(15.6)	37(23.1)	87(54.4)	11(6.9)	0	.68	.60
Dissolution, solutions	12	22(13.8)	87(54.4)	39(24.4)	10(6.3)	2(1.3)	.41	.66
	16	9(5.6)	44(27.5)	80(50.0)	18(11.3)	9(5.6)	.89	.81
	24	29(18.1)	33(20.6)	95(59.4)	3(1.9)	0	.63	.52
Atom, mass, conservation of	14	35(21.9)	79(49.4)	40(25.0)	5(3.1)	1(0.6)	.33	.57
mass	15	35(21.9)	66(41.3)	37(23.1)	11(6.9)	11(6.9)	.58	.89
	17	14(8.8)	37(23.1)	63(39.4)	16(10.0)	30(18.8)	1.15	1.07
Metals	7	11(6.9)	40(25.0)	69(43.1)	26(16.3)	14(8.8)	1.01	.91
	19	23(14.4)	45(28.1)	75(46.9)	12(7.5)	5(3.1)	.71	.74
	23	28(17.5)	69(43.1)	61(38.1)	2(1.3)	0	.41	.52

No students gave fully true answer to the questions 10, 23, 24 and 25. These questions are about greenhouse effect, reaction of metals, solubility of gases and condensation. When Table 6 investigated it is seen that students answered most of the questions in wrong way. The students answered the first part of the question about dissolution and solutions, gases, greenhouse effects, effect of heat on matter correctly but they couldn't explain the reasons. The most unanswered and misunderstood questions are about boiling, evaporation, condensation, gases, mass and conservation of mass. 50% of the sample group answered the first part of 13th, 21th and 24th questions but they couldn't make explanations. These questions are about acidic properties, gases and solubility. Such a case was undesired as the students got chemistry education beforehand.

Descriptive analysis was done grading the students' answers. When the item averages investigated the highest ones were seen in 7th and 17th items. In the analyses of the total points, it is found out that maximum point 40.0, mod and median 18.0, average 17.89 standard deviation 6.76. It can be said that the average was low from the questionnaire with 25 items.

The answers are given in frequency - percentage tables related to the departments. Table 7 shows the answers of the science education students.

Table 7. The descriptive analysis of science education students' answers (n-%)

No	Unanswered	Incorrect	First part true	Partially true	True	Mean
1	7 (13.5)	15 (28.8)	16 (30,8)	10 (19.2)	4 (7.7)	.92
2	2 (3.8)	19 (36.5)	17 (32.7)	9 (17.3)	5 (9.6)	.96
3	5 (9.6)	9 (17.3)	21 (40.4)	15 (28.8)	2 (3.8)	**1.09**
4	3 (5.8)	**25 (48.1)**	17 (32.7)	6 (11.5)	1 (1.9)	.61
5	4 (7.7)	**25 (48.1)**	13 (25.0)	10 (19.2)	-	.63
6	2 (3.8)	**35 (67.3)**	10 (19.2)	5 (9.6)	-	.38
7	1 (1.9)	10 (21.2)	21 (40.4)	11 (21.2)	9 (17.3)	**1.34**
8	8 (15.4)	8 (15.4)	**33 (63.5)**	2 (3.8)	1 (1.9)	.77
9	1 (1.9)	16 (25.0)	22 (42.3)	13 (25.0)	-	.92
10	**11 (21.2)**	5 (9.6)	**33 (63.5)**	3 (5.8)	-	.75
11	**11 (21.2)**	15 (28.8)	24 (46.2)	2 (3.8)	-	.54
12	4 (7.7)	**32 (61.5)**	12 (23.1)	2 (3.8)	2 (3.8)	.42
13	3 (5.8)	9 (17.3)	**37 (71.2)**	1 (1.9)	2 (3.8)	.86
14	5 (9.6)	**32 (61.5)**	15 (28.8)	-	-	.29
15	7 (13.5)	**22 (42.3)**	15 (28.8)	3 (5.8)	5 (9.6)	.69
16	4 (7.7)	16 (30.8)	**29 (55.8)**	3 (5.8)	-	.67
17	5 (9.6)	20 (38.5)	23 (44.2)	3 (5.8)	1 (1.9)	.61
18	6 (11.5)	**24 (46.2)**	15 (28.8)	5 (9.6)	2 (3.8)	.60
19	6 (11.5)	15 (28.8)	**26 (50.0)**	5 (9.6)	-	.70
20	**9 (17.3)**	**28 (53.8)**	15 (28.8)	-	-	.29
21	3 (5.8)	7 (13.5)	**41 (78.8)**	-	1 (1.9)	.85
22	4 (7.7)	19 (36.5)	**26 (50.0)**	3 (5.8)	-	.62
23	8 (15.4)	18 (34.6)	25 (48.1)	1 (1.9)	-	.52
24	7 (13.5)	11 (21.2)	**34 (65.4)**	-	-	.65
25	7 (13.5)	13 (25.0)	**31 (59.6)**	1 (1.9)	-	.63

According to the Table 7, the science education students could not answer total 13 questions correctly; the most wrong answers were given to 4, 5, 6, 12, 14, 15, 18 and 20 questions. True answers given to the first part are 8, 10, 13,16, 19, 21, 22, 24 and 25th questions. The most partially true answers were given to the 3rd which related with colligative properties; 7th about metals; 9th about gases. The fully true answers were given to 7th about metals; 2nd about colligative properties and 15th about conservation of the mass. 15% of the students could not answer the questions 8,10,11, 20 and 23. When mean item observed 3 and 7 items had the highest mean.

Examples of the questions that were answered wrongly by the science prospective teachers are given below (S39 shows 39th student, Q4 shows 4th question).

> S39; Q4. The boiling point of the water in pressure cooker becomes low; because, it keeps the vapour in it.

S31; Q6. Water with carbonate is used to clean limestone in teapot; because carbonate is solved limestone.

S 38; Q16: If five teaspoon of sugar is stirred in a glass, the solution conducts electricity; because water with sugar conducts electricity.

S38; Q17: The weight of the person with eighty kg doesn't change on the Moon; because the mass increases but weight stays the same.

The analysis of the elementary school teacher education students' answers are given in Table 8.

Table 8. The descriptive analysis of elementary school department students' answers (n-%)

No	Unanswered	Incorrect	First part true	Partially true	True	Mean
1	9 (11.7)	28 (36.4)	16 (20.8)	24 (3.2)	-	.83
2	3 (3.9)	**41 (53.2)**	8 (10.4)	**21 (27.3)**	4 (5.2)	.81
3	5 (6.5)	20 (26.0)	16 (20.8)	**31 (40.3)**	5 (6.5)	**1.21**
4	4 (5.2)	**36 (46.8)**	23 (29,9)	13 (16.9)	1 (1.3)	.67
5	**15 (19.5)**	**37 (48.1)**	8 (10,4)	13 (16.9)	4 (5.2)	.60
6	10 (13.0)	**39 (50.6)**	16 (20.8)	6 (7.8)	6 (7.8)	.60
7	5 (6.5)	18 (23.4)	**39 (50.6)**	11 (14.3)	4 (5.2)	.95
8	12 (15.6)	8 (10.4)	**50 (64.9)**	3 (3.9)	4 (5.2)	.88
9	4 (5.2)	32 (41.6)	26 (33.8)	14 (18.2)	1 (1.3)	.74
10	9 (11.7)	19 (24.7)	**46 (59.7)**	3 (3.9)	-	.67
11	**19 (24.7)**	27 (35.1)	28 (36.4)	3 (3.9)	-	.44
12	11 (14.3)	**43 (55.8)**	17 (22.1)	6 (7.8)	-	.37
13	4 (5.2)	6 (7.8)	**60 (77.9)**	4 (5.2)	3 (3.9)	**1.00**
14	**18 (23.4)**	**41 (53.2)**	16 (20.8)	2 (2.6)	-	.26
15	**19 (24.7)**	**35 (45.5)**	13 (16.9)	4 (5.2)	6 (7.8)	.51
16	2 (2.6)	26 (33.8)	**41 (53.2)**	2 (2.6)	6 (7.8)	.82
17	3 (3.9)	8 (10.4)	31 (40.3)	6 (7.8)	**29 (37.7)**	**1.68**
18	5 (6.5)	**39 (50.6)**	21 (27.3)	7 (9.1)	5 (6.5)	.65
19	11 (14.3)	27 (35.1)	30 (39.0)	5 (6.5)	4 (5.2)	.67
20	13 (16.9)	**38 (49.4)**	25 (32.5)	1 (1.3)	-	.35
21	6 (7.8)	13 (16.9)	**58 (75.3)**	-	-	.75
22	3 (3.9)	30 (39.0)	29 (37.7)	12 (15.6)	3 (3.9)	.80
23	7 (9.1)	**42 (54.5)**	27 (35.1)	1 (1.3)	-	.38
24	9 (11.7)	15 (19.5)	**50 (64.9)**	3 (3.9)	-	.72
25	9 (11.7)	29 (37.7)	38 (49.4)	1 (1.3)	-	.52

According to the Table 8, the elementary school education department students mostly unanswered the questions 5-11 about change of manner; 14-15 atom and mass; the most wrongly answers were given to 2 about colligative properties; 4-5 about change of manner; 6-18 about acidity; 12 about solubility;14-15 about atom-mass; 20 about gases and 23 about metals. True answers given to the first part were the questions 7-13 about acidity, 8 about change of manner; 10 about greenhouse effect; 16-24 about solubility and 21 about gases.

Partly correct answers were given to 2,3 about colligative properties and nevertheless no correct answers were given to 9th and 10th questions. The mostly answered question was 17 related to mass concept. The most partially answered was given to the question about heat exchange. 3, 13 and 17 had highest mean.

Examples of the questions that were answered wrongly by the elementary school department prospective teachers are given below.

S49; Q4. The boiling point of the water in pressure cooker rises; because the water is kept closed in it.

S49; Q14. ... when living things die, they fall into pieces in natural environment; because of decomposers.

S49; Q22...the air amount in the bicycle tires increases in winter because it expands S43; Q7. Pickles cannot be kept in metal containers; because we have to see the inside of the container.

S22, Q16: If five teaspoon of sugar is stirred in a glass, the solution doesn't conduct electricity; because of polarity.

In Table 9, the answers given by chemistry associate degree students were given according to the categories.

Table 9. The descriptive analysis of chemistry first degree students' answers (n-%)

N	Unanswered	Incorrect	First part true	Partially true	True	Mean
1	8 (25.8)	5 (16.1)	4 (12.9)	**13 (41.9)**	1 (3.2)	**1.06**
2	2 (6.5)	**17 (54.8)**	11(35.5)	1 (3.2)	-	.42
3	**10 (32.3)**	**15 (48.4)**	4 (12.9)	2 (6.5)	-	.26
4	2 (6.5)	**14 (45.2)**	10 (32.3)	5 (16.1)	-	.64
5	7 (22.6)	3 (9.7)	12(38.7)	8 (25.8)	1 (3.2)	1.00
6	**10 (32.3)**	4 (12.9)	**15 (48.4)**	1 (3.2)	1(3.2)	.64
7	5 (16.1)	**12 (38.7)**	9 (29.0)	4 (12.9)	1 (3.2)	.64
8	**10 (32.3)**	5 (16.1)	13 (41.9)	3 (9.7)	-	.61
9	8(25.8)	**14 (45.2)**	7 (22.6)	2 (6.5)	-	.35
10	5 (6.1)	**13 (41.9)**	8 (25.8)	5 (16.1)	-	.58
11	6 (19.4)	5 (16.1)	**15 (48.4)**	4 (12.9)	1 (3.2)	.83
12	7 (22.6)	**12 (38.7)**	10 (32.3)	2 (6.5)	-	.45
13	7 (22.6)	11 (35.4)	11 (35.5)	12 (6.5)	-	.48
14	**12 (38.7)**	6 (19.4)	9 (29.0)	3 (9.7)	1 (3.2)	.58
15	9 (29.0)	9 (29.0)	9 (29.0)	4 (12.9)	-	.54
16	3 (9.7)	2 (6.5)	10 (32.3)	**13 (41.9)**	3 (9.7)	**1.45**
17	6 (19.4)	9 (29.0)	9 (29.0)	7 (22.6)	-	.74
18	7(22.6)	10 (32.3)	11 (35.5)	2 (6.5)	1 (3.2)	.58
19	6 (19.4)	3 (9.7)	**19 (61.3)**	2 (6.5)	1 (3.2)	.84
20	7 (22.6)	6 (19.4)	**16 (51.6)**	-	2 (6.5)	.71
21	8 (25.8)	8 (25.5)	10 (32.3)	5 (16.1)	-	.64
22	**12 (38.7)**	8 (25.8)	11 (35.5)	-	-	.35
23	**13 (41.9)**	9 (29.0)	9 (29.0)	-	-	.29
24	**13 (41.9)**	7 (22.6)	11 (35.5)	-	-	.35
25	7 (22.6)	**12 (38.7)**	11 (35.5)	1 (3.2)	-	.42

An analysis of the answers of chemistry first degree students is given in Table 8. According to table when compared with the others it is seen that the questions except 2, 4, 7, 10 and 16 were unanswered above 20%. When evaluated questions above 30%; 8-22 about change of matter, 14 about atom and mass; 23 about metals and 24 about solution were the most unanswered. The most wrongly answered questions were 2-3 about colligative properties, 4 about change of matter, 9 about gases, 10 about greenhouse effect, 12 about solubility and 25 about change of matter. Question with the highest percentage in the first section true without a comment were the questions 6 about acidity, 11 about effect of heat/ change of state, 19 about metals and 20 about gases. The Question 1 about separation of mixtures and question 16 about solubility were partially answered correctly while no one gave the correct answer total 15 questions. The question answered most wrongly was related to colligative properties; the most correct answer was the question related to electrical conductivity of solutions. When item means examined, it was seen that question 16 about solubility and question 1 about separation of mixtures were answered the highest. The examples of chemistry first degree students' answers are below.

S18, Q5: Making tea on the Erciyes Mountain takes longer than making tea in Samsun; because the boiling point increases when the altitude rises.

S18, Q2: I add salt first when cooking; because the solution of the salt takes a long time.

S30, Q2: I add salt later when cooking; because I try the taste first.

S7; Q12: When sugar added into tea, it is becoming cold proves that solubility is exothermic; because heat releases.

Finally, these tables show that science department students could not give true answers to the 13 questions out of 25. The same students answered 7th question about metals and 3rd question about colligative properties with the highest mean. Elementary school department students could not give true answers to the 10 questions out of 25; they answered 17th question about mass and 3rd question about colligative properties with the highest mean. Chemistry first cycle students could not give true answers to the 15 questions out of 25. Question 16 about solubility had the highest mean.

Total points of associating students' chemistry knowledge in daily life of all students were calculated and than they were compared regarding to the departments. Results were analyzed with ANOVA and they were given in Table 10.

Table 10.a. Descriptive statistics of total points according to departments

Department	N	Mean	s
Science E.	52	18.00	6.43
Elementary S.E.	77	18.63	6.02
Chemistry first degree	31	15.87	8.59
Total	160	17.26	6.75

Table 10.b. ANOVA Results

	Sum of Squares	df	Mean Square	F	p
Between Groups	169.89	2	84.946		
Within Groups	7083.30	157	45.117	1.883	.156
Total	7253.194	159			

There is no significant difference between the total scores of students regarding to the departments ($F_{2\text{-}159}$=1.883; p> .05). The mean of elementary school teaching students is higher.

Independent sample t-test was used to investigate the differences associating their knowledge with daily life related to gender. Results are given below in Table 11.

Table 11. t-test results of associating their knowledge in daily life related to gender

Gender	N	Mean	s	t	df	p
Female	123	18.60	6.73	2.455	158	.015*
Male	37	15.54	6.39			

Meaningful differences were found in favor of female students (t_{158}=2.455; p< .05). This difference may have been caused by the fact that number of female students are larger. However, in the education faculty, which constitutes most of the sample, in general, there is a large number of female students in some departments. This has influenced the structure of the sample.

When the total scores of the students according to the high school types they graduated from were analyzed, the other option which has less than 15 students was grouped and included in the general group. ANOVA was used to find out the differences related to the graduated school type. Results were given in Table 12.

Table 12.a. Descriptive statistics of total points according to high school type

School type	N	Mean	s
General high school	40	18.50	6.82
Anatolian high school	93	18.40	6.75
Vocational high school	27	15.26	6.26
Total	160	17.90	6.75

Table 11.b. ANOVA results

	Sum of Squares	df	Mean Square	F	p
Between Groups	225.73	2	112.86		
Within Groups	7027.46	157	44.76	2.521	.084
Total	7253.19	159			

According to the graduated high school types, students' level of associating chemistry knowledge with daily life did not show a significant difference ($F_{2\text{-}157}$=2.521; p> .05). It is remarkable that the average of the vocational high school graduates is low.

DISCUSSION AND CONCLUSIONS

In the research, the students expressed that they were mostly using internet, their families and the school as the source of their knowledge. Balkan Kıyıcı (2008) investigated the level of prospective teachers' academic knowledge with their daily life and the factors that affect it. She found out that the prospective teachers got knowledge from internet and school. Acun, Yücel and Demirhan (2018) stated that university students considered experience and authority as the source of their knowledge. Kılıç, Ünal and Ergin (2015) in their research done on the people with different ages, carriers and occupations, stated that these people get their knowledge about science from internet and television instead of scientific journals and schools. Roth (1988),

Reiss and Tunnicliffe (1999) claimed in their researches that students received their knowledge from people outside the classroom such as family and community members. It proves that our research is in accordance with the other researches. Outside school learning sources such as zoo, museum and science centers are the least sources that the students refer to. Lebak (2005), stated that student encountered limited experiences in schools, and they get limited knowledge. It is important to carry the learning outside the school walls and the curriculum should contain activities done outside school (NRC, 1996; MoNE, 2015). The students benefit more from the experiences of their families and their own experiences rather than scientific knowledge to solve problems. They benefit from the directors' ideas the least. Such a result is in accordance with the results of Balkan- Kıyıcı (2008).

In general, the answers given by the students to the test implemented are incompetent in using chemistry knowledge in explaining events in daily life. Similar results have been given for different stages of education in the literature (Ay, 2008; Hürcan & Önder, 2012; Özmen, 2003; Yıldırım & Birinci Konur, 2014). While the students do not respond to condensation, mass conservation and gases, the false rates related to colligative properties, boiling point, acids, dissolution heat and atomic structure are very high. Students are also incompetent in explaining the reasons for events related to these concepts. Question 17 about mass was the one answered truly. It may affect students to understand and answer the question about mass recognized as unchanged of matter amount starting from the elementary school. When examined related to the departments, this question was answered in a true way by elementary school department students, whereas only one student answered it form the science education department and none answered from the chemistry first degree students. Science education department students could not give full answer to 13 question; elementary school education students 10 questions and chemistry first degree students 13 questions. Students answered the first part of the questions in a true way; but they couldn't explain or felt incompetent about them. The questions about greenhouse effect, gas solubility, reaction of metals and condensation subjects weren't answered exactly. The reason why they couldn't explain the questions that they encounter in their daily life result from the lack of knowledge they get from the different sources. Memorized knowledge could not help students use it where and when it is necessary. Condensation is a concept that students have difficulty in understanding at each stage of education (Gopal, Kleinsmidt, Case & Musonge, 2004). Hürcan and Önder (2012), stated that students are incompetent in using their knowledge about change of state and material structure in daily life. Pekdağ, Azizoğlu, Topal, Ağalar and Oran (2013), pointed out that the level of associating chemistry knowledge with daily life is at a moderate level in prospective science teachers, Karagölge and Ceyhun (2002) indicated that this level is inadequate in their study with undergraduate students in primary education department. Akgün, Tokur and Duruk (2016) investigated to what extent secondary school students associate "Water Chemistry and Water Treatment" with the events they encounter daily. They stated that the level of the students about the concepts of water chemistry is so low that they found that the students could not fully associate concepts with their daily lives. Yıldırım and Birinci Konur (2014) found that university students had inadequate understanding of gasses, acid-bases, change of state and chemical reactions, and low association with daily life.

Greenhouse effect, acidity, dissolution also have partially high correct answer percentages. Çelikler and Aksan (2014) stated that pre-service teachers have insufficient knowledge and have misconceptions about greenhouse effect. It was pointed out in various studies that the students are inadequate about the definition, causes and effects of the greenhouse effect (Andersson & Wallin, 2000; Boyes & Stanisstrret, 1997; Koulaidis & Christidou, 1999). Kaya (2016) determined that most of the students could not associate the relationship between the facts about their daily life and the knowledge they get from the school related to the large intestine, friction, heat and temperature in 'a certain misconception' the category. Mozeika and Bılbokaıte (2011) stated that there are few

(38% sample) who use chemistry knowledge correctly in explaining daily events in a similar study conducted on Lithuanian students. Koray, Akyaz and Köksal (2007), stated that students have many misconceptions about solubility and dissolution in everyday situations. Özmen (2003) stated that prospective teachers' knowledge of chemistry related to acid and base concepts is insufficient to explain events in everyday life. Similarly, there are study results in chemistry and at different levels of learning that indicate that there is a low level of association of knowledge with daily life by the students (Ay, 2008; Gürses et al, 2004; Ayas & Coştu, 2001). Chemistry teaching process should be designed in a way to build up the knowledge with their daily life and it helps students make the knowledge meaningful (Gilbert, 2006).

Explanations of students' understanding and interpretation of knowledge about everyday events can lead to the creation of misconceptions. To teach chemistry, it is necessary to ensure that students see the sources of their misconceptions and their consequences. Herron (1996) examines misconceptions in two categories; knowledge of what is happening in the physical world, i.e. acquired from observations, which are contrary to experimental data. Other misconceptions are related to the explanations of students in the natural world. "*The students conception works it explains what happens in the natural world. However, the explanation differs from the one accepted in science. Students' alternative explanations are logical from their perspective, consistent with their understanding of the world and are resistant to change*." was expressed by Herron (1996, p.187).

In the study, there was not found significant difference in the total scores according to departments, but the average of elementary school department students and the number of correct answers were higher than others. That of chemistry first degree students is lower. In the elementary school department, there were two hours for chemistry and 2+2 science laboratory courses in the curriculum in the term the research was done. In the science department, in the first year there are 4+4 hours chemistry and 2 hours chemistry laboratory courses; there are 4+4 different chemistry courses in the second year. In the chemistry first degree department, there are 4+2 hours chemistry course, 2+2 chemistry lab course in the first year and 22+20 hours chemistry courses in the second year. When consider the hours in the departments it is expected that the chemistry first degree students' knowledge is more than the others. Nevertheless, it was seen that the mean of the elementary school department students who receive less chemistry course is higher (18.63). Such a case reminds us that there are different factors that they associate their chemistry knowledge skills with the events they encounter in their daily life. This may be due to the students' acceptance scores for the university. It can influence students' readiness and information processing functions. There may also be a reason that course content is too theoretical. It can be considered that in the classroom teaching program, prospective science teachers associate with daily life in order to provide more concreteness with the target group to be educated. In the study conducted by Balkan Kıyıcı (2008), it was determined that candidate science teachers cannot associate their knowledge with daily life because of the reasons such as the place of the faculty, the language of education, the attitudes of the lecturers, the excessive theoretical content of course and the application, and they have partial literacy in science.

In this study, it was found that the total scores of female students were significantly different from male students. The mean of females is higher than the males. This case can depend on the skills of females that they interpret the daily life better and have higher academic success. In the study of Balkan-Kıyıcı (2008), there was no significant according to gender of students' knowledge of chemistry associated to daily life. Anagün, Ağır and Kaynaş (2010) stated that there is no significant difference between the genders in associating science knowledge with everyday life. Kenar, Şekerci, Erdem, Geçgel and Demir (2015) stated that in the attitudes of high school students towards the chemistry in daily life, it was found that there was a significant difference in favour of female students. In the study by Bacanak (2002), male teacher candidates were more successful in

the field of Science Literacy than female students. Moreover, the literature on science education shows that male students prefer science subjects more than female (Grambo, 2004). There is no meaningful differences between explaining and using the chemistry knowledge with daily life related to high school they graduated. When means investigated vocational high school students got lower grades. It was caused from that vocational subjects are stressed more, and these schools are preferred by the students with lower academic success.

For a person to learn a concept or thought, he or she should apply it in academic and everyday life (Smith & Siegel, 2004). If scientific concepts are used in every life events and problems, the concepts may be deepened and transferred to the students. Cajas (1999) noted that teachers do not know how to combine school-taught science with out-of-school experiences. It is important that the teachers explain the contents of the courses by exploiting the out-of-school learning environments and associating the concepts with the examples. This association can be achieved with different teaching materials. Jarman and McClune (2001), in the studies with examples from newspapers, Mayoh and Knutton (1997), in the studies with examples from the press, television, and newspapers, in which they associate the science courses, pointed out that the participation of students has increased.

As a result of the research, it was found that university students are incompetent in getting information from out-of-school learning environments and rather resort to their experiences when solving problems. The students should be ensured to used academic knowledge while solving problem. In addition, they have been unable to learn the details of chemistry in depth. The levels of association of chemistry knowledge with everyday life are similar and inadequate even if they attend different departments. Even if high grades are received in courses, this information cannot be applied in daily events. The aim in chemistry teaching should indicate more than the meaning of concept but what chemistry learning means. Students should be able to use their chemistry knowledge to solve real problems in everyday life. For chemistry learning to be meaningful, it should be planned in such a way as to ensure that the teaching process establishes links with the lives of the students. The methods and techniques different from the traditional method should be applied to increase students' awareness of this issue. Content in curricula should be organized by considering the principles of up-to-date and vitality. It is suggested to conduct similar studies with different samples and measurement tools, and to investigate the reasons why science concepts cannot be associated with daily life.

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