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Context-based chemistry problem solving: Question-answering strategies for preservice chemistry teachers'

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Abstract

The purpose of this study was to investigate preservice chemistry teachers' science expectations on learning science after they completed the introductory Context-Based Chemistry Problem Solving. The sampling of the study consisted of 22 preservice chemistry teachers studying at Hacettepe University, Faculty of Education. The scores obtained by participating groups from the 'Science Expectations Questionnaire'. In addition, preservice teachers' interviews are given as evidence. As a result of the evaluation of preservice chemistry teachers' the expectations about learning science on independence, coherence, concept, reality link, math link and effort dimensions, it is thought that there will be important outcomes in terms of improvement of the quality of teacher training at the university and that there will be an important contribution to literature in this sense.

Keywords: Context-based chemistry problem solving, science expectations, teacher education.

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1. Introduction

In the ever-changing world, there is a need for individuals who embrace innovations and developments while being aware of their responsibilities. For a community to reach modern levels, it is never enough to transfer knowledge, beliefs and emotions to individuals directly. Today, individuals are required to produce knowledge rather than consuming it. An individual in a modern world neither accept the transferred knowledge directly nor expect to be shaped or directed; they interpret knowledge and participate actively in process of constructing the meaning. Individuals of the modern world have different ways of perceiving, understanding, approaching, problem solving and learning. Creating learning environments where learners actively participate is closely related to choosing appropriate methods and techniques. Therefore, learning process that involves thinking and research shall be enriched with well-structured teaching techniques and students will be encouraged to be active participants in the classroom (Alkan, 2017; Bonwell & Eison, 1991; Kocak, 2013). One of the teaching methods promoting the active participation of students in their learning processes is the 'Context-Based Teaching Model'. Students bring their science content knowledge, attitudes, beliefs based on their own prior experiences to the class. Therefore, students have expectations which are about their understanding of the process of learning science (biology, chemistry and physics) and the structure of science knowledge (Redish, Saul & Steinberg, 1998; YalcinCelik et al., 2014). 'Science Expectations' has been one of the most popular concepts studied in the field of education in recent years. Determining science expectations of teachers and student teachers and developing these expectations are essential for the provision of effective education. In the constructivist paradigm, it is believed that each individual's past experiences, beliefs and perceptions are different and that through them knowledge is constructed in diverse forms by that individual (Jonassen, 1990). This is because learning is an active process, and in this process, knowledge is handled by means of organisation. Individuals use different channels in order to process knowledge visually and aurally (Kocak & Alkan, 2015; Mayer, 2001). In addition, in order to solve the problems emerging during the teaching of chemistry, it is required to have teachers with qualifications that allow them to associate chemistry with daily life in a more meaningful way. Training such chemistry teachers will be possible by closely monitoring various characteristics of the prospective chemistry teachers enrolled in educational institutions and forming these characteristics in the environments that are closely linked with daily life (Freienberg, Kriiger, Lange & Flint, 2001). Indeed, daily life stands for a 1-day period of the mental and physical world (Lindemann & Brinkmann, 1994; Yaman, 2009). However, it is quite easy to find a daily life connection with a chemical problem that is the subject of chemistry courses. Learning and inference occur following a series of cognitive processes. Therefore, the adequacy of the cognitive processes of preservice chemistry teachers' is of great importance in order for the learning and inference process to be efficient (Altundag Kocak, 2018).

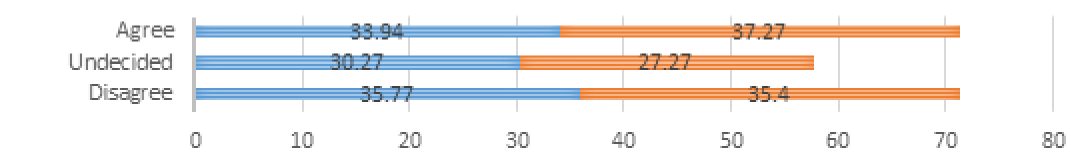
2. Method

The aim of this study is to examine the effects of activities designed according to context-based chemistry problem solving under the name of daily life chemistry on preservice chemistry teachers' expectations about learning science. The sampling consisted of 22 preservice chemistry teachers at the Chemistry Education Department, Faculty of Education, Hacettepe University. The 'Science Expectations Questionnaire (SEQ)' developed by Redish et al. (1998) and adapted into Turkish by Demirci et al. (2010) was used in the study. The SEQ was applied to 22 preservice chemistry teachers. The items of the SEQ were categorised in six dimensions which were independence, coherence, concepts, reality link, math link, and effort as used by Redish et al. (1998). In the context of research, context-based chemistry problems, which are appropriate for daily life chemistry, can be done simple and interesting for preservice chemistry teachers have been designed. Context-based chemistry problems have been done with daily substance and materials, without having necessity for materials related to chemistry and chemical substances. Context-based chemistry problems, which are appropriate for acquisition of daily life chemistry, can be done with daily materials that have been designed according to stages of question-answering strategies and presented to preservice chemistry teachers. Stages of the study were categorised according to question-answering strategies: (1) A question (problem) incident selected from daily life related to the subject have been asked to the preservice chemistry teachers. (2) The materials used in the problem and the way how to do the problem have been explained so that the experiment can be conducted by preservice chemistry teachers without having any problems. (3) In the stage of answering, the preservice chemistry teachers' were asked to make an explanation related to results and observations from the problem. The answering was been made as classroom discussions.

3. Findings

3.1. The independence dimension

In the independence dimension, the items aim to seek whether preservice chemistry teachers construct their understanding by themselves or they receive information by an authoritative source. The independence dimension involved items 1, 8, 13, 14, 17 and 27 on the questionnaire.



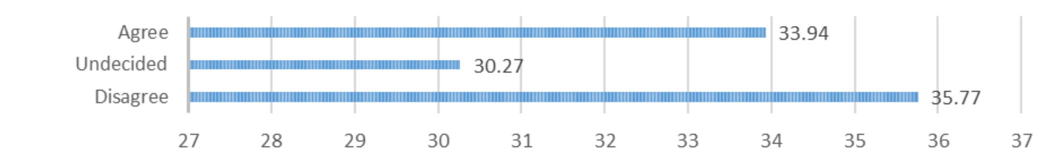
	Disagree	Undecided	Agree
1	35.77	30.27	33.94
8, 13, 14, 17, 27	35.4	27.27	37.27

Chart 1. The independence dimension

Chart 1 displays the percentages of items that represent the views of 22 preservice chemistry teachers for the independence dimension. According to Chart 1, the views of the preservice teachers of regarding their agreement with item 1 (90.9%) and 8, 13, 14, 17 and 27 (37.27%) indicate a significant difference. The views of the preservice chemistry teachers of regarding the disagreeing with item 1 (0%) and 8, 13, 14, 17 and 27 (35.4%) percentage are significantly different from each other. Disagreeing with item 1 indicates a naïve view of learning while disagreeing with items 8, 13, 14, 17 and 27 indicates a sophisticated view of learning.

3.2. The coherence dimension

In terms of the coherence dimension, science should be considered as a connected, consistent framework. The preservice chemistry teachers should disagree for all items in the coherence dimension, which are 12, 15, 16, 21 and 29.



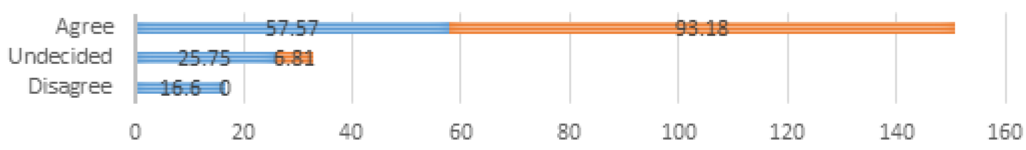
	Disagree	Undecided	Agree
12, 15, 16, 21, 29	35.77	30.27	33.94

Chart 2. The coherence dimensions

While the 'The SEQ' scores of the preservice teachers were checked, the descriptive statistics were applied in order to determine whether there were differences among the disagreeing and agreeing scores of the same scale. Chart 2 shows that the overall percentage of disagreeing is much higher than that of the agreeing. The favourable responses for all these items indicate a sophisticated view of learning in terms of epistemological beliefs.

3.3. The concept dimension

In terms of the concept dimension, the items aim to seek whether preservice chemistry teachers focus on memorising and using formulas when learning science or whether they understand the ideas and concepts underlying science. The concept dimension involved items 4, 19, 26, 27 and 32.



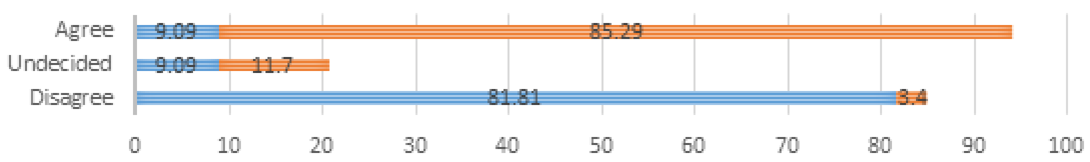
	Disagree	Undecided	Agree
4, 19, 27	16.6	25.75	57.57
26, 32	0	6.81	93.18

Chart 3. The concept dimension

The results of the analysis given in Chart 3 show that when the distribution of the preservice teachers according to their disagreeing with items 4, 19, 27 and 26, 32 is considered, there are differences. As shown in Chart 3, it is determined that the agreeing of the preservice teachers with items 26 and 32 was higher than the disagreeing score. In other words, the scores of the questionnaire on agreeing and disagreeing with items 26and 32 were compared using the descriptive statistics; and it was determined that there were differences favouring the agreeing. In addition, it is determined that the agreeing of the preservice teachers with items 4, 19 and 27 was higher than the disagreeing. On the 'The SEQ', 'disagree' responses for items 4, 19 and 27 are favourable and 'agree' responses for items 26 and 32 are favourable.

3.4. The reality link dimension

The reality link dimension involved the items 10, 18, 22 and 25 on the questionnaire.



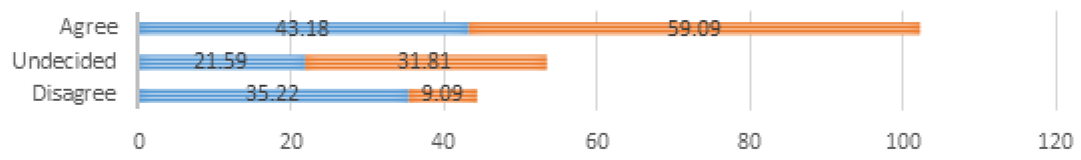
	Disagree	Undecided	Agree
10, 22	81.81	9.09	9.09
18, 25	3.4	11.7	85.29

Chart 4. The reality link dimension

The percentages of preservice science teachers' responses on items 10, 18, 22 and 25 are shown in Chart 4. According to Chart 4, the views of the preservice teachers regarding the agreeing with items 10, 22 (9.09%) and 18, 25 (85.29%) indicate a significant difference. The views of the preservice teachers regarding the disagreeing with items 10, 22 (81.81%) and 18, 25 (3.4%) are significantly different from each other. According to the experts, students should know that science is in close relationship with their everyday experiences and agreeing with items 10 and 22 shows a naïve view of learning, while agreeing with items 18 and 25 represents a sophisticated view of learning.

3.5. The math link dimension

Items in the math link dimension aim to seek thinking on the mathematics behind scientific phenomena or just using mathematics algorithmically to explain that phenomena. The math link dimension involved items 2, 6, 8, 16 and 20 in the questionnaire.



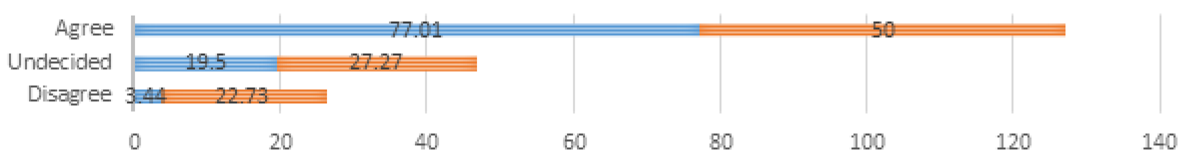
	Disagree	Undecided	Agree
2, 8, 16, 20	35.22	21.59	43.18
6	9.09	31.81	59.09

Chart 5. The math link dimension

The results of the analysis given in Chart 5 show that when the distribution of the preservice teachers according to their disagreeing with items 2, 8, 16, 20 and 6 is considered, there are differences. It is determined that the agreeing (59.09%) with item 6 of the preservice teachers was higher than the disagreeing score (9.09%). The scores of the questionnaire regarding the agreeing and disagreeing with items 2, 8, 16 and 20 were compared using the descriptive statistics; and it was determined that there were differences favouring the agreeing. In addition, it is determined that the agreeing with item 6 of the preservice teachers was higher than the disagreeing. Disagreeing with items 2, 8, 16 and 20 and agreeing with item 6 shows a sophisticated view of learning.

3.6. The effort dimension

This dimension was probed by items 3, 6, 7, 24 and 31 on the questionnaire.



	Disagree	Undecided	Agree
3,6,7,31	3.44	19.5	77.01
24	22.73	27.27	50

Chart 6. The effort dimension

Chart 6 shows that the overall percentage of agreeing is much higher than that of the disagreeing. Agreeing with items 3, 6, 7 and 31 represents a sophisticated view of learning, while agreeing with item 24 shows a naïve view of learning.

4. Discussion

This study aimed to determine teacher candidates' expectations about learning science through Context-Based Chemistry Problem Solving. In this respect, components of the expectations about learning science such as 'independence, coherence, concept, reality link, math link and effort dimensions' were categorised. The sampling of the study consisted of 22 preservice chemistry teachers studying at the Chemistry Department, Faculty of Education, Hacettepe University. This is a two-dimensional research study where qualitative and quantitative research methods are used together. The expectations of teacher candidates about learning science were collected according to the Question-Answering Strategies. Learning is a product of experiences. This product of experience is shaped by the events in our environment and gains a meaning. Therefore, it is obvious that daily life is an effective factor in the occurrence of learning. Daily life is a domain where people try to address their physical, emotional and cultural needs and fulfil the requirements of their existences as individuals (Kocak & Onen, 2012). However, there were certain studies similar to this study on determining different samples and problem situations from daily life (Akpinar & Ozkan, 2010; Cepni, Ulger & Ormanci, 2017; Schmidt, Freienberg & Flint, 2002; Toroslu & Gunes, 2010; Ulusoy & Onen, 2014). The findings of these studies are supportive of the findings of this study. Generally, in the studies that were carried out according to the Context-Based Teaching models, it was found that students were quite satisfied with the activities and they expressed that similar activities based on daily life should be performed more often (Huntemann, Honkomp, Parchmann & Jansen, 2001; Schmidt, Parchmann & Rebentisch, 2003). 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. It is expected that meeting students' needs and desires to learn a subject using context-based learning activities will make a positive contribution to research in this field.

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