

The Development and Implementation of a Scenario Concerning the Topic of 'Carbohydrates and Lipids'

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'Karbhidratlar ve Yağlar' Konusuna Yönelik Senaryo Geliştirilmesi ve Uygulanması

SUMMARY

This research aimed to develop and implement a scenario based on problem-based learning (PBL) concerning 'Carbohydrates and Lipids' in the basic biochemistry course and to determine the students' opinions about the PBL approach and group work. The study was of a descriptive research design. The study group consisted of first grade students (aged between 18 and 21) (N=67) in MLT and MPMT Associate's Degree Programs at Ahmet Erdogan Vocational School of Health Services at Bulent Ecevit University. A scenario was developed with the input of three experts. It was entitled 'Unforgettable New Year's Fun' and was oriented towards the relevant topic. The 'Structured Interview Form' was used as a data collection tool at the end of the application. The results of the content analysis of this form showed that the students had positive opinions, stating that the PBL approach was positive, memorable, comprehensive and instructive, and related to daily life. In addition, they also expressed the opinion that the group work was enjoyable and memorable.

Key Words: Associate's degree level, biochemistry, carbohydrates, lipids, problem-based learning, structured interview form

ÖZET

Bu çalışmada, temel biyokimya dersi 'Karbhidratlar ve Yağlar' konusunda probleme-dayalı öğrenme (PDÖ) yaklaşımına dayalı bir senaryo geliştirilerek uygulamak ve öğrencilerin PDÖ yaklaşımına ve grup çalışmasına yönelik görüşlerini belirlemek amaçlanmıştır. Çalışma betimsel araştırma desendir. Çalışma grubunu Bulent Ecevit Üniversitesi Ahmet Erdoğan Sağlık Hizmetleri Meslek Yüksekokulu TLA ve TTP ön lisans programlarında okuyan birinci sınıf öğrencileri (18 ile 21 yaşları arasında) (N=67) oluşturmaktadır. Üç uzman görüşü alınarak söz konusu konuya yönelik 'Unutulmaz Yılbaşı Eğlencesi' başlıklı bir senaryo geliştirilmiştir. Uygulama sonunda veri toplama aracı olarak 'Yapılandırılmış Görüşme Formu' kullanılmıştır. Yapılandırılmış görüşme formunun içerik analizi sonuçları öğrencilerin PDÖ yaklaşımının tamamen olumlu, anlaşılır, öğretici, akılda kalıcı ve günlük hayatla ilişkili olduğuna dair olumlu görüşleri olduğunu göstermiştir. Ek olarak, öğrenciler grup çalışmasının da zevkli ve akılda kalıcı olduğunu ifade etmişlerdir.

Anahtar Kelimeler: Ön lisans düzeyi, biyokimya, karbhidratlar, yağlar, problem-dayalı öğrenme, yapılandırılmış görüşme formu

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INTRODUCTION

Biochemistry focuses on the basic clinical sciences of chemistry and biology, food and agriculture etc. They are common themes in these sciences, and biochemistry is both a theoretical and an applied course. The topic of biochemistry is based on the structure and metabolism of organic substances such as carbohydrates, lipids and proteins, and inorganic substances such as acid, base and salts, which are essential for the survival of living things. The topic of carbohydrates and lipids, in particular, plays an important role in relevant course content since carbohydrates are important for the normal functioning of the brain, red blood cells and central nervous system and lipids also are crucial for absorption and transport of fat-soluble vitamins in our bodies (Fujioka, Matsuzawa, Tokunaga and Tarui, 1987; Ma et al., 2005). Therefore, the importance of biochemistry is increasing daily and it is necessary that a student who has graduated in the field of health is easily able to apply this knowledge gained to solve problems which they could encounter in the professional life.

Today, active learning methods are used in education in order to gain and apply this knowledge. Problem-based learning (PBL), which is based on a constructivist approach and active learning methods, is a pedagogical approach that has been applied successfully in the fields of medicine, health, chemistry, physics, biology, engineering and others, and which enables students to acquire meta-cognitive skills through solving problems related to real life (Barrows and Tamblyn, 1980; Bridle, Morton, Cameron, Desmulliez and Kersaudy-Kerhoas, 2016; Chin and Chia, 2005; Folashade and Akinbobola, 2009; Gimenez, 2015; Gurses, Acikyildiz, Dogar and Sozbilir, 2007; Hung, Jonassen and Liu, 2007; Wood, 2003).

There are many studies in the literature about the development of self-directed learning, upper cognitive thinking skills, academic achievement and the positive opinions that emerge through solving real life-related problems, especially in the field of biochemistry. Niwa et al. (2016) examined the impact of PBL on the academic achievement of medical students in the basic and clinical sciences and the National Undergraduate Exam. The study concluded that PBL was effective in improving the cognitive abilities of students compared to conventional teacher-centered teaching. Abraham, Hassan, Damanhuri and Salehuddin (2016) investigated the effects of PBL on students' self-learning processes in basic medical sciences. The self-learning process has been studied in four ways: individual study, self-management, independent learning and learning-centered learning.

The conclusion of the study showed that PBL enhanced the self-learning skills and motivation of students. Doubleday et al. (2015) noted that the use of case studies in the teaching of biomedical and clinical sciences in the field of health is effective for students' learning processes and in assessing the reality of a problem. They also stated that this learning method is related to the social constructivist approach supported by PBL in the study. Murugaiyan et al. (2016) studied the effect of case-based PBL on medical students' learning of the topic of minerals in the biochemistry course. The conclusion of the study showed that PBL enhanced students' performance and desire for self-learning. Cowden and Santiago (2016) examined the impact of PBL on students' ability to conduct research and critical thinking in advanced biochemistry course in their research. The result of their study was that PBL developed research and multidisciplinary thinking skills in students. The result of the research of Al-Shaikh et al. (2015) showed that students expressed the positive opinion that PBL developed self-learning, critical thinking and problem-solving skills. Lescallete, Knecht, and Dries (2015) showed that PBL enhanced students' learning and understanding of upper-level biochemistry courses. In their study, Karpa et al. (2015) provided students with interactive courses based on PBL sessions where high school students could communicate with medical students through a program called PULSE. This study has reached the conclusion that high school students gained information in health field with PBL sessions and communication with medical students was effective in high school students' career choices. Gulpinar, Alkac and Yegen (2015) examined the effect of PBL enriched by brain-based learning activities on the academic achievement of students in pre-clinical medical education. Their research reached the conclusion that students were positively affected by PBL and their academic achievements were increased. Villamor (2001) aimed to determine the opinions of medical students regarding PBL for the topic of 'Endocrine System' in a biochemistry course. The research found that the students expressed positive opinions, stating that PBL motivated them to understand the topic of the endocrine system, and encouraged them to develop self-learning skills to help them meet their learning needs. O'Neil, Morris, and Baxter (2000) showed that they were pleased that students were able to combine their experiences with their collaborative work in PBL and their clinical knowledge. It was stated in their study that PBL can be successfully applied in a clinical setting.

Although there are many studies in the literature focusing on the topic of biochemistry in the field of health, there is a limited number of studies using PBL and real life situations and case studies with

regard to 'Carbohydrates and Lipids'. Cornely (1998) suggested that conventional teaching make students passive learners, and that teaching should also use case studies. A case study on the topic of 'Metabolism' was prepared for a biochemistry course for medical students. During the exercise, students were given the medical history of a patient with a chronic metabolic disease, providing students with biochemical explanations of the patient's symptoms, and they were asked to find appropriate treatment methods. The result of this research indicated that solving real-life problems improved students' analytical and higher-order thinking skills, increased their self-confidence, and allowed them to learn how to transfer the biochemical concepts they had learned into a clinical situation. Passos, Se, Wolff, Nobrega and Hermes-Lima (2006) reached the conclusion that designing and carrying out an experiment associated with daily life for the topic of 'Metabolism' in a biochemistry course increased medical students' achievement scores in their exams. Stuckey, Lippel and Eilks (2012) designed and implemented a chemistry course about different sweeteners in their work. In the study, students conducted a discussion about the use of non-sugar, 'light' products and natural low-calorie sweeteners produced from stevia (sugar beet) in media commercials. The result of this study showed that students found the socio-scientific chemistry education courses realistic and motivating and that it was effective to use advertising in chemistry courses. In the study of Kulak and Newton (2015), they concluded that the case-based learning method increased students' knowledge of the topic of 'Metabolism' in a biochemistry course and increased their problem-solving, communication and cooperative working skills. Tarhan and Ayyıldız (2015) showed that PBL enhances students' academic achievement in the topic of 'Metabolism' within a biochemistry course. Moreover, it has been observed that there are only limited studies in the literature where PBL was applied in the associate's degree level biochemistry course of the university health field (Karadas, 2010).

In this context, due to the limited study of the use of PBL with regard to the health associate's degree and in the topic of 'Carbohydrates and Lipids' in biochemistry courses, a scenario was developed and implemented in this study with the aim of contributing to biochemistry education. In addition, the aim was also to determine students' opinions about the PBL approach and group work. The problem statement of this research is: "What are the opinions of first year students studying in the associate degree programs in Medical Laboratory Techniques (MLT) and Medical Promotion and Marketing Techniques (MPMT) at the

Ahmet Erdogan Vocational School of Health Services, Bulent Ecevit University about PBL and group work?"

METHOD

The Study Group

The study was a descriptive research design (Best and Kahn, 2017; Christensen, Johnson and Turner, 2015). The study group consisted of first year students (aged between 18 and 21) studying in MLT and MPMT Associate's Degree Programs at the Ahmet Erdogan Vocational School of Health Services, Bulent Ecevit University (N=67) in the spring semester of the 2015–2016 academic year. In the exams conducted at the students' selection and placement center, all students studying on these programs had similar scores and the aim of these programs is that students acquire fifth-level vocational and academic qualifications. In this research, all students learned about carbohydrates and lipids according to the PBL approach. Before the application, all students were informed about the PBL approach, group work, how the application would be run and that there would not be any risks to their health such as the exposure to any chemical substances during the process. The permission for the implementation of this research was obtained from the Bulent Ecevit University Scientific and Technological Research Project Coordinator with the petition dated 13 December 2016 and numbered 47459466/604.02. The students were participated the research voluntarily and their informed consent forms were taken. These ethical precautions were appropriate as the research activity and participating in this research was doing in full knowledge of their involvement (Christensen, Johnson & Turner, 2015; Taber, 2014).

Data Collection Tools

Structured Interview Form

At the end of the application, a "Structured Interview Form" consisting of two open-ended questions was applied. The form was developed following input from three pedagogical and biochemistry experts (See **App.1**). In the structured interview form, the students expressed their opinions about PBL and group work in written form.

Data Analysis

The content of the data obtained from the structured interview form at the end of the teaching process was analysed separately by three pedagogical and biochemistry experts. The first stage of content analysis was that coding the obtained data from the interview and after coding the data, a code list was formed by these three experts separately. Then the average percentage agreement was calculated. The average percentage agreement was calculated by $P = \frac{N_a}{N_a + N_d} \cdot 100$ formula (N_a = the amount of agreement; N_d = the amount of disagreement, P = the

percentage of agreement) (Birkimer and Brown, 1979; Robson, 2015; Tanriogen, 2014). As a result of the content analysis of the structured interview form, the average agreement percentage was found to be 86%. A percentage agreement of 70% and above indicates that reliability has been attained (Birkimer and Brown, 1979). The numerical data obtained was presented as frequencies and percentages.

Creating PBL Scenario

For the Basic Biochemistry course, the opinions of three biochemistry and pedagogical experts on the topic of carbohydrates and lipids were taken and a scenario entitled “*Unforgettable New Year’s Fun*” was created. This consisted of four education sessions, using related literature and daily life situations (Blanco-Colio et al., 2000; Celik, 2014; Coultate, 1990; Elgun, 2011; Gozukara, 2011; Ilter and Tekin, 2005; Karlson, 1992; Mukamal, Maclure, Muller, Sherwood and Mittleman, 2001; Yenigun, 2006). The use of this developed scenario was intended to increase the interest in the biochemical data and in the sub-topics included in the content of Basic Biochemistry course. The scenario was developed based on sub-topics including the structure, classification, bond structure, digestion and absorption in the body of carbohydrates, lipids, and essential fatty acids, and the metabolism of carbohydrates and lipids was also briefly discussed in the scenario. The scenario is about Jenny and Tom, a newly married couple, who are drinking alcohol to excess with friends on New Year’s Eve leading Jenny to become unwell from the alcohol and being taken to hospital (See **App.2**). In each education session of the scenario, the aim was that students would express the problem using their own statements, produce hypotheses, question and discuss the hypotheses they had produced, determine new information they might need, summarize new information and observe hypotheses in the light of this new information, and do independent research and group work in the library and online with the guidance of the instructor. Each education session ended with a section entitled ‘What should I learn?’ and in the final education session students were asked to draw a flowchart of the scenario and repeat what they had learned in all the education sessions.

In Education Session I, Jenny and Tom, a newly married couple, were having fun with their friends on New Year’s Eve, when Jenny was taken late at night to the emergency room of the nearest hospital with symptoms of vomiting, trembling and headache. In this session, the aim was for students to find the cause of the problem, to set up hypotheses and to identify the new information that they will need.

Education Session II started with the initial examination in the emergency department and the

physician requesting the laboratory to analyze lung and cranial graphs, electrocardiography, blood and urine, blood sugar, electrolytes and liver functions. In Education Session II, Jenny was reported to be quite healthy, was not taking any medication, had not eaten much at dinner and had drunk a bottle of whisky, champagne and wine with Tom and their friends. In this education session, the aim was to:

- Determine the reason why Jenny’s pulse is slow, her body temperature is low and she is semi-conscious,
- Investigate whether Jenny is suffering from alcohol poisoning or not,
- Investigate the cause of Jenny’s illness, if there is alcohol poisoning,
- Find out that the degree of influence of alcohol depends on genetic changes in the enzymes that play a role in alcohol metabolism in the body, the amount of alcohol ingested, the physical and mental health of the person, body weight and digestive conditions (Yenigun, 2006),
- Investigate the average percentage of alcohol in whisky, wine, champagne and other drinks,
- Determine the alcohol types of drinks.

Education Session III started with that the emergency doctor stating that Jenny has alcohol hypoglycemia and that acute alcohol poisoning is indicated according to the laboratory results. In this session, the aim was to:

- Determine that the form of alcohol is ethyl alcohol in the drink on the basis of some acetic acid being found in the urine, rather than formic acid, and that the lethal limit of formic acid was found in the body in accordance with laboratory analyses (Yenigun, 2006),
- Learn the metabolism of ethyl and methyl alcohol in the body, and the metabolism of carbohydrates and lipids in the body,
- Learn what causes physiological changes in the body during alcohol metabolism,
- Find out how alcohol metabolism affects carbohydrate and lipid metabolisms in the body, and therefore how alcohol hypoglycaemia, hyperlactic acidemia, hyperlipemia, hyperketonemia and respiratory depression are caused depending on these physiological changes,
- Find out how the acid-base balance and liquid-electrolyte balance deteriorate because of these physiological changes,
- Learn briefly about the lipoproteins that are chylomicrons, very low-density lipoproteins (VLDL), low-density lipoproteins (LDL) and high-density

lipoproteins (HDL),

- Find out that alcohol ingested is easily absorbed from the mucosal epithelium in the gastrointestinal tract, and the consumption of excess alcohol may lead to vitamin B deficiency, as the region is also the site of absorption of B vitamins (Blanco-Colio et al., 2000; Mukamal, Maclure, Muller, Sherwood and Mittleman, 2001),

- Investigate what the treatment methods are,
- Learn the structure, classification, digestion and absorption in the body of carbohydrates and lipids and essential fatty acids during their research.

In addition, in this education session, training director questions (TDQ) were also asked, in order that the required information was repeated.

Education Session IV started with the treatment methods that the emergency doctor was applying to

Jenny. The aim was to learn which treatment methods can be applied and to learn about alcohol-drug interaction in the body, and drug-alcohol interaction or damage that may occur to the liver in case of acute alcohol poisoning.

Implementation of PBL

Prior to PBL, the MLT and MPMT first-year students were randomly divided into five groups and students were given information about PBL approach, the educational process, and independent and group work. The application was carried out over 16 course hours. In this process, under the guidance of the instructor, students were provided with the ability to conduct research, discussion and group work during the problem-solving phase and to reach appropriate solutions. At the end of the application, a structured interview form was applied to determine the opinions of students about the method and group work (Table 1):

Table 1. Application of PBL

Task	Course Hour
Separation of students into groups and giving information about the PBL approach	2
Education Session I	2
Education Session II	4
Education Session III	4
Education Session IV	2
General recapitulation of the scenario and the topic of carbohydrates and lipids	1
Structured Interview Form	1

RESULTS AND DISCUSSION

Results and Discussion of the Education Sessions

During Education Session I, students hypothesized that Jenny could use some form of medication, that she may have a chronic or acute illness, an allergic condition and/or psychological distress, that she may be suffering as a result of something she had eaten or drunk, or may have been poisoned. They indicated that the new knowledge they needed to solve the problem was to learn the answers to the hypotheses they had produced and, in addition, to know the results of Jenny’s blood and urine analysis in the hospital.

In Education Session II, in the light of new information, students discarded the hypotheses they had produced during Education Session I other than the hypothesis that Jenny might be poisoned and produced new hypotheses about alcohol poisoning having occurred, and of the alcohol being methyl alcohol. As a result of the research they conducted, they indicated that Jenny’s pulse is slow, her body temperature is low and that she may be semi-conscious due to her excessive consumption of alcohol and they learned the factors that determine the degree of the

influence of alcohol, the presence of ethyl alcohol in drinks and the average percentage of ethyl alcohol in drinks such as whisky, wine and champagne. In addition, they indicated that the new information they needed to solve the problem was to know what the results of laboratory analysis were and whether the alcohol in the drink was ethyl or methyl alcohol.

In Education Session III, students eliminated the hypothesis of methyl alcohol poisoning by confirming the hypothesis that Jenny was experiencing acute alcohol poisoning and that the type of alcohol was ethyl alcohol. Students learned the following:

- 90–98% of alcohol in the body is metabolized by oxidation in the liver, the remaining 2–10% is removed unchanged through the kidneys, lungs and by sweating,
- Ethyl alcohol is converted to acetaldehyde by alcohol dehydrogenase enzyme (ADH), acetaldehyde is converted to acetic acid by acetaldehyde dehydrogenase enzyme (ALDH) in the hepatocyte cytosol in alcohol metabolism,
- Although the affinity of gastric ADH to ethanol is low, it is important in the metabolism of ethyl alcohol,

- Methyl alcohol is converted into formaldehyde by ADH enzyme and formaldehyde is converted to formic acid by ALDH enzyme,

- Acetaldehyde, which is formed in ethyl alcohol metabolism, has a toxic effect and acetaldehyde in a large amount causes symptoms such as palpitations, vomiting, headache and sweating,

- Formic acid in the body has high toxicity, doses above 20 mg / dL are considered toxic, and the lethal limit level is 80–100 mg / dL,

- Changes in the ratio of NAD / NADH used as cofactor during alcohol metabolism in the body impair the physiological functions of the body, thus affecting the metabolism of carbohydrates and lipids and causing alcohol hypoglycemia, hyperlactic acidosis, hyperlipemia, hyperketonemia and respiratory depression,

- How the alcohol metabolism breaks acid-base balance and liquid-electrolyte balance,

- The metabolism of carbohydrates and lipids in the body, the structure, classification, digestion and absorption in the body of carbohydrates and lipids, essential fatty acids and lipoproteins,

- The relationship between alcohol use and B vitamins by investigating the treatment methods for acute alcohol poisoning (Champe and Harvey, 2007; Coultate, 1990; Elgun, 2011; İlter and Tekin, 2005; Karlson, 1992; Yenigun, 2006).

The students shared their knowledge in classroom discussions and gained new insights into carbohydrates and lipids while researching alcohol metabolism in the body.

In Education Session IV, students learned the following:

- Treatment methods for alcohol poisoning in the body,

- The role of microsomal enzymes (Microsomal Ethanol Oxide System, MEOS), which is another important metabolic pathway responsible for alcohol metabolism in the body, in the hepatocyte endoplasmic reticulum,

- Ethyl alcohol and accompanying drugs will compete for metabolism in the microsomal system

and will eventually slow down the metabolism of drugs,

- Some of the drugs which decrease metabolisms will inhibit gastric ADH, and the formic acid resulting from the metabolism of methyl alcohol in the body causes high toxicity,

- Alcohol will cause damage to the liver depending on the amount of alcohol and disorders related to alcohol metabolism, and will cause liver fatigue and cirrhosis (İlter and Tekin, 2005; Yenigun, 2006).

At the end of this education session, students were asked to draw a flowchart of the scenario. In this way, students had the opportunity to repeat both the education sessions and the information they have gained.

Results and Discussion from the Structured Interview Form

The results of the content analysis of the structured interview form aimed at determining the opinions of the students about the method and group work at the end of the application are given in Table 2:

As can be seen in Table 2, the majority of students expressed positive opinions about the PBL approach. They stated that it was completely positive, understandable/instructive, memorable, connected to everyday life, engaging, fun, and that it was an opportunity for researching, generating ideas, discussion, inquiry and group work. In addition, the majority of students expressed the positive opinions that they were able to exchange ideas and that opportunities for collaborative work in groups were provided. Among the negative opinions of the students were that the PBL approach was unusual, time-consuming and boring, that there were communication problems and that disputes broke out during the group work. Only three students expressed the negative opinion that group work was unnecessary because they preferred to work individually. These findings are supported by some studies in the literature (Azer, 2009; Carder, Willingham and Bibb, 2001; Dolan and Collins, 2015; Hartfield, 2010; Islek and Guner, 2006; Jaleel, Rahman and Huda, 2001; L'Ecuyer, Pole and Leander, 2015).

Table 2. Positive and negative opinions about the PBL approach and group work

Positive Opinions			Negative Opinions		
Main Theme 1: PBL approach	f	%	Main Theme 1: PBL approach	f	%
Sub-themes:	158	87.29	Sub-themes:	23	12.71
Completely positive	35	22.15	Unusual	7	30.44
Understandable/ Instructive	31	19.62	Doing more research	6	26.09
Memorable	19	12.03	Group disagreement	6	26.09
Doing research	23	14.56	Time-consuming	2	8.70
Linked to everyday life	12	7.60	Boring	1	4.35
Creating ideas/Discussion/Inquiry	10	6.33	Learning incorrect information	1	4.35
Enjoyable	8	5.06			
Interesting	7	4.43			
Teamwork	7	4.43			
Active role	3	1.90			
Communication	2	1.27			
Self-confidence	1	0.63			
Main Theme 2: Group work	f	%	Main Theme 2: Group work	f	%
Sub-themes:	101	66.45	Sub-themes:	51	33.55
Exchange of ideas	36	35.64	Group disagreement	25	49.02
Cooperative work	31	30.69	Communication problems	22	43.14
Understandable/ Instructive	12	11.88	Unnecessary	3	5.88
Communication	10	9.90	Discussion	1	1.96
Discussion	6	5.94			
Enjoyable	3	5.94			
Memorable	2	1.98			
Self-confidence	1	0.99			
Total (Positive Opinions)	259	77.78	Total (Negative Opinions)	74	22.22

Some of the students' positive and negative opinions regarding PBL and group work are as follows:

“Our group was not really a group, because we couldn't solve any problems together. We didn't even ask how to do this question because everyone in the group had their own friend and only communicated with them. Everyone else tried to solve the problem on their own. So we were not a good group and our group was negative.”(S5)

“Although this exercise had some bad consequences, the scenario seemed to become more permanent through the investigations and analyses we carried out. It was real.” (S6)

“The negative aspect is that one person would do something while someone else wouldn't. The positive aspect is that our friendships developed and we talked to people we have never talked before.”(S7)

“We found it positive to research the information ourselves, that made it more permanent. The negative aspect is that it was difficult for us to get used to the PBL approach because it was the first time we had encountered it, and even I did not understand it every session, but later I started to understand it and got used to the approach.”(S8)

“Working with a group was absolutely appropriate. Sharing information, discussing, presenting our ideas, gaining in self-confidence and how we integrated by having conversations with people we'd never talked about were great. The negative aspect was that people being absent and not having friends in the group affected all of us.”(S18)

“The workload was low. Unclear topics were discussed and resolved, but conflicts could arise.”(S29)

“There were more positive aspects than negative aspects. When I assessed myself, I found a lot of positive things. I learned that if we were to practice the course on a regular powerpoint slides or book, we would not understand it. Therefore with this approach, I learned the information permanently but without doing this by rote learning. Maybe we'll forget it later if we do it by rote. But thanks to how the scenario flowed, I enjoyed doing the research and answering the questions. And in the end, when I looked at myself, I noticed that I had learned to understand things even when I was not working.”(S33)

“The PBL approach is a very positive approach for me. On the downside, I was nervous the first day, because I had a very busy student life. Even so, I have only encountered this in the biochemistry course. I'm not nervous right now. On the contrary, I'm curious. I'm doing research. I'm a bit tired of having to say what I have found in different places, but it's a good kind of tired.”(S47)

“The positive aspects are that people do research, exchange information with each other, and that we were able to find out how our bodies and our organs work during disease. It has the positive aspects of learning information and knowledge about different topics while focusing on a specific topic. I don't think there is anything negative about it.”(S53)

“The PBL approach was instructive and related to daily life. It was enjoyable and we can do research. There are not any negative aspects. We can work collaboratively but sometimes we can not communicate with each other.”(S55)

“This method was a bit different for us from the old method we were exposed to. Obviously this method didn't work well for me, I didn't get used to it. Rote learning is better.”(S66)

CONCLUSION

This study aimed to develop and implement a PBL scenario on the topic of carbohydrates and lipids for a basic biochemistry course at associate's degree level in the health field and to investigate the students' opinions concerning the PBL approach and group work. A structured interview form was used in order to gather the opinions of students in this research. The results of the content analysis of the structured interview form showed that the majority of the students had a higher frequency of positive opinions (f: 259, 77.78%) than the frequency of negative opinions (f: 74, 22.22%) for PBL approach and group work. The majority of students stated that the PBL approach was intuitive,

understandable, instructive, fun and provided them with an opportunity to do research, have discussions, carry out inquiries. They also expressed the positive opinion that they were able to exchange ideas during group work.

Carder, Willingham and Bibb (2001) found that the case-based learning method based on PBL was successfully applied in the field of science and health sciences and that the self-learning skills of students increased in the problem-solving process. Dolan and Collins (2015) stated that the complex problems used in PBL should be interesting and motivating. L'Ecuyer, Pole and Leander (2015) examined the impact of PBL on nursing students' collaborative work in their study. In their research, the critical views of students related to a PBL scenario prepared based on clinical application were obtained. It was concluded that PBL was an effective way to increase the cooperative working skills of students. In our research, the negative opinions of the students included the views that PBL could be time-consuming, exhausting and lead to communication problems during group work. In the study of Islekel and Guner (2006), they found that students expressed negative opinions about the PBL approach being unusual, long and exhausting.

In light of these findings, PBL implemented for the topic of carbohydrates and lipids in a basic biochemistry course at associate's degree level increased the students' positive opinions about the PBL approach and group work.

IMPLICATIONS

The effect of PBL on students' academic achievement in basic biochemistry could be further investigated, and to increase the validity of the study a control group could be added to the study. This will contribute to the literature because of the limited number of studies of PBL for associate degree students.

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