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SDU University, Kaskelen, Kazakhstan.

E-mail: gulmira.bekenova@sdu.edu.kz**USING CASE METHOD IN TEACHING CHEMISTRY****Bekenova Gulmira** — Candidate of Chemical Sciences, Associated Professor, SDU University, Kaskelen, Kazakhstan,E-mail: gulmira.bekenova@sdu.edu.kz, ORCID ID: <http://orcid.org/0000-0001-8060-3554>;**Abilbek Zhangyl** — PhD, SDU University, Kaskelen, Kazakhstan,E-mail: zhangyl.abilbek@sdu.edu.kz, ORCID ID: <http://orcid.org/0000-0003-2387-0714>;**Zhumakayeva Bota** — Candidate of Chemical Sciences, Associated Professor, SDU University, Kaskelen, Kazakhstan,E-mail: bota.zhumakayeva@sdu.edu.kz, ORCID ID: <http://orcid.org/0000-0001-8328-0404>.

Abstract. Modern chemistry education requires approaches that develop students' functional scientific literacy, higher-order thinking, and ability to apply knowledge in real-life contexts. Teaching chemistry methods was characterized by the peculiarities of students' activity in cognition of chemical objects (Nygmanuly, 1993). Within this perspective, the case method is considered a promising strategy because it engages learners in analyzing authentic situations and encourages discussion-based learning. The relevance of this study lies in identifying instructional approaches that not only transmit chemical knowledge but also promote communication, analytical reasoning, and independent decision-making among school students. The purpose of the research was to examine the effectiveness of the case method in chemistry teaching and to explore teachers' and students' perceptions of its benefits and challenges. Surveys were conducted among experienced teachers, pre-service chemistry teachers, and high-school students, and a sample lesson on "Energy Drinks" was implemented to observe how case-based learning affects interest, understanding, and participation. Descriptive analysis was used to compare responses across groups. Findings showed that most teachers recognize the pedagogical value of case studies, noting increases in students' analytical abilities, engagement, and motivation. Students also reported greater interest, clearer understanding, and improved communication when chemistry topics were linked to real-life problems. However, teachers pointed to limited instructional materials and time constraints as barriers to wider application. Overall, integrating case-based learning into chemistry curricula can enhance lesson effectiveness, strengthen student-centered instruction, and foster key competencies

relevant to 21st-century education. Continued teacher training and development of supporting resources are recommended for systematic implementation.

Keywords: Case methods, chemistry, functional literacy, goal, communication, efficiency

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SDU университеті, Қаскелең, Қазақстан.

E-mail: gulmira.bekenova@sdu.edu.kz

ХИМИЯНЫ ОҚЫТУДА КЕЙС ӘДІСІН ҚОЛДАНУ

Бекенова Гүлмира — химия ғылымдарының кандидаты, қауымдастырылған профессор, SDU университеті, Қаскелең, Қазақстан,

E-mail: gulmira.bekenova@sdu.edu.kz, ORCID ID: <http://orcid.org/0000-0001-8060-3554>;

Әбілбек Жаңыл — PhD, Қауымдастырылған профессор, SDU университеті, Қаскелең, Қазақстан,

E-mail: zhangyl.abilbek@sdu.edu.kz, ORCID ID: <http://orcid.org/0000-0003-2387-0714>;

Жұмакаева Бота — химия ғылымдарының кандидаты, қауымдастырылған профессор, SDU университеті, Қаскелең, Қазақстан,

E-mail: bota.zhumakayeva@sdu.edu.kz, ORCID ID: <http://orcid.org/0000-0001-8328-0404>.

Аннотация. Қазіргі заманда химияны оқыту ғылыми сауаттылықты, жоғары деңгейлі ойлау дағдыларын және алынған білімді өмірде қолдана білу қабілетін дамытуды талап етеді. Химияны оқыту әдістемесі оқушылардың химиялық объектілерді тану жөніндегі қызметімен ерекшеленеді (Нығманұлы, 1993). Осы тұрғыдан алғанда кейс-әдісі нақты проблемалық жағдайларды талдауға тарту арқылы оқушылардың белсенді қатысуын қамтамасыз етеді. Зерттеудің өзектілігі – химиялық білімді жай ғана жеткізумен шектелмей, оқушылардың коммуникациялық, талдау және дербес ойлау дағдыларын дамытатын тиімді оқыту тәсілдерін анықтауға бағытталуымен түсіндіріледі. Зерттеудің мақсаты – химияны оқытуда кейс-әдісін пайдаланудың тиімділігін бағалау және оның артықшылықтары мен қиындықтары жөніндегі мұғалімдер мен оқушылардың пікірлерін анықтау. Зерттеу барысында тәжірибелі мұғалімдер, болашақ химия мұғалімдері және жоғары сынып оқушылары арасында сауалнама жүргізілді. Сонымен қатар «Энергетикалық сусындар» тақырыбында сынақ сабағы өткізілді. Мәліметтер сандық сипаттамалық талдау арқылы өңделіп, қатысушы топтар арасында салыстырылды. Алынған нәтижелер бойынша мұғалімдердің басым көпшілігі кейс-әдісінің оқушылардың қызығушылығын, талдау қабілеттерін және сабаққа қатысу белсенділігін арттыратынын мойындайтынын көрсетті. Оқушылар да химияны өмірмен байланыстыру олардың түсінуін жақсартып, өз ойын еркін жеткізуге және бір-бірімен тиімді қарым-қатынас орнатуға мүмкіндік беретінін атап өтті. Сонымен бірге мұғалімдер уақыттың шектеулілігі мен оқу материалдарының жеткіліксіздігін негізгі кедергілер ретінде көрсетті. Жалпы алғанда, зерттеу нәтижелері кейс-әдісін жүйелі енгізу сабақ тиімділігін арттырып, оқытудың сараланған әрі

білім алушыға бағытталған моделін қалыптастыруға, сондай-ақ ХХІ ғасыр дағдыларын дамытуға ықпал ететінін дәлелдеді. Мектеп тәжірибесінде әдісті кеңінен қолдану үшін мұғалімдерді даярлау және оқу-әдістемелік материалдарды дамыту ұсынылады.

Түйін сөздер: кейс-әдістер, химия, функционалдық сауаттылық, мақсат, байланыс, тиімділік

Г.С. Бекенова, Ж.А. Абилбек, Б.Ж. Жумакаева, 2025.

SDU университет, Каскелен, Қазақстан.

E-mail: gulmira.bekenova@sdu.edu.kz

ИСПОЛЬЗОВАНИЕ КЕЙС-МЕТОДА В ОБУЧЕНИИ ХИМИИ

Бекенова Гулмира — к.х.н., ассоц. профессор, SDU университет, Каскелен, Казахстан,

E-mail: gulmira.bekenova@sdu.edu.kz, ORCID ID: <http://orcid.org/0000-0001-8060-3554>;

Абилбек Жаңыл — PhD, ассоц. профессор, SDU университет, Каскелен, Казахстан,

E-mail: zhangyl.abilbek@sdu.edu.kz, ORCID ID: <http://orcid.org/0000-0003-2387-0714>;

Жумакаева Бота — к.х.н., ассоц. профессор, SDU университет, Каскелен, Казахстан,

E-mail: bota.zhumakayeva@sdu.edu.kz, ORCID ID: <http://orcid.org/0000-0001-8328-0404>.

Аннотация. Современное обучение химии требует таких подходов, которые развивают научную грамотность учащихся, навыки высокого уровня и умение применять знания в реальных жизненных ситуациях. Методы преподавания химии характеризуются спецификой познавательной активности учащихся при изучении химических объектов (Нугманулы, 1993). В этом контексте кейс-метод рассматривается как перспективная стратегия, поскольку вовлекает школьников в анализ реальных ситуаций и стимулирует обучение через обсуждение. Актуальность исследования связана с необходимостью выявить педагогические подходы, которые не только передают химические знания, но и способствуют развитию коммуникативных навыков, аналитического мышления и способности к самостоятельному принятию решений. Цель работы — оценить эффективность кейс-метода в обучении химии и выявить мнения учителей и учащихся о его преимуществах и трудностях. Были проведены опросы среди опытных педагогов, студентов-практикантов и старшеклассников, а также организован пробный урок по теме «Энергетические напитки». Полученные данные подвергались описательному анализу и сопоставлялись между группами участников. Результаты показали, что большинство учителей высоко оценивают педагогическую ценность кейс-метода: он усиливает аналитическое мышление, повышает мотивацию и активность школьников на уроке. Учащиеся также отметили рост интереса к предмету, более глубокое понимание материала и улучшение взаимодействия со сверстниками при анализе учебных ситуаций, связанных с повседневной жизнью. В то же время педагоги указали на нехватку учебных материалов и ограниченность времени как на ключевые препятствия при внедрении метода.

В целом интеграция кейс-метода в школьный курс химии способствует повышению эффективности уроков и поддерживает ориентированное на учащегося обучение, формируя важные компетенции XXI века.

Ключевые слова: кейс-методы, химия, функциональная грамотность, цель, коммуникация, эффективность

Introduction. Case method provides great opportunities for the creative development of the teacher and student. Case method is a method of finding effective ways to solve a real or imaginary situation, *aimed* at achieving this goal. In a case study, students must first fully understand the problem, then look for possible variants, analyze and draw conclusions, which will greatly help students to develop all the skills in Bloom's taxonomy: analyzing, evaluation and application (Anderson&Krathwohl, 2000). Using the case method, it would be built interdisciplinary connections, because the student investigates the solution of case problem in detail (Palanque, et al. 2023). Through the case method, students develop the following skills: Analytical skills, practical skills, creativity, communication skills, social skills, and making decisions.

Materials and methods. The case method is a sufficient teaching method that helps students to solve problems, increase their ability to work independently and increase their interest in the lesson (Krain, 2016). Case studies help students think about a story, find a solution, and communicate, i.e work as a team. Teachers can create case studies that students complete by "asking questions, discovering content, applying theories, or providing critical analysis" (Columbia CTL.). The teachers share a case or ask students about the situation necessary for the lesson and guide the student and assigns roles to students in the analysis of the situation. Students roles are discussion on case and beginning discussion is essential to start the conversation with a question (Krain, 2016).

Pedrosa de Jesus *et al.* (2005) research chemistry question-based learning by a mini-project on 'thermochemistry of fitness' by attending one group of three students. This study has contributed to students in a way discipline engagement, interaction, and confidence. In some studies, there were investigated that the effectiveness of case-based instruction on conceptual change in chemistry, school students' attitudes and motivations toward chemistry. The purpose of these studies are to compare the effectiveness of case-based learning method instruction over traditional method instruction on high school students' understanding of solubility equilibrium concepts (Çam, 2009) and electrochemistry concepts (Tarkin, 2017). Yalcinkaya *et al.* (2012) investigated the effectiveness of case-based learning (CBL) over traditionally designed chemistry instruction (TDCI) on 10th grade students' perceived motivation about chemistry as a school subject.

Yadav, *et al.* (2007) purposed to investigate the contexts of using case studies in science courses as well as faculty perceptions of the benefits and challenges of using them by conducting a national survey. Yilmaz&Bekenova (2017) on their study the benefits of problem based learning and case method on teaching process were deter-

mined. It was investigated the ways of use of case method on chemistry subjects in order to increase teaching methods for secondary education. Therefore, case method in school chemistry about periodicity was explained in detail, some steps on implementation of case method on teaching process. The steps; preparation, completion questions, discussion and finding solutions, self-working of students and working with the teacher.

This study (Bonney, 2015) tested the hypothesis that case studies are more effective than classroom discussions and textbook reading at promoting learning of key biological concepts, development of written and oral communication skills, and comprehension of the relevance of biological concepts to everyday life. This study indicated that case studies were significantly more effective than other methods on learning performance biological topics. In other study (Ertmer *et al.*, 1995) described the students' opinions and approaches to case-based instruction. Students' responses are described in terms of the motivational components of case-based instruction: the interest expressed, the value students perceived in case-based instruction, as well as their confidence for learning from the case method.

Although the more advantages of case method on teaching and learning process, the most of teachers cannot use these methods and students cannot have information of the implementation of case study in learning process (Yin Robert, 2009). The simple way to use case studies in class is by introducing one example and assigning one student or small groups to relate concepts from class to real-life examples (Kaushal, 2004). In this respect, it was required to literate the teachers and students in high schools so that it was conducted the survey and sample lesson to practice and literate the teachers and students. In this research study, the research question was figured as "case-based method effective for teaching and learning process". The purpose of this survey is to determine the effectiveness of the use of the case method in the teaching of chemistry in accordance to the views of teachers and students.

In this research, surveys were conducted with the participation of experienced teachers, pre-service chemistry teachers and high school students. Through a survey, we asked questions to find out what method teachers use in the classroom and the effectiveness of this method. For the determination of the views of students, a sample lesson with case study in chemistry was conducted with the topic of 'Energy Drinks' for 8th class students during 40 min of lesson. The purpose of this lesson is to explain to students the harm of energy drinks, increase students ' interest in the lesson through this problem, explain to students the connection between chemistry and life, and the importance of the chemical composition of substances used in everyday life, get acquainted with the chemical composition of energy drinks and explain to students what chemical compounds are harmful to health. The topic of this lesson was about a problem that aroused students ' interest, and there was a lively discussion among students. During the lesson, using the case method as a practice in chemistry, we learned about the features of the case method and how to pass the lesson correctly. In order for a case study to be rational, the Case question should be relevant, that is, it should immediately arouse students ' interest, and on the contrary, if the case

question is uninteresting and incomprehensible, it may not get hot discussion among students and become incomprehensible to students.

In the first type of survey 6 experienced teachers and 37 pre-service teachers took part. Everyone agreed to participate in the research and fill in a questionnaire. We know the theoretical significance of using the Case method in general, but is it the same in practice? This survey was conducted to find out. To learn about the advantages and disadvantages of the case method, it is important for us to know the views of both teachers and students. In the next type of survey 100 Kazakhstani school children took part. They are high school students, who learned in 9-11th grades. The purpose of this survey is to find out what high school students think about teaching methods and which new and old teaching methods are effective, how students view case studies, how to increase students' interest in the lesson, and how to improve lesson quality.

Data collection and Analysis

The study was conducted in the form of a survey which was made on the Google Form platform. Each survey was submitted with template description below: Consent Form for participation in research entitled "Using case method in teaching Chemistry". Eight questions for each Teachers' and Students' survey. Data was analyzed with calculating percentage of each questions and compared data from both teachers' and students' survey.

Results. The results of teachers' responses were shown on Table 1. According to Table 1, the questions between 1 and 4 were about the effectiveness and uses of case study in teaching process. For question 1, the more extent of teachers (totally 96%) agreed that the use of the Case method was effective in teaching chemistry. The question 2 shows that the mostly like three methods were Case method indicating by seven teachers, using different methods by five teachers, and new modern methods by three teachers. The question 3 indicated the use of new methods by teachers that the 74 percent of teachers always use the new methods. The question 4 presented the efficiency of methods on student' interest, the more effective methods were playing game (16.3%), video lesson (11.6%), group work (9.3%) and case study (9.3%). To find out the effect of the case method on the development of students' thinking and the communication skills of students, the 5th and 6th questions were asked. The question 5 shows that the most of teachers (35%) indicated that the different methods for solving problems increases the ability of students especially 20 percent of teachers said that students can explain their opinions to other friends during the work of finding solutions of casing problems. The question 6 presented that the most of teachers' opinions (65%) were about the increase students' analytical skills by case method and as second most popular option (30%) is a better understanding of the topic. Also to find The 7th and 8th questions were about the difficulties of teaching by case method. From 7th question the most teachers (10 teachers, 23.2%) have not yet used the Case method in practice. The four teachers' options for each following opinions 'developing problem-solving skills, developing students 'logical thinking skills, developing students' analytical skills, and helping them to better understand

the lesson` were found out. From 8<sup>th</sup> question indicated the disadvantages of using case method were the teachers` responses about insufficient materials (49%) and taking long time (40%).

Table 1. Teachers` responses

1.Do you think that the case-based method of solving problems with students is effective in chemistry?	I completely agree		I agree		I disagree		I completely disagree	
	26%		70%		2%		2%	
2.What method do you like to work with?	The three methods mostly like by teachers: Case method (seven teachers, 16.3%) Using different methods (five teachers,11.6%) New modern methods (three teachers, 7.0%)							
3.Do you often use new methods in your lessons	I always use new methods		I often use new methods		I use old teaching methods		I always use new methods	
	74%		19%		7%		74%	
4.What methods have a positive effect on the interest of students during the lesson:				The four methods have a positive effect on the interest of students: play game (seven teachers, 16.3%) video lesson (five teachers, 11.6%) group lesson and case study (four teachers for each, 9.3%)				
5.What impact does working with a video or text have on students discussing problems:	Can solve problems in the future	Can listen to other people's thoughts	Increases the ability to find different methods for solving problems		Can explain your thoughts to other students		No effect	
	15%	18%	35%		20%		0	
6.What is the impact of the case study method on the development of students ' thinking:	The ability to perform analysis increases		Delves into the topic		Can assess the complexity of the problem		No effect	
	65%		30%		3%		2%	
7.The most important efficiency of working with the case method for			Not enough experience to use of the Case method in practice (10 teachers, 23.2%) The four teachers' options for each (9.3%) following opinion 'developing problem-solving skills, developing students 'logical thinking skills, developing students' analytical skills, and helping them to better understanding.					
8.Difficulties encountered in working with the case method:			Insufficient materials		Take a long time		Students do not understand	
49%			40%		9%		2%	

The second part of research was the effectiveness of using the case method in teaching chemistry in accordance to the views of High school students. The results of students' responses were shown on Table 2. According to Table, the first question was about the students' like the format lesson and the questions between 2 and 6 were about the effectiveness and uses of case study in teaching process. The following 7th and 8th questions were asked to find out the results after the lesson by the case method. For question 1, watching video in lesson was the favorite format in accordance to students' views (56%). For the questions between 2 and 6 were about the effectiveness and uses of case study in teaching, the more extent of students was completely agree and agree the effectiveness of case method as shown Table 2. The 7th and 8th questions were asked to find out the results after the lesson by the case method.

Table 2. Students' responses

<i>(Before the sample lesson)</i> 1. I like the format of the lesson:	I like to watch videos	I like to write more reports	It would be nice if we were separated by a group and defended ourselves		I would like to conduct experiments
	56%	21%	18%		5%
<i>(After the sample lesson)</i>	Completely agree	Agree	Neutral attitude	Disagree	Completely disagree
2.Solving problems in Chemistry Lessons and connecting them to everyday life will help you understand the topic	37%	49%	6%	5%	3%
3.Conducting a lesson using the problem method has increased your interest:	20%	63%	11%	3%	3%
4.The Case study method helped me fully express my point of view:	25%	60%	11%	1%	3%
5.It was interesting to discuss and discuss during the lesson	44%	37%	9%	7%	3%
6.Case study helped to improve communication between students or between students and teachers	30%	58%	10%	1%	1%

7.Taking a case study affects my better understanding and knowledge of Chemistry Lessons:	Yes, I understand perfectly		Yes, however, there will be some difficulties	No, it's interesting that the teacher explained		I don't understand at all
	34%		51%	8%		7%
8.Advantages of the problem method:	Convenient to understand the lesson	It is interesting to discuss with the group	Increases my leadership skills	Useful for future use	I understand chemistry better	It helped me come up with new ideas
	43%	29%	13%	16%	21%	20%

In first question, before the sample lesson, most students said that they like to watch the lesson by watching a video. 56 students chose the most liked method as watching video before the sample lesson. The most popular options after watching the video are: writing more reports and volunteering students in groups. In general, these formats are the favorite format of students. After the sample lesson the open question asked as 'If you were a teacher, what format would you take the lesson in' and then most of students (13 students) like the case method. The result was figured in the Figure1.

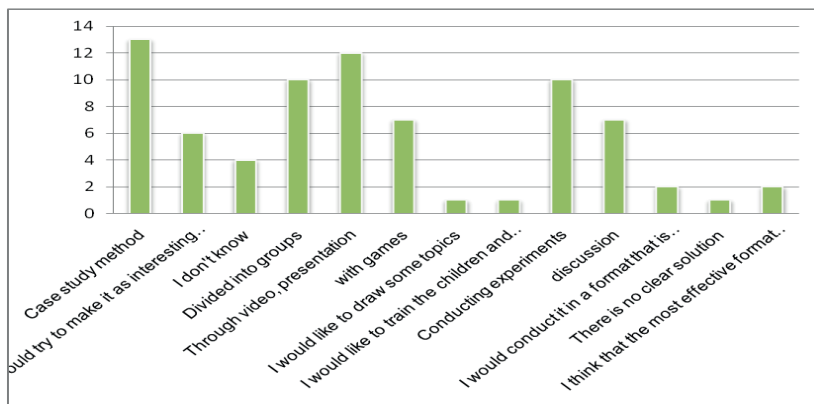


Figure 1 - The result of student responses after the sample lesson

In second question, most students answered that solving problems with real-life examples will help them better understand the lesson. Because the lessons taught in this way are of interest to students, help them to easily understand the topic, the topic covered in this way will never be forgotten. It was considered that the opinions of students to questions between 3-6 about the Case method the majority of students agreed that this method was allowed students to learn to express themselves openly during the lesson; analyzing their results during the lesson, increasing students' interest in the lesson; helps to improve students' communication with each other and between student and teacher. The questions 7 and 8 resulted that students understand

the lesson using the Case method because of the increase students' understanding and knowledge of the lesson. That is, according to students, the case method has such advantages.

Discussion. Is it effective to use the case method in chemistry? In order to find out the answer to this question, teachers and students were interviewed. According to the first and second questions' results of teacher survey, the advantages of the Case method was most likely (agreed by seven teachers), and effective (totally 96% of teachers' opinions). The study results (Çam, 2009; Tarkin et al., 2017; Yalcinkaya et al., 2012) showed that case-based learning instruction produced significantly greater achievement in understanding. Case based learning was effective for remediation of misconceptions and enhancing students' understanding of chemical concepts, attitude toward chemistry, and motivation to learn chemistry. Yadav et al. (2007) also indicated that cases have a positive impact on student learning, critical thinking, and participation. Bonney (2015) founded that case studies should be considered as a preferred method for teaching about a variety of concepts in science courses.

According to the question 3, the 74 percent of teachers always use the new methods. For the question 4, the more effective methods were playing game (16.3%), video lesson (11.6%), group work (9.3%) and case study (9.3%) on student' interest.

To find out the effect of the case method on the development of students' thinking and the communication skills of students, the 5th and 6th questions were asked. The question 5 shows that the most of teachers (35%) indicated the sufficiency of the use of different methods for solving problems to develop the ability of students especially 20 percent of teachers responded as increase of communicative skills during the determining solutions of casing problems. The question 6 also presented that the most of teachers' opinions (65%) indicated the increase of students' analytical skills by case method. Yilmaz&Bekenova (2017) have resulted that the use of the case method was based on student-centred learning and on cognitive activity to improve their knowledge and development of thinking abilities. Students were had an influence on increasing interest and the development of self-studying in school subjects.

The 7th and 8th questions help to determine the teaching difficulties of case method. From 7th question the most teachers (10 teachers, 23.2%) have not yet used the Case method in practice. From 8th question indicated the disadvantages of using case method as insufficient materials (49%) and taking long time (40%).

According to the students' survey responses, 56 students chose the most liked method as watching video before the sample lesson. After the sample lesson the most students (13 students) accepted case method as the first method that was differently responded in accordance to results of before lesson. In the change of opinions of students, the opinions about first question before the sample lesson and the opinions of students after the lesson were compared and most of them (13 students) change their own opinion towards case study after the sample lesson when students imagined themselves as teachers. 12 of students responded the second like method was to conduct the lesson through video, and 10 students selected group work analysis and doing experiments. One of the results of the study (Ertmer et al., 1995) was compari-

son of students' responses at the initial and end of course. Students' initial responses to case-based instruction were assessed by asking questions during interviews and students were indicated that case-based instruction was more interesting. By the end of the case-based course, most of students maintained (except three), a positive attitude toward the use of cases.

In second question, most students answered that solving problems with real-life examples will help them better understand the lesson. Because the lessons taught in this way are of interest to students, help them to easily understand the topic, the topic covered in this way will never be forgotten. The questions 7 and 8 also resulted that student understand the lesson using the Case method because of the increase students' understanding and knowledge of the lesson. That is, according to students, the case method has such advantages

It was considered that the opinions of students to questions between 3-6 about the Case method the majority of students agreed that this method was allowed students to learn to express themselves openly and analyzing their results during the lesson, increasing students' interest in the lesson; helps to improve students' communication with each other and between student and teacher. Pedrosa de Jesus et al. (2005) in their research study have resulted students' engagement, classroom interaction or communication, and confidence by asking questions in the learning and teaching of chemistry.

Conclusion. According to the results of the survey, students were able to solve problems with case study and also made videos, analyzed in groups, connected chemistry with everyday life, expressed their opinions, and improved their relationships with each other. That is, this method has many advantages and benefits that case teaching is effective for teachers and provide a deeper understanding of the lesson by solving problems in chemistry; helps to increase students 'interest in the lesson; develops students' thinking, analytical and decision-making skills. It was also concluded that the implementation of the lesson with case study, students changed their opinions about case study.

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