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LEARNERS' VIEWS ABOUT USING CASE STUDY TEACHING METHOD IN AN UNDERGRADUATE LEVEL ANALYTICAL CHEMISTRY COURSE

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Abstract. *This study presents pre-service science teachers' views about implementing a case study and which skills they improved as a result of using the method. Sixteen participants in a chemistry class were the subjects in the 2013 summer school term. In the teaching about the properties of chromium, students watched selected parts of the movie Erin Brockovich in four sections. Each part of the movie was followed with a question, and students were then given about 15-20 minutes to find out the answer to the question by using Internet-based resources in the classroom environment. Qualitative data were collected by having participants respond in writing to open-ended questions and through semi-structured interviews. Overall, students' reactions to the method were positive. The results showed that students found it to be an effective instructional method, despite having some difficulties with the expectations of the method and this method has provided many benefits for pre-service teachers.*

Key words: *case study teaching method, chemistry education, science education, teacher education.*

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Introduction

The *case study method* is a family of teaching strategies in which students apply their knowledge to solve real-life problems (Gallego, Fortunato, Rossi, Korol, & Moretton, 2013). Although, case study methods have a long history in business, law, and medical education, their use in science education is relatively recent (Cameron,Trudel,Titah, & Léger, 2012). Case study methods in science education were first used by James B. Conant of Harvard in 1949 through scientific stories (Herreid, 2006).

The cases created for discussion are derived from real-life practice and problems that require resolution through critical analysis of the situations, including key qualities and the context in which ongoing decisions must be made. Through the case study process, multiple sources of data are provided for analysis, allowing different interpretations. In case study instructional methods, students are required to carefully review the case in advance of the discussion session, to identify the essential issues and to research supplementary knowledge as needed. The preparatory work is done independently or in study groups prior to the discussion session, which serves as the setting in which students collaboratively apply learned principles and data analyses, and evaluate the usefulness of various strategies to achieve best resolution of the problems presented (Bowe, Voss, & Aretz, 2009). Discussions are facilitated by the instructors in order to help students decide what issues are most important to the analysis, how those come up within the problems, and what conclusions can be made (Joroff & Moore, 1984).

The related academic literature indicates that implementing the case study method has many benefits. Libby (1991) developed taxonomy of case study benefits in terms of cognitive benefits, skills development, and affective benefits. Based on the taxonomy, provided by Ballantine and McCourt Larres (2004), the cognitive benefits of the case study method include relating theory

to practice, integrating major concepts, improving judgment and problem solving skills, thinking conceptually and critically, and so on. They also refer to skills development as improving library skills, data organization, verbal communication, and written skills as a result of using case studies. The researcher identifies the affective benefits of the case study method as increasing students' interest in the use of case studies, including factors such as motivation, enhanced interest in the subject, concern for their own learning, and confidence building. Although affective benefits do not essentially improve the students' basic skills, they might contribute to an increase in their overall case study experience. While literature cites several benefits of case study methods in fields other than science education, to the researchers' knowledge no one, if few any, has studied this method in science education. In an effort to address the gap in science education literature, this study explored the impact of case study method on pre-service teachers' cognitive and skills development, and attitudes towards learning.

The following research questions guided this study:

- Which benefits of case study method were expressed by pre-service science teachers?
- What kind of challenges did the pre-service science teachers face during case study instruction?
- How did the benefits which pre-service science teachers gained from case study implementation, affected their studies later?
- What are pre-service science teachers' suggestions for the better implementation of case studies?

Next, a discussion of the literature on the strengths and challenges of teaching through the case study method is presented.

Theoretical Background

Benefits of Case Studies

Many researchers have found that case studies provide students cognitive benefits with opportunities to gain content knowledge (Camill, 2006; Chaplin, 2009; Casotti, Beneski & Knabb, 2013; Jalgaonkar, Sarkate, & Tripathi, 2012), understand the contexts in which knowledge is relevant (Camill, 2006), apply science to their daily lives (Camill, 2006; Joroff &Moore, 1984; Yadav, Shaver, & Meckl, 2010), enhance clinical reasoning/critical thinking (Chaplin, 2009; Delpier, 2006; Dochy, Segers, Van den Bossche, & Gijbels, 2003; Gallego et al., 2013; Harrison, 2012; Healy & Mccutcheon, 2010; Iqbal & Rubab, 2012; Jones, 2003; Popil, 2011; Yadav, Lundeberg, DeSchryver, Dirkin, Schiller, Maier, & Herreid, 2007; Yadav et al., 2010), improve analytical skills, decision making and independent thinking (Cameron et al., 2012; Joroff & Moore, 1984), problem solving skills and discussion (Chaplin, 2009), relating theory and practice (Yoon, Pedretti, Bencze, Hewitt, Perris, & Van Oostveen, 2006).

Some of the studies have focused on case studies' affective benefits that enhance students' attitudes and interest (Ayyıldız & Tarhan, 2012; Casotti et al., 2013; Jalgaonkar et al., 2012), self-confidence (Cameron et al., 2012), facilitate self-learning (Harrison, 2012), motivation (Yalçınkaya, Boz, & Erdur-Baker, 2012) and improve active involvement in the learning process (Yadav et al., 2007; Yadav et al., 2010).

Although findings from Cameron et al. (2012) reveal that a discussion-based format helps to develop cooperation, synthesis, listening, presentation, and time management skills, these are not classified directly within the skill development benefits identified by some researchers (Ballantine & McCourt Larres, 2004). Still, these effects can be considered as being related to the skill-related benefits. Finally, the case method allows students many benefits, specifically regarding how to learn by doing, which is believed to be one of the best ways to integrate new knowledge.

Limitations of Case Study Method

However, while many beneficial outcomes are observed in student learning when using the case method, there are also some limitations. Popil (2011) stated that although case studies are useful in presenting difficult facts requiring problem solving, the method does not fit well in teaching concrete concepts. Moreover, developing cases is difficult and time consuming, so that it requires instructors to have good reasoning and questioning skills (Prince & Felder, 2007). Cameron et al. (2012) indicate that if the students do not pay serious attention to cases, or feel that the cases lack realism, they may not participate in the case and may not prepare satisfactorily for the class. As a result, students may not be well prepared for class discussion. Cassimjee (2007) found that the students, who were engaged in case based learning, pointed out their concerns about the difficulty of working in a group



and the amount of independent work involved. The other concern is that limited knowledge of the instructor's presentation of the case can impede the students' participation in the class discussion. In addition, cases relating to technological content are likely to lose their significance more rapidly than the other type of cases.

Studies on Perceptions of Learners on Case Study Method

It is also important to determine the perceptions of learners on using the case teaching methods in terms of increasing the benefits discussed in previous section. This is especially important that there is a great deal of attention given in higher education in terms of participant-centered beliefs and practices (Pierce & Kalkman, 2003).

In fact, several studies have already reported on learners' views on the case study instructional method. However, most of the studies that have focused to learners views are conducted in the other fields such as medical education and business. For example, Cassimjee (2007) investigated the students' perceptions about a case based teaching and group work in a first year nursing program. The researcher reported that the students found a case-based learning interesting in class and in the practical area. The participants mentioned that they improved their communication skills and their preparation for class. They also thought that it facilitated open discussion, increased interaction and the sharing of information among classmates. Another finding was that the participants thought the group discussions made learning easier.

Scott (2007) addressed the introduction of the case method of teaching on student perceptions of teaching effectiveness in a Tourism Strategic Planning Course taught at the third year undergraduate level. He found that students considered a case study method contributed to their critical thinking and problem solving skills. Shieh, Lyu and Cheng (2012) explored how the participants perceived the case based instructional approach teaching in management. Their findings indicated that the students were overall satisfied with the instructional process of the course. The students stated that they learned to be more logical in their approach in terms of solving the problems, engaged in 'deeper thinking', were able to connect theory with practice, and stimulated their thinking skills.

The studies discussed below have specifically focused on learners' perceptions of the case study based teaching in science and teacher education settings. Yadav (2008) explored pre-service elementary teachers' perceptions of the influence of video cases on their learning. The researcher found that learners had a positive learning experience from the video cases and thought that video cases were beneficial to them in terms of the impact the videos had on their own ideas of literacy instruction and their ability to observe teaching, connecting theory and practice, analyzing, discussion of ideas, and practice.

Murray-Nseula (2011) studied the impact of a case based teaching on students' perception and performance in an undergraduate genetics course. The researcher found that all of the students indicated a positive perception of the course and they improved their grades compared to previous years. The student evaluations also showed that the course increased students' analytical, problem-solving and critical thinking skills. According to the findings of the study, case studies can promote intellectual and practical skills, and integrative learning.

Çelik, Çevik and Haşlaman (2012) inquired about the perceptions of prospective Computer Education and Instructional Technology teachers toward case-based learning in a teaching methods course. They found that prospective teachers perceived cases gave them opportunities to think as real teachers and apply their theoretical knowledge to practical situations, as well as improving their understanding and conceptions of teaching profession. The results of the study also revealed that prospective teachers found cases to be effective in improving their problem solving and critical thinking skills.

Hernandez- Serrano and Jonassen (2003) stated that the most important advantage of this teaching method is that the learners have to find the opportunity to cope with complex problems, similar to those they will come across in their future professions. In this respect, the potential effects of the method fit well with the goals of teacher education programs (Colburn and Tillotson, 1998). Although such methods are used in some graduate-level courses in science education, limited research has examined whether or how these case-based teaching methods are being used (Yadav et al. (2007). Thus, more research is needed as to what science faculty think are the benefits of case-based instruction on student outcomes, or what challenges faculty face when implementing cases in their own teaching, and the possible effects on the teacher education. The present study is an effort to contribute to the pre-service teacher education programs through examining the benefits and challenges of case study teaching methods on pre-service teachers' perspectives. Implications for effective implementation of the method are also discussed.



Methodology of Research

An exploratory study was undertaken to investigate the views of pre-service science teachers on the case study teaching method, a thematic content analysis was conducted of responses to an open-ended survey and semi-structure interviews. The study was conducted at the 5-weeks summer school term in 2013 in an undergraduate level analytical chemistry class, which is a four-credit compulsory course for pre-service science teachers. Analytical chemistry is the division of chemistry which includes qualitative (identification) and quantitative (how much) analysis techniques in a mixture. Theoretical sessions cover an introduction into measurements in analytical chemistry, the analysis of measurement errors, accuracy and sensitivity of the chemical analysis methods, gravimetric and volumetric methods, the analysis of the chemical interactions in equilibrium systems, basic instrumental methods of chemical analysis, spectrophotometer and atomic absorption, and basic separation techniques, such as chromatography. Practical sessions include the calculations and practice with the experiments about the methods indicated above. The course instruction consists of six 45-minute weekly lectures and six 45-minute laboratory application, totaling 12 class hours per week in the summer school term. During the first four weeks, all of the topics mentioned above are presented to the students through lectures and labs according to the lesson plan. In the last week, the case study was implemented to the participants.

Participants

Sixteen pre-service science teachers (eight females and eight males), who had failed at taking an undergraduate-level analytical chemistry course for the first time and had to re-take the course for the second time in summer term, were all enrolled in this study. The participants were sophomores and the average ages were 20.5 years (females) and 21.28 years (males). The selection of students who had failed the course was not particularly aimed and was a coincidence, thus convenient sampling.

Implementation

This case study presents students with a real-life story describing a scientific study of hexavalent chromium using and its effects on human health. The case was conducted using a mix of individual and interrupted methods. Herreid (2005) described the Interrupted Case Format as the format in which the teacher works with a small group where the instructor gives the students a problem faced by real researchers. Then, the students work in small groups for bout 15 minutes and after that time they report their thoughts on the approaches to solving the problems. Information is given in sessions, followed by the questions after each segment. In the study, the students worked individually, since, a very small number of students were enrolled in the course. All the students had individual computers and Internet connection in the classroom.

In the instruction about the properties of chromium with a case study teaching method, the students watched selected parts of the movie *Erin Brockovich* (DeVito et al., 2000) in four sections. Each part of the movie was followed with a question, and the students were then given about 15-20 minutes to find the answer to the question by using Internet-based resources in the classroom environment. At the end of the time provided for finding information, the students discussed their answers with peers and the instructor. In brief, during the instruction the students took on the role of *Erin* (the heroine of the movie) with respect to learning about the chemistry of chromium, and they tried to solve problems similar to those she faced in the movie. At the end of the instruction, additional videos were shown and the answers to the questions were discussed again by the instructor. The case study implementation as below:

- In the first session, the students' attention was drawn to the Chromium by having them watch the first part of the movie. They saw local people having problems related from chromium uptake in the movie. The movie was stopped here and a series of questions were asked for the learners to think about. Then, they were asked to start to investigate the properties of chromium by using Internet and computers in the classroom. At the end of the 15-20 minutes of research time, the students started to present their findings. After a short discussion the students watched the related parts of the movie. So, the students learned that chromium could have two different oxidation states, Cr (III) and Cr (VI) that have different toxicities, mobility and bioavailability.

- In the second session, they watched the other selected/related parts of the movie, about the heroine who wonders how she can find out if there are any traces of chromium in tap water. Then, the students were asked to explore and study the qualitative and quantitative analysis methods used with chromium compounds taking the



position of the heroine in the movie. Finally, they discussed their findings.

- In the third session, the students investigated the effects of chromium compounds on human health. First, they watched several illnesses experienced by the people who lived around the chromium processing company. They were given questions that asked them to calculate the chromium amount in a waste-water sample. Then, they were asked to conduct gravimetric, volumetric, and spectrophotometric analysis. They tried to decide whether the amount of chromium, caused the observed prevalent illness within community in the movie. In addition they tried to decide which analysis method was most reliable and which result they should take into account for making their decisions.

- In the last session, the students investigated which chemical techniques could be used to remove hexavalent chromium from the waste water. After the discussion, the last part of the movie where the heroine finds that the company did not take the necessary removal techniques, and where the law firm, which heroine works at, succeeds at getting a multi-billion dollar corporation to reveal the truth was shown to the participant.

Data Collection

Qualitative data were collected by having participants respond in writing to two open-ended questions:

- Which skills do you think specifically improved as a result of implementing the method?
- What kind of challenges have you faced during the case study method?

Semi structure interviews were conducted with four of the participants 8 months after the implementation. Two male students were chosen intentionally for the interviews. They were the only students who mentioned some challenges and had negative comments on the open-ended questions about the case-based teaching. In addition, two female participants with positive comments on the open-ended questions were randomly selected for the interview to ensure equality of gender and opinion. All participants volunteered for the interviews. The focus questions asked to students in the interview during the 15-30 minutes duration were:

1. Do you remember our last class in analytical chemistry course in the past summer term? Would you please briefly explain the implementation we used?
2. What is your general opinion regarding the case study teaching method used in the course?
3. Please give a score according to 10-point grading scale to the items on the list to what extent you have developed the skills through case study method?

Items	Failure	Very bad	Bad	Weak	Satisfactory enough	Satisfactory	Good enough	Good	Very good	Excellent
Case study implementation enabled me to …	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
understand the phenomena studied.										
relate theory to practice.										
develop my problem solving skills.										
improve my judgment skills.										
integrate major concepts of the course.										
be more aware about multiple solutions.										
have increased interest in the subject.										
be actively involved in learning process.										
be more motivated.										
be more aware about self-learning.										
develop my research skills.										
develop my verbal communication skills.										

4. Did you use the skills and knowledge you gained as a result of the case study implementation in your other studies or practices later?
5. Do you plan to use the case study method in your instruction when you become a science teacher?
6. What are your suggestions for improving or better implementation of the case study method?

Data Analysis

A thematic content analysis method was used to determine learners' views regarding which skills most developed as a result of using case method in instruction for the open-ended and interview questions. Participant's responses were read and relevant statements separated, that were thematically related to the categories being used. A total of 60 relevant statements were coded with respect to the categories and sub-categories identified by Ballantine and McCourt Larres (2004, p.180), as can be seen in the results section. The data were independently coded by two raters using the identified categories to increase inter-coder reliability. The Cohen Kappa inter-rater coefficient calculation showed that experts had an agreement rate of 0.92, which is accepted as "good agreement". The interview responses were evaluated for the third and fourth research questions.

Results of Research

Findings of Open-Ended Questions

Open-ended responses are organized according to categories, corresponding to the benefits of case studies that were mentioned earlier; cognitive, 'affective', and skills development. The categories, sub-categories, and frequencies are also presented in Table 1. Challenges of the method were also evaluated within the findings.

1. Cognitive Benefits

All of the participants reported several important benefits with regard to this category. In addition, within the category, 11 statements related to *Enhance understanding of phenomena studied*, 8 statements related to *theory to practice*, 6 statements related *to problem solving skills*, 4 statements related to improve *judgment skills*, 3 statements related to *integrate major concepts of science,* and 1 statement related to awareness of multiple solutions. The following comments are typical of the participants (acronym P) that fit into these categories respectively.

> **-***Enhance understanding of phenomena studied*: If we write the properties of chromium only on the blackboard we have forgotten all the knowledge one week later. Case method supported the movie and videos have been very effective on understanding the topic. I think I will remember the entire subject even after years of….(P 8).
>
> -*Relate Theory to Practice*: We have implemented the several analytical chemistry topics such as qualitative and qualitative analysis methods on the same real world problem. This was done so that we could find an opportunity to apply the theoretical knowledge to a daily life situation (P 3).
>
> …The movie we watched in the course was adapted from real life. The movie ensures a correlation between course knowledge and its practical application. Thus, we did not limit our knowledge with just a book (P 5).
>
> -*Problem Solving Skills*: …I believe I mostly developed my problem solving skills as we used several analysis methods on determination of chromium element (P 1).
>
> -*Improve judgment skills*: We discussed the benefits and harmful effects of hexavalent chromium. This has been effective at developing my judgment skills regarding the question of whether should we use Cr (VI) or not?...(P 11).

-*Integrate major concepts of science*: Applying various methods to determine the amount of chromium of a waste water sample helped me to compare to reliability of the methods and judgment, finding the sample's effects on the environment and human health (P 9).

- *Awareness of multiple solutions*: I learned that Cr (VI) can be eliminated from waste water by using several different techniques. This indicates that there would be several different solutions to the problems we face in life. I am aware that deciding the best solution needs to consider many different factors at the same time…..(P 14).

2. Affective Benefits

Eleven students mentioned that case study method lessons *enhanced their interest* in the subject, 9 of them stated that they are *involved in the learning process* more actively compared the other methods, and 2 of the students mentioned that their *motivation* has increased. In addition, 2 of them stated that they got more *responsibility for their own learning*. Some of the learners' responses can be seen below:

-*Interest in subject*: Teaching the lesson with case method was very interesting, attractive, and fun as well. It was a different type lesson that I have not seen before. This increased my attention to the chemistry course. It was a very creative idea to teach the topics by watching a movie. I liked that very much. Thank you…. (P 3).

-*Involvement in learning process*: I like the instruction with case method. It was a well-designed lesson. It provides a feeling as if we are in the laboratory even when we were not there and encouraged active participation to the lesson….(P 13).

-*Motivation:* It was so different. It attracted my attention and increased my motivation. I liked solving problems as the heroine of the movie….(P 6).

-*More responsibility for own learning*:…..also to do research on the topic ensures me literature skills and judgment skills. Thus I got more responsibility for my own learning (P 13).

3. Skill Development

Three of the students discussed the skill development benefits as follows:

-*Research skills*: It raises curiosity, interest, and motivation to do research by using case method. Students find the knowledge by doing Internet searches themselves….Doing search caused me to both use research skills and apply judgment skills in a limited time (P 10).

-*Verbal communication skills*: We both watched and discussed about the topic deeply. It increased the quality of our discussion skills with our friends (P 2).

Table 1. Categories, sub-categories, and frequencies about the benefits of case studies.

Categories of Benefits	F	Sub-Categories	f
Cognitive benefits to students	33	Enhance understanding of phenomena studied	11
		Relate theory to practice	8
		Problem solving skills	6
		Improve judgment skills	4
		Integrate major concepts of course	3
		Awareness of multiple solutions	1

Categories of Benefits	F	Sub-Categories	f
'Affective' benefits to students	24	Interest in subject	11
		Involvement in learning process	9
		Student motivation	2
		More responsibility for own learning	2
Skills development of students	3	Research skills	2
		Verbal communication skills	1

4. Challenges of the Method Faced by Learners

Three of them among 16 students expressed some challenges as well as indicated below. These limitations were about the nature of videos presented in the study, finding the answers in a given period and time consuming feature of the case study teaching method.

> -…..The lesson was good but watching videos was not interesting (P 5).
>
> -Answering the questions after watching the parts of movie was a little bit harmful. I have learned that elaborating the chromium from waste water needs a very complex process. I do not think negatively about applying case method for instruction. I just have been compelled to find answers in a limited time. That's all…On the other hand I have learned to do time management….(P 7).
>
> -…….I think positively about the method. My only concern is that we have wasted too much time…(P 6).

Findings of Interviews

The interview data are organized into three categories: overall perceptions, permanence of the benefits they gained through case based instruction, and suggestions for better implementation of the case study method.

1. Participants' Overall Perceptions of Case Based Teaching

The first, the second and the fifth interview questions were evaluated for determining the overall thoughts of students on a case based instruction. The results show, that all of the participants remember the lesson well even 8 months after its implementation. This shows that the case study method helps with the retention of information. They stated that they were satisfied with the method as they found it interesting. They stated that they gained several benefits as similar their previous responses for open-ended questions. One of the participants said;

> I have been wondering whether there are any other harmful elements in our tap water after the lesson. I believe that it is definitely a teaching method that increases students' curiosity (P 10).

Four of the participants stated, that they might use the method after they became a science teacher. However, they mentioned that they would use the method when they could find appropriate cases in science textbooks or when they gained necessary skills and knowledge for development of their own case studies. Some illustrative comments speaking to this assertion are below:

> Yes I would definitely think about using case studies in almost all of my lessons. I would specifically use case studies that will require children to combine all of the knowledge that they've gained in each science unit. This is a wonderful approach. I would use it at the end of the unit so they can see the relationships between theory and practice. I usually think deeply about how I may be able to find interesting videos or stories on a specific science topic so I can use it with my students in the future. I can use this method especially when teaching chemistry and biology units. I do not think about using case studies in physics topics as I am not good at physics (P 3).

Yes, I would like to use the method in my teaching, but I do not see myself having necessary knowledge and skills to develop meaningful cases. If the case studies were provided in our textbook, then I would definitely use the method (P 10).

I would if they were present in our textbooks. If not, I will try to develop my own cases. However I am not sure if I have the knowledge and skills to develop good cases (P 7).

If I was trained on how to develop such cases, I would use it… However, I am not sure if I will, because I know that they are not used in our textbooks (P 5).

2. Participants' Thoughts on Permanence of Their Skills

The third and the fourth interview questions were used to evaluate the impact of the case study method on students' performance skills. When they were asked to rate items in Table 2 on a scale ranging from 0 to 10, the participants rated the effects of the method on their performance skills very high. P3 and P10 were completely positive and P5 and P7 had some challenges on case study implementation. As shown in Table 2 all of the participants gave high scores on all items.

Table 2. Summary of learning outcomes related to performance skills.

Categories of Benefits	Sub-Categories	P3	P10	P5	P7
Cognitive benefits to students	Enhance understanding of phenomena studied	10	10	10	9
	Relate theory to practice	10	10	9	9
	Problem solving skills	8	9	8	10
	Improve judgment skills	9	10	8	9
	Integrate major concepts of course	10	10	8	10
	Awareness of multiple solutions	10	10	9	9
'Affective' benefits to students	Interest in subject	10	10	10	10
	Involvement in learning process	10	10	8	8
	Student motivation	10	10	8	7
	More responsibility for own learning	8	10	7	8
Skills development of students	Research skills	10	10	8	8
	Verbal communication skills	10	10	8	8

When asked which skill on the listed they improved most, the participant 3 stated, that the mostly benefit she gained taking attention to the course as she watched a movie in class for the first time and then she was able to gain thinking skill, to connect theory and practice on her other subjects and studies. Participant 10 mentioned that she developed her research skill more than the other skills as she started doing research, just she was curious herself not to request somebody else. Participant 5 said, he understands well the topic by using the case method. Participant 7 mentioned that he gained the problem solving skill mostly, as he did the project assignment relating the chromium after the implementation.

Students gave comments, indicated their willingness to continue to use some of the skills they gained in class in their current/future practices. For example, the first comment shows that the participant uses her knowledge, relating the theory and practice skill, the second participant uses his integrate major concepts of science and research skill, the third participant uses her research skills.

Yes I have used the method for preparation a lesson on the Special Instructional Methods Course. As I said before the method has been effective in helping me to connect theoretical knowledge and practi-

cal skill. I tried to present a lesson with a real life problem similar to the one you used in your methods course. Of course mine is not very professional… (P 3).

I have been doing more research on the properties and effects of chromium since the implementation. Then, I presented my paper at the Special Issues in Chemistry course. I am not aware of the problem (P 10).

I developed a project on determination of the effects of hexavalent chromium on plants for the science laboratory course in the last fall semester. I found that waste-water with chromium was more hazardous than the other types of waste waters (P 7).

3. Suggestions of Pre-Service Science Teachers for Teaching Science through Case Study Method

The pre-service teachers stated several important suggestions for the effective implementation of case studies. The results indicated that students perceived that the teacher lost instructional time when teaching through the case study method and offered several suggestions to address the issue. One of them preferred to do practice experiments in the laboratory. Another one of them indicated her willingness to develop the cases.

I would like to practice the experiments in the laboratory myself in order to find answers to the questions as the heroine did in the story or the movie, instead of just watching the videos of experiments being presented to us. I think this approach would make case studies more effective than the traditional approach (P 3).

I will definitely use the case method when I become an in-service teacher in the future. However, we do not have any class in my program that can teach us how to develop and implement cases. I would like to take an elective course about the method offered by you. Specifically, I wonder, how can I adopt this method to the elementary level? (P 10)

The implementation would have been more effective, if more research time, extended into few days, was built in to the activity, instead of just trying to find the answers in a limited amount of time given to us in the classroom environment (P 7).

We wasted too much time trying to find the answers of the questions. If you had answered the case questions right after watching the videos, instead of us trying to find the answers, it would have been less time consuming. We could have spent our time more wisely that way. We could have benefited more from the activities if you had answered the questions (P 5).

Discussion

In this study, the learners' views about the use of a case study method lesson in class and how their skills were affected as a result of using the method were investigated. The conclusions of this study will be discussed around the research questions, (i) benefits of the method, (ii) challenges and limitations of the method, and (iii) pre-service science teachers' suggestions to make case study teaching method more effective.

(i)Benefits of the Method

Benefits of the method will be discussed in terms of the first and the third research questions. All of the participants stated that they gained several benefits in terms of cognitive, affective and skills development as a result of using this method.

The responses indicate that *cognitive benefits* were paid more attention than the others, since all of the learners discussed the benefits they gained within the cognitive category. Much more attention is given to *enhancing understanding of phenomena studied* than to other benefits by learners, while *relating theory to practice* was also considered to a high degree within the cognitive benefits. This result is consistent with the benefits of case method instruction identified by other researchers, including gains in content knowledge (Camill, 2006; Chaplin, 2009; Casotti, Beneski & Knabb, 2013; Jalgaonkar, Sarkate,& Tripathi, 2012), and students' ability to apply science to their daily lives (Camill, 2006; Joroff &Moore, 1984; Yadav, Shaver, & Meckl, 2010). Bowe et al.,

(2009) suggest that case based teaching is a practical instructional method to encourage understanding and practice of basic science concepts. Similarly, Cameron et al., (2012) stated, that although numerous pedagogical approaches have been used to understand the bridge between theory and practice, a case based teaching method is one of the best ways to accomplish this goal. The other important finding of the study is that all of the participants indicated in the interview, continued to use some of the skills that they had gained with the method, such as relating theory and practice and research skills. One of the participants specifically stated, that because of her early exposure to this method, she was able to make connections between theory and practice in all subjects. This result is consistent with the findings of Yadav's (2008), who reported that video cases were beneficial in helping pre-service teachers to connect theory and practice.

Regarding the *affective* benefits almost all of the students stated, that they enjoyed the lessons and that the presentation was an interesting, not monotone, creative, different, and well-designed instructional approach. They appreciated being placed in the role of the heroine as a way of learning the topic. The results showed that the students not only were satisfied about learning with a case study method, but that they also found it an effective instructional method. This result parallels with Murray-Nscula's (2011) findings. Çelik, Çevik and Haşlaman (2012) stated that pre-service teachers perceive case studies as an important motivating factor for their own learning. This result also indicates that, as expressed Libby (1991), while affective benefits do not essentially improve students' cognitive skills, they are worthwhile with respect to improving students' attitudes towards learning. One of the interesting results is that, although, students previously failed the course and all of them had taken the course for the second time, they felt positive about learning chemistry through the method. This result is similar to the results reported in the study conducted by Shieh, Lyu and Cheng (2012) on students' satisfaction with the instructional process of the course. They also indicated that they are willing to use the case method for their own teaching when they become in-service science teachers, if necessary instructional resources could be found in their curriculum. This result is an indicator that the method influenced the students' learning experiences in a positive way and thus helped them to develop positive attitudes towards the method. Moreover, even with limited exposure to the method, they felt that they could implement the skills they had gained through case based instruction in their future professional lives.

It is obvious that the *skills development* category was a relatively low consideration for these pre-service science teachers as 2 sub-categories were related to the research skills and only one of those was related to communication skills. This is not surprising given the fact that they were exposed to and experienced the method only for a short period of time. Of course, only one implementation is not enough for the students to develop such skills. Cassimjee (2007) found that a case based teaching improved students' skills on accessing academic literature and helped them to feel free and comfortable in group discussions. It follows, that in order for students to develop research, discussion, communication, and writing skills, they will need to be exposed to the case study method for a sustained period of time.

(ii) Challenges and Limitations of the Method

The results showed that the main challenge with the implementation of the method was that the students perceived it being time consuming. This concern was also reported by (Popil, 2011). I must note, however, this concern was raised only by one participant. Even then, this concern must be addressed to ensure the best subsequent implementations of the method. While case method is time consuming, it ensures many benefits to the learners as mentioned in Casotti et al., (2013). Similarly, learners felt there were some difficulties, such as finding true answers during the class sessions and that it was time consuming, they stated that the case study method was worthwhile with respect to benefits of cognitive, affective, and skill development as sharing their knowledge and experiences with each other, developing abilities to do research and apply problem solving skills, and that it enhanced their content knowledge specific to the chemistry topic. However, the implementing of the case method was not a simple intervention as Scott (2007) indicated. For instance, the integration of the case method with a movie into the analytical chemistry class required a complete curriculum revision. Moreover, it took a lot of time both to develop the case and implement it in my classroom. However, when considering the advantages and benefits of the method in terms of teacher education, the method should be integrated into methods courses so the students have a positive learning experience with content and develop pedagogical skills to teach science through their teaching once employed in a school.



(iii) Suggestions of better Implementation of the Case Study Teaching Method

The suggestions of the participants were about implementation type of the method in the classroom. These statements can be also considering as the suggestions for further research. One of the participants mentioned that it would be better if they were given more time to find the answers to the questions raised in the movie. The other said, they wasted too much time to find the answers in the classroom. They also found it challenging to find the answers in a limited amount of time. These concerns suggest that the implementation of the method should extend into a few days rather than being limited to a classroom period. Also one participant stated that she would like to practice the experiments, such as determination of the chromium amount in a waste water sample, in the laboratory instead of just solving mathematical problems. If the same study was to be implemented with these concerns in mind, the students would have had a better experience with the case study.

The other suggestion had an important application for teacher education. The students are willing to take an elective course on methods of case studies. Faculties could take this suggestion into account and start to offer an elective course in which students could develop and implement case studies. Offering such a course could have a positive impact and offer many benefits for teacher education programs (Colburn and Tillotson, 1998). In fact, some teacher education programs have offered such a course. Heitzmann (2008) stated that the case study method should be a central component of teacher education programs. However, we caution that the case study should not be used just to facilitate student learning of content. Pre-service teachers should be taught about the implementation strategies as well as methods to develop well-written cases when they do not have pre-designed resources. It is clear that pre-service teachers' professional development in teaching through the case studies would greatly benefit their student learning.

Conclusions

This study presents pre-service science teachers' views about implementing a case study method lesson on the properties of chromium compounds in an analytical chemistry course. This study showed that pre-service science teachers improved their cognitive *i.e.,* enhance content knowledge, bridging between the theory and practice, problem solving; affective skills *i.e.,* enhance their interests and motivation to the subject; and developmental skills *i.e.,* research and verbal communication as a result of using a case study teaching. It also presents the learners' views about the use of a case study method lesson in the class for better implementation. These results demonstrate that, if the necessary suggestions are considered on the implementation of the method, it would be more effective in terms of gaining the benefits of pre-service science teachers as a result of using the case study teaching method in instruction.

Research indicated that, teachers need to have both scientific knowledge and scientific methods for effective science instruction. Benefits of the case based teaching for pre-service teachers' professional development have been largely accepted in the literature. In teacher education, the case method instruction can be provided as both a method that can be learned and used in professional settings, and also as a method for problem solving with respect to specific classroom situations. That is, the cases used can be intended to model a way to teach science, but they can also be developed to address professional situations that the pre-service teachers might encounter. This could add a category of professional knowledge development to the potential benefits of a case method teaching, but research would be needed to investigate the quality of this effect.

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References

Ayyıldız, Y., & Tarhan, L. (2012). Effect of case studies on primary school teaching students' attitudes toward chemistry lesson. *Hacettepe University Journal of Education, 43*, 62-70.

Ballantine, J. A., & Mccourt Larres, P. (2004). A critical analysis of students' perceptions of the usefulness of the case study method in an advanced management accounting module: The impact of relevant work experience. *Accounting Education, 13* (2), 171-189.

Bowe, C. M., Voss, J., & Aretz, T. (2009). Case method teaching: An effective approach to integrate the basic and clinical sciences in the preclinical medical curriculum. *Medical Teacher, 31*, 834-841.

Cameron, A. F., Trudel, M. C., Titah, R., & Léger, P. M. (2012). The live teaching case: A new IS method and its application. *Journal of Information Technology Education: Research, 11,* 27-41.

Camill, P. (2006). Case studies add value to a diverse teaching portfolio in science courses. *Journal of College Science Teaching*, *36* (2), 31-37.

Casotti, G., Beneski J.T., Knabb, M. T. (2013). Teaching physiology online: Successful use of case studies in a graduate course. *Advances in Physiology Education, 37*, 65-69.

Cassimjee, R. (2007). An evaluation of students' perceptions of the use of case-based teaching and group work in a first-year nursing programme. *SAJHE (South African Journal of Higher Education), 21* (3), 412-428.

Çelik, S., Çevik, Y. D., & HaşFlaman, T. (2012). Reflections of prospective teachers regarding case-based learning. *Turkish Online Journal of Qualitative Inquiry, 3* (4), 68-82.

Chaplin, S. (2009). Assessment of the impact of case studies on student learning gains in an introductory biology course. *Journal of College Science Teaching, 39,* 72-79.

Colburn, A., & Tillotson, J. W. (1998). A case study for use in science methods courses. *Journal of Science Teacher Education, 9* (2), 153-164.

Delpier, T. (2006). Cases 101: Learning to teach with cases. *Nursing Education Perspectives, 27* (4), 204-209.

DeVito, D., Shamberg, M., Sher, S., Grant, S., Soderbergh, S., Newman, T., Roberts, J., Universal Studios Home Video (Firm). (2000). *Erin Brockovich*. Universal City, CA: Universal Studios.

Dochy, F., M. Segers, P., Van den Bossche, P.,& Gijbels, D. (2003). Effects of problem-based learning: A meta-analysis. *Learning & Instruction, 13* (5), 533-568.

Gallego, A., Fortunato, M. S., Rossi, S. L., Korol, S. E., & Moretton, J. A. (2013). Case method in the teaching of food safety. *Journal of Food Science Education, 12*, 42-47.

Harrison, E. (2012). How to develop well-written case studies the essential elements. *Nurse Educator, 37* (2), 67-70.

Healy, M., & Mccutcheon, M. (2010). Teaching with case studies: An empirical investigation of accounting lecturers' experiences. *Accounting Education: An International Journal 19* (6), 555-567.

Heitzmann, R. (2008). Case study instruction in teacher education: Opportunity to develop students' critical thinking, school smarts and decision making. *Education, 128* (4), 523-542.

Hernandez-Serrano, J., & Jonassen, D. H. (2003). The effects of case libraries on problem solving. *Journal of Computer Assisted Learning, 19* (1), 103-114.

Herreid, C. F. (2005). Using case studies to teach science. *Action Bioscience.org*. Retrieved 24th February 2014 from http://www.actionbioscience.org/education/herreid.html

Herreid, C. F. (2006). *Start with a Story: The Case Study Method of Teaching College Science*. Arlington, VA: NSTA Press.

Iqbal, N., & Rubab, H. (2012). Teaching pediatrics nursing care to second year nursing students using case study method. *Medical Channel, 12* (1), 13-16.

Jalgaonkar, S. V., Sarkate, P. V., & Tripathi, R. K. (2012). Students' perception about small group teaching techniques: Role play method and case based learning in pharmacology. *Education in Medicine Journal, 4* (2), 13-18.

Jones, K. (2003). Making the case for the case method in graduate social work education. *Journal of Teaching in Social Work, 23* (1/2), 183-200.

Joroff, M. L., & Moore, J. A. (1984). Case method teaching about design process management. *Journal of Architectural Education, 38* (1), 14-17.

Libby, P. A. (1991). Barriers to using cases in accounting education. *Issues in Accounting Education, 6* (2), 193-213.

Muray-Nseula, M. (2011). Incorporating case studies into an undergraduate genetics course. *Journal of the Scholarship of Teaching and Learning, 11* (3), 75-85.

Pierce, J. W., & Kalkman, D. L. (2003). Applying learner-centered principles in teacher education. *Theory into Practice, 42* (2), 127-132.

Popil, I. (2011). Promotion of critical thinking by using case studies as teaching method. *Nurse Education Today, 31*, 204-207.

Prince, M., & Felder, R. (2007). Many faces of inductive teaching and learning. *Journal of College Science Teaching*, *36* (5), 14-20.

Scott, N. (2007). An evaluation of the effects of using case method on student learning outcomes in a tourism strategic planning course. *Journal of Teaching in Travel & Tourism, 7* (2), 21-34.

Shieh,R. S., Lyub, J. J., & Cheng, Y. Y. (2012). Implementation of the Harvard case method through a plan-do-check-act framework in a university course. *Innovations in Education and Teaching International, 49* (2), 149-160.

Yadav, A., Lundeberg, M., DeSchryver, M., Dirkin, K., Schiller, N. A., Maier, K., & Herreid, C. F. (2007). Teaching science with case studies: A national survey of faculty perceptions of the benefits and challenges of using cases. *Journal of College Science Teaching, 37* (1), 34-38.

Yadav, A. (2008). What works for them? Pre-service teachers' perceptions of their learning from video case. *Action in Teacher Education, 29* (4), 27-38.

Yadav, A., Shaver, G. M., & Meckl, P. (2010). Lessons learned: Implementing the case teaching method in a mechanical engineering course. *Journal of Engineering Education, 99* (1), 55-69.

Yalçınkaya, E., Boz, Y., & Erdur-Baker, Ö. (2012). Is case-based instruction effective in enhancing high school students' motivation toward chemistry? *Science Education International, 23* (2), 102-116.

Yoon, S., Pedretti, E., Bencze, L., Hewitt, J., Perris, K. & Van Oostveen, R. (2006). Exploring the use of cases and case methods in influencing elementary preservice science teachers' self-efficacy beliefs. *Journal of Science Teacher Education, 17*, 15-35.

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