

Pre-Service Science Teachers' Views on Their Online Argumentation about What Is Happening In Middle School Science Classrooms During Their Practicum Period*

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Abstract: In this study, Pre-service Science Teachers' (PSTs) views about the potential benefits and existing barriers of their argumentation on the World Wide Web about what is happening in middle school science classrooms during two semesters of their practicum experiences were investigated. "Special Web Group" called the *Collaborative Action Research in Science Teacher Education* (CARSTE) was constructed together with seven PSTs. PSTs were individually asked to send their observations reflecting whatever happens in the middle school science classes to CARTSE. Also, PSTs met twice each week for a 3 - hour group session in order to carry out face to face argumentation in addition to their online argumentation. Simultaneously, PSTs had online and face to face argumentation about important issues of science education, such as traditional teaching, constructivist approach, attitudes toward and perceptions of science, authentic assessment, and nature of science. At the end of this study, CARSTE compiled an archive consisting of 325 individual e-mails. Both a paper-pencil test consisting of open-ended questions and individual interviews were employed to identify PSTs' views about their online argumentation. The results indicated that the important barriers that PSTs encountered when using the CARSTE appear to be the lack of adequate access to a network computer and structuring time to engage on the Internet. The results of open-ended survey showed that PSTs' online argumentation improved their attitudes toward teaching science and self-confidence, teachers' behaviors as a science teacher

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and their knowledge and perspectives about the important topics of science education. Also, the interpretive analysis of interview data indicated that PSTs described their online argumentation as an interesting way of sharing information, discussing their ideas as well as improving their ability to use computers and Internet. Almost all of the PSTs stated that their argumentative ability improved during the time of the study.

Introduction

Teachers now have the opportunities to join on-line discussion groups on the World Wide Web, post questions to electronic bulletin boards, and share thoughts and ideas using an e-mail listserv. Today, the World Wide Web is familiar to students and very accessible at various university locations and at home by students with computers. In school placements, a pre-service teacher can usually find one computer networked to the Internet that contains a web browser software such as Netscape or Internet Explorer. Benefits of network participation may include exchanging ideas about projects, requesting and giving technical support, social exchanges and discussing general teaching approaches (DiMauro & Gal, 1994; Ebenezer et al., 2003; Hughes & Hewson, 1998; O'Neil, 1995; Ruopp et al., 1993; Zulich, 1992).

The renewed emphasis on science education reflects a distinct shift from science as exploration and experiment to science as *argument and explanation* (NRC, 2000, p. 113). From the reform perspective, priority is given to evidence and the development and evaluation of scientific explanations. Practices, such as assessing alternatives, weighing evidence, interpreting texts, and evaluating the potential viability of scientific claims are all seen as essential components in constructing scientific arguments (Driver, Newton, & Osborne, 2000; Erduran et al., 2004). Recently, various authors (e.g., Jimenez, Rodriguez, & Duschl, 2000) have called attention to the significance of argumentation to science education. In this connection, seven pre-service science teachers (PSTs) and us made online argumentation about what was happening in the middle school science classrooms during two semesters of their practicum experiences through a "Special Web Group" called the Collaborative Action Research in Science Teacher Education (CARSTE[†]) that was constructed together with these PSTs.

[†] <http://groups.yahoo.com/group/CARSTE>

Purpose

The aim of this study was to investigate pre-service science teachers' (PSTs) views about the potential benefits and existing barriers of their online argumentation about what is happening in the middle school science classrooms during two semesters of their practicum experiences.

Research questions

- 1) What kinds of online discourse are going on among the PSTs?
- 2) What are PSTs' perceptions of their experience during their online argumentation?
- 3) What barriers PSTs encounter when using CARSTE on the Internet?

Methods

Participants

CARTSE consists of seven pre-service middle school science teachers (1 male, 6 females), two science educators and one chemistry educator in Gazi Faculty of Education in Gazi University, Turkey, and one science educators at Wayne State University in the USA. All of the PSTs voluntarily participated in this study. During the two semesters of 2003-2004 academic year, PSTs spent Monday through Wednesday mornings and afternoons in practicum at public elementary schools (K-8) in Ankara, Turkey.

Procedures

In this qualitative action research study, online argumentation about what is happening in the middle school science classrooms during PSTs' practicum experiences were made between PSTs and researchers and among PSTs. PSTs were individually asked to post individual messages including their observations and comments reflecting whatever happens in the middle school science classrooms to CARTSE. PSTs met twice each week for a 3-hour group session, in order to carry out face to face arguments in addition to their online argumentation. PSTs discussed online about important issues of science education selected by the researchers to help them on some important areas. Some of the selected topics that were used for online argumentation are:

- Goals of Science Teaching
- Traditional Science Teaching

- Students' Attitudes and Perceptions toward Science
- Alternative Conceptions
- Traditional and Authentic Assessment Approaches
- Meaningful Learning in Science
- Conceptual Change Theory
- Constructivist Teaching Approach
- Science Process Skills
- Nature of Science
- Theory of Multiple Intelligences

During the practicum, each PST taught science to middle school students from grades 6 to 8. Their teaching was observed by the research team twice per month. The observers wrote descriptive notes, especially reflecting the change in their skill of teaching science in real classrooms. At the end of this study, CARSTE compiled a permanent archive consisting of 325 individual e-mails related to their observations, comments and experiences in their practicum schools.

Instrument

A paper-pencil test consisting of open-ended questions and individual interviews were employed to identify PSTs' views about their online argumentation at the end of the study. All interviews were audio-recorded and transcribed verbatim. One external expert cross-checked the analyses of the PSTs' survey and interview data. There were 92.60% and 91.90% agreements between the expert and the researcher for the analyses of the PSTs' survey and interview data, respectively. Some interview questions are below.

- What was the most beneficial aspect of using the CARSTE during your student teaching experience?
- What is the least beneficial aspect of using the CARSTE during your student teaching experience?
- Which barriers or problems did you encounter when using the CARSTE?
- What do you think about whether or not you learned instructional techniques or activities that you will use in your future classrooms from CARSTE?
- What is the difference between face to face and online argumentation?

Results

Analysis of PSTs' Online Discourse

Our preliminary analysis of the CARSTE archive reveals four emerging themes from 325 individual e-mails as follows:

1. *Science pedagogy* - comments relating specifically to teaching science content and assessing students' understanding.
2. *Content knowledge*- the adequacy of teachers' subject matter in science.
3. *Nature of science teaching* - Message postings relating to classroom atmosphere, methods, management, teachers' behaviors in general.
4. *Socio-emotional* - Messages pertaining to sharing PSTs' classroom experiences with students and teachers in their practicum schools.

Three major examples of PSTs' online argumentation are given below. In the following discourse presented in Figure 1, Aslihan, sharing her observations with CARSTE during her student teaching class, explains whatever teachers say should be sound when they talked with students about science. Then, she defends the teacher solving the question by himself in spite of the students raising their hands. Meryem, who did not agree with Aslihan about the teacher solving the question on the board by himself, points out that students should have tried to find answer of the question because of several reasons. Also, Filiz, supporting Meryem's ideas against to Aslihan, explains that the teacher should have direct students to correct answer in spite of solving the question himself.

From: "aslihansan"

Date: Mon Dec 1, 2003 11:41am

Subject: My observations

Message: *Today the teachers said "If I am not wrong in the positive ion called cation $p > \acute{e}$, and in the negative ion called anion $\acute{e} > p$. Can you tell me how the ionic charge occurs? The number of students who raised their hands was small at the beginning and gradually increased as the time was prolonged.*

The teacher should never have started the question as "If I am not wrong" which may cause the confidence of the student in the teacher be diminished. Also there should be

ample time given to the students to solve the question. The teacher did that. It was appropriate that the teacher solved the question by himself because no matter the number of the students who raised their hands the teacher should solve the question on the board thinking the ones who didn't raise their hands.

From: "meryemsapmaz"

Date: Wed Dec 3, 2003 10:57am

Subject: About Aslihan's observation

Message: You think that it was appropriate that the teacher solving the question on the board in spite of the students raising their hands. I don't agree with that.

In my opinion in order for the teacher to reach his/her aim by asking questions he/she should not answer the question by himself/herself. Because one of the objectives of asking questions is to recognize the students with different opinions and create a medium of discussion for them. Also the students who are willing to answer the question should not be discouraged.

From: "filizhulya"

Date: Wed Dec 24, 2003 1:32pm

Subject: About Aslihan's observation

Message: I also support Meryem here. The teacher must encourage the student to answer the question as much as possible. At this point without saying whether the answers were right or wrong, the teacher should ask the class "what do you think about the opinion of you friend ".That will provide a medium where the students may actively participate in to the lesson.

Figure 1. Online Discourse about Aslihan's observations.

In the following discourse given in Figure 2, Filiz first writes her observations and conversations on her mentor teacher in the practicum school, and then criticizes the teacher based on what should be done in the classroom. In this message, Filiz discusses with herself about "If I were the teacher of this class,...", and writes her reasons to CARSTE. Aslihan focuses on especially the following explanation of Filiz' mentor teacher: "I am doing my utmost to give something to the students but they are not willing to take it " and writes some so important questions for other members of CARSTE.

From: "filizhulya"

Date: Mon Dec 22, 2003 4:10pm

Subject: My observations about teaching methods of the teacher

Message: *Hi there, this week the teacher explained oxygenated respiration in detail and the students wrote them down. The teacher uses the traditional lecture method. She has never made any experiment or had any other activity in any of the lectures I have attended up to now. She only used the direct approach to draw the attention of the students by giving some examples from our everyday lives.*

This week the teacher told the students that she was going to get retired in the second term and she complained that she was unable to reach the desired rate of success. She asked the reasons to the students but she got no answer. We had a small discussion together. She said "I am doing my utmost to give something to the students but they are not willing to take it "I was unable to ask "Don't you think you may be at fault as well. Is it appropriate way to teach science like that ". I think that this question should be asked For instance, she also employed the lecture method when he was teaching the subject of "carbohydrates "and had everything written down. Could she have done something different? For instance, the students could have carried out a study about the subject which would have enabled them to participate the lecture. She could have organized a competition and give rewards to the winners. A related VCD could have been shown. There might have been many activities like that. This would certainly have increased the interest towards the course which may in turn increase the rate of success.

From: "filizhulya"

Date: Wed Dec 24, 2003 1:32pm

Subject: How could I have carried out the lecture?

Message: *Had I been the in the place of the teacher I wouldn't have started from the detoriative life and nitrogen cycle to teach oxygenated respiration. I would have only concentrated on the oxygenated respiration as I learned form this group. This subject is already cumbersome to the students since it involves energy and equations. I think it is not appropriate to include other concepts in it. The lecture should be related on the main theme. I could have asked the class to take a deep breath and keep it for a while. I then would have asked them what happen if stop breathing. That would have made them think on the subject. I also would have mentioned the energy which occurs as a result of respiration and I would have endeavored to have them reach the conclusion by*

themselves

I would have expressed the equation by words at first and tried to demonstrate it by having the students stand up and hold hand by hand. I would have chosen the most active person in the class as ATP and asked him/her to write the expressions on the board. This would have resulted in a much more permanent learning process.

These are the things which come into my mind now. I can think something much better in larger time span

From: "aslihansan"

Date: Thu Dec 25, 2003 4:47pm

Subject: About Filiz's observations

Message: Hi there, the teacher in the practice School of our friend Filiz decided to get retired and she made some comments about the students. I don't think the students are the only ones to blame here. They are there to take new knowledge and the way the knowledge is presented is of utmost importance. If we are looking for a mistake we should start from ourselves. The teacher who came at the verge of retirement should ask herself/himself "Am I really sufficient? Is there anything in me what may make the students bored? How sincere is my dialogue with the students? Am I giving this lecture with enthusiasm? Do I come out from the lectures thinking that I gave something to them? Do I make anything to activate and direct the students? "

I think she should first have asked these questions to herself before blaming the students that they were unable to take the lecture. I think we should also ask these questions to ourselves.

From: "euphrosyne0602"

Date: Mon Jan 5, 2004 8:42pm

Subject: To filiz'e

Message: Dear Filiz, I really like your ideas about teaching oxygenated respiration. .This is a quite a difficult subject. I think such a subject could best be given with drama or animation....

Figure 2. Online discourse about Filiz's observations and ideas.

In the following discourse shown in Figure 3, Aslihan gives an example of her first laboratory class in her practicum school, and states some problems related to this lab class.

She explains how she should have carried out this lab class to CARSTE. Ebru supports to Aslihan about whether or not the teacher should carry out the experiment by herself in spite of students. Meryem, who don not agree with Filiz and Aslihan, explains her reasons especially with the perspectives of the goal of science lab investigations and science process skills. İlper, who agrees with Meryem, points out that the students should have performed the experiments by themselves because of getting the opinions of the students about science and scientists.

From: "aslihansan"

Date: Fri Oct 24, 2003 2:55pm

Subject: About lab practice

Message: I write this because we observed the same lab lecture with Demet. I am doing my practice in Ulubatlı Hasan primary school. Our teacher has been in teaching business for 20 years. She is quite experienced. She seems sufficient regards to basic skills and knowledge. I am writing this since we had a very interesting lab practice on 13th of October. The teacher told us that this was the first time that the students were going to have a lab practice .All the students were taken from the class to the lab after the bell rung. This took first five minutes of the lecture. When we came to the lab there was also quite a time loss fro routine record writing process and preparing the table where the experiment was going to be carried out. During that time there was an incredible noise in the room. The students were warned but this had no effect on them whatsoever. The teacher watched the group who carried out the experiment from a certain corner of the room. The results of the experiment were shown to the other students. The teacher made a short explanation and the lab practice ended with the bell. There was no attempt to determine who understand what.

According to me this lab practice could have been much more fruitful had the teacher acted differently. First of she could have previously warned the students that there was going to be a lab practice after the bell. This could have saved quite a time. Secondly the teacher should have given prior knowledge about the activity to be carried out in the lab to the students who were going to have such a practice for the first time. The rules could have been set before. The experimental material could have been prepared well before the practice. The noise could have been largely prevented if the experiment had been carried out with groups. Finally the results of the experiments should definitely have been discussed with student centralized approach.

From: "euphrosyne0602"

Date: Fri Oct 24, 2003 3:20 pm

Subject: About lab practice

Message: I think the teacher should have carried out the experiment by herself since it was the first lab practice. If you take the lack of material and equipment this is much more appropriate.

From: "meryemsapmaz" >

Date: Wed Oct25, 2003 10:57am

Subject: About Aslihan's observations *Message: I don't agree with you. The major objective for lab practice is to find a question to searched, design experiments fro the solution of this question , forming relate hypotheses about it , test these hypotheses with experiment, take necessary measurements , draw conclusions and discuss these conclusions . In order to do all these it is necessary that the experiments should be carried out by the students. The teacher may assume the role of a guide since it was the first lab experience of the students. She also should have given some prior information about the lab practice in the previous lecture. The experiment carried out by the teacher is like my mother showing me how to make a cookie.*

From: "ilpersen"

Date: Tue Oct 25, 2003 2:29pm

Subject: About lab practice

Message: I too am against the experiments be performed by the teacher... This gives the student the impression that scientific experiments are so complicated that they could only be carried out by the teachers or the scientists. I reached this conclusion as a result of a interview I carried out with a student who was not willing to do an experiment in the lab. This adversely affects the opinions of the students about the scientists. The teacher may ask the students to bring simple material for simple experiments and carry out the experiment together.

Figure 3. Online discourse about Aslihan's views.

PSTs' Views on their Online Argumentation

The first part of the open ended survey was consisted of the questions in relation to how and how often PSTs would have an access to CARSTE. The answers given to this

question showed that two of the PSTs used the computer lab in the Faculty of Education, two of them had the access from internet cafes, and two reached the group from their own computers at their homes. All PSTs were found to have an access to CARSTE at least twice a day. Five PSTs told that they read the emails coming from the other group members without regarding to their names. The reason for that was that if they did not know the identity of the sender they could evaluate the contents of emails in a much objective manner. On the other hand, two of the PSTs stated that they read the emails by taking both the content and the identity of the sender into account. They claimed that knowing the identity of the sender they had an idea what they were thinking when they wrote the message and this made them understand the contents in a much clearer way. Two of the PSTs stated that they had no difficulty in accessing CARSTE while the other five PSTs who used the computers of the faculty or internet cafes complained that they had big difficulties to establish contact due to the incapacities and lack of data transfer rates of the computers.

Both individual interviews and second part of the survey were devoted to the determination of the opinions of the PSTs about online discussions. The results indicated that both the face to face and online discussions helped them to define their insufficiencies for the effective teaching of science. Especially two PSTs who graduated as the second and third from the department stated that although they were very sure that that they would make good science teachers they realized that they had need to learn more about issues of science education after this study. They said that they felt like that mostly through their online discussions. These two PSTs told that they felt the lack of self confidence near to the end of the first term, but it wore of from the beginning of the second term. Other five PSTs indicated that they profited from online discussions as regards to their needs as science teachers.

PSTs who used to think that the major purpose of science teaching was to teach the concepts of science said that they changed their opinion continuously though online discussions. They especially emphasized that teaching science process skills and nature of science related to how the scientific knowledge is produced, its changeability and how the scientists carry out scientific research are equally important.

The analysis of the answers given to open ended survey revealed that the teachers are only aware of the names and basis features of the teaching methods frequently discussed in educational literature. Some of the PSTs indicated that that although they obtained some theoretical information via their assignments they were lacking very much in their applications.

Another important fact was that the PSTs had only known traditional assessment methods such as open-ended and multiple-choice exams in the evaluation of the students before CARSTE. However, after their online discussions, they realized that the evaluations should be carried out with the inclusion of the students by the application of various authentic methods (i.e. individual or group interviews, portfolios, concept mapping). All PSTs stated that they were much better listeners and looked at other peoples' view in a different perspective after this study. They said that they had never achieved these in any of the courses they had taken during their university education, and this was very important for them.

Analysis of the answers given to the question “ what is the difference between face – to face and online argumentation” revealed that two PSTs stated that they were able to express their opinions freely without any interruption and the things written by their friends forced them to think much deeper about their opinions in online argumentation. Three PSTs mentioned that their discussion ability has shown a marked improvement. Another important difference of the online discussions allowed the PSTs to write CARSTE about their observations and opinions on their practice schools without loosing any time. They also advocated that these online discussions formed the basis for the face to face discussions.

Five of the PSTs mentioned that they were affected by the opinions of their friends and refrained from taking part in face to face discussions while this was never the case in online discussions. Only adverse effect of online discussions was determined to be the misunderstanding of the opinions of the PSTs written on the net by the others. At this point they stated that the face to face discussions facilitate to discuss the subjects in more in detail. Another disadvantage was stated that it was difficult to understand whether the opposing side was satisfied during online argumentation; however, this was much easier in face to face discussions. The PSTs also thought that the decision making process is much smoother in face to face discussions. Some PSTs expressed that the group members who were not satisfied in online discussions were persuaded in face to face discussions. They also stated that online discussions also provided them an opportunity to freely write their opinions since there is no time limitations and someone in front of them who can get bored in the course of time.

Summary and Conclusions

The results of open-ended test and individual interviews indicated that the important barriers that PSTs encountered when using the CARSTE appear to be the lack of adequate access to a network computer and structuring time to engage on the Internet. The results of

open-ended test showed that PSTs' online argumentation improved their attitudes toward teaching science and self-confidence, teachers' behaviors as a science teacher and their knowledge and perspectives about the important topics of science education. Also, the interpretive analysis of interview data indicated that PSTs described their online argumentation as an interesting way of sharing information, discussing their ideas as well as improving their ability to use computers and Internet. Almost all of the PSTs stated that their argumentative ability dramatically improved during the time of the study.

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