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A case study on constructivist learning environment in content knowledge courses in science teaching

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Abstract

The present study aims to find out the situations reflecting a constructivist learning environment by analysing the teaching-learning process in the content knowledge courses in Second Grade of Science Teaching Department in Education Faculty, Pamukkale University. It is believed that the results of the study will contribute to the improvement of teacher training programs as it reveals to what extent the learning environments provided to pre-service teachers have constructivist qualities and to what extent these teachers are trained within a constructivist approach. In the study, besides employing a qualitative research method namely case study, the research design "Single Case with Embedded Units" was used. In order to maintain the reliability and validity of the study, data and methodological triangulation were performed. The research study took place in 2011-2012 fall term, in Pamukkale University Education Faculty Science Teaching Department. The classes observed, instructors and students that are interviewed constituted the data sources of the study. As for the data collection instruments, "semi-structured in-class observation form", "individual interview form for instructors and "focus group discussion form for students" were used. The data obtained from observation and interviews were combined together to create a data set. By means of content analysis, codes and themes were identified. As a result of the study, it was found that a learning environment that includes "active learning", "reflective learning", "associating with life" and "assessing simultaneously with teaching " were created in teaching-learning process in content knowledge courses.

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Keywords:creative writing; writing disposition; English course attitude; writing success.

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1. Introduction

Teaching-learning approaches and theories explain in what kind of environment and in what way education takes place, also the qualities and the roles a teacher should have. That's why, the effect of these approaches and theories on teacher training programs is undeniable. While individual based learning is replacing the concept of knowledge-based teaching-learning, in terms of the notion of teacher training, a variety of different approaches have emerged namely "behaviouristic approach" supporting the idea that learning occurs via knowledge transfer; "field expert" approach supporting the efficiency of knowing subject matter; "experience/practice-based approach" supporting that teacher should gain more and more experience in order for learning to come true, "constructivist approach" totally centralising the learner while giving the teacher a guidance role (YalazAtay, 2003; Gökçe and Demirhan, 2005; Ekiz, 2006; Oğuz, 2009; Yıldırım, 2011)

Primary teaching programs based on constructivist approach have started to be implemented in Turkey since 2005-2006 academic year. It can be suggested that the situation required a need to train teachers that will have the qualities to employ these constructivist approach based programs. Teaching programs applied in Turkey focus on an active learning based on constructivist learning theory whose main consideration is how students learn rather than what students should know and where the learner is placed in the centre of learning by a guiding, leading, facilitating, organizing and motivating teacher.

Teachers constitute the most crucial factor in order for the program to meet these objectives (Ekinci and Öter, 2010). However, since, in Turkey, in 2005, curriculums based on constructivist approach started to be implemented straight forwardly, teachers who were not educated according to the constructivist approach and did not have enough knowledge about the theory encountered a number of difficulties. About this new concept Turkey, having the idea that we can prepare teachers by transferring knowledge based on the old paradigms poses another part of the problem.

No matter how much information we give to teachers pre-service and in-service, unless they are trained and modelled within an approach that supports learning by participating, doing and practicing, it is inevitable that after a while young teacher candidates and teachers will switch back to their old habits of the system in which they were taught. Therefore, creating a proper understanding requires more than presenting the approach in a few lessons (Fosnot, 2007).

When research studies conducted in Turkey about the learning environment of Education Faculties are analysed, it is understood that some of professional teaching knowledge courses have been evaluated in terms of constructivist learning environment; student interviews have been referred to about which qualities of constructivist approach these environments have and which qualities they need to have; and also experimental studies on the efficiency of constructivist curriculum have been carried out. In a study called "Evaluation of the effectiveness of a constructivist teacher education program applications" carried out by Bay (2008), it was found that constructivist program applications are more effective in the attitudes of students towards constructivist approach and success. Ekici (2009), in his study "Science Teaching Tendency of Pre-service Teachers of Science and Technology Course", states that when interview and experimental findings of pre-service teachers are compared, it is seen that they haven't fully embraced constructivism. According to another study called "The Evaluation of Relevancy of Applications In Teacher Training Programs with Constructivist Approach through Pre-Service Teachers' Opinions" by Oğuz (2009), there is some effort to employ learning-teaching process within an constructivist framework, however, it is suggested that this is not in a sufficient level. In this regard, in teacher training programs, revealing to what extent learning environments provided to students have the characteristics of constructivism and to what extent pre-service teachers are trained in this approach and the evaluation of learning-teaching process in terms of constructivist approach can make a contribution to train qualified teachers.

1.1. Aim of the Study

By studying teaching-learning process in second grade theoretical and practical content knowledge courses in Science Education Department, the study aims to find out the situations reflecting constructivist leaning environment.

2. Method

2.1 Research Design

In the study, as well as using a qualitative research method namely case study, among the case study designs "Single Case with Embedded Units" suggested by Yin (2003) was employed. This research design is preferred when Single case includes more than one sub units to analyse (Yıldırım and Simsek, 2008). In the study,

constructivist learning environment in content knowledge courses is considered as the single case. Sub units to analyse in this case consist of content knowledge courses specifically General Biology- I, General Biology Lab-I, General Physics- I, General Physics- III, General Physics Lab- III and General Chemistry- III. So as to maintain the reliability and the validity, data and methodological triangulation were performed. For method variation, "observation" and "interview" were carried out. In order to maintain variety in data, (data triangulation) "observed lessons" and "interviewed instructors and students" have been used as separate data sources.

2.2 Data Sources

This research was conducted in the fall term of 2011 -2012 academic year at Pamukkale University. Pamukkale University Faculty of Education, Department of Primary Education Science Teaching Department was chosen as the study field. That the research was based on long time observations and the researcher was a graduate of Science Teaching Department of the same university had influence on choosing the Science Teaching as the study field. The courses that have been observed, the instructors and the students that have been interviewed compose the research's data sources. The observations continued in content knowledge courses in four different classes for the progress of learning&teaching to be examined thoroughly till the end of the semester. With the purpose of containing the consistency of the research, during the observations in the class atmosphere, apart from the instructor, a program development specialist took part as a second observer. Before participating in the process of the observation, the program development specialist had been informed about the constructivist learning environment and the observation dimensions. Also the program development specialist took observation notes during the observation. This situation was thought to contribute to the consistency of the research. Individual interviews with the instructors who were responsible for the courses to be observed and focus group discussion with the students who took these courses were carried out. Maximum variation sampling method was used for choosing the students to have focus group discussion. The purpose of maximum variation sampling is to try to find out whether or not there are any common or shared facts between the varied cases, and to present the different dimensions of the problem considering this variation (Yıldırım and Şimşek, 2008, 108). Therefore, with the purpose of getting a maximum variation in the research, five students in total were chosen with the condition that one voluntary student would be taken from each of the four different sophomore classes which were responsible for the content knowledge courses included in the research scope and one would be taken from each classes for the focus group discussion.

2.3. Data Collection Tools

As the data collection tool in this research, "semi-structured in-class observation form", "individual interview form for instructors" and "focus group discussion form for students" were used. As the "semi-structured in-class observation form" to be used in collecting data was improved, pilot observations were performed not only to decide on the dimensions to be observed but also to let the researcher gather experience for carrying out purpose-oriented observations. The last shape of the observation form was given by taking the literature and specialist views into consideration. Instructor and student observation forms were improved with the aim of supporting the data acquired from the observations as well as explaining the research question deeply. Open-ended questions and probes that take place in both instructor and student observation forms were determined based on the literature and considering the dimensions on the observation forms, and were arranged in accordance with specialist views. The draft interview form was tested in consultation with an instructor and three students. Necessary corrections were required in terms of intelligibility. Therefore, how the original interview form that would be used at the end of the application would be was decided. Focus group discussion was carried out considering it would be essential to enable the students to interact with each other and to act courageously during the interview.

2.4. Data Collection

In the study, in order to determine how the learning-teaching process in content knowledge courses (General Biology-I, General Biology Lab-I, General Physics-III, General Physics Lab-III and General Chemistry-III) found in the sophomore degree program of Pamukkale University Science Teaching Department in the fall term of 2011-2012 academic year works, participant observation technique was employed. Content knowledge courses were observed for totally 54 hours in all of the sophomore classes during the term by the researcher and a program development specialist and field notes regarding the learning environments were taken. At the end of the term, focus group discussion with the students and interviews with the instructors were carried out.

2.5. Data Analysis

Content analysis method was used for the analysis of the data obtained within the context of research. Similar descriptions regarding the observation dimensions and which were involved in the observation notes of the researcher and program development specialist were determined and integrated and data set was formed relating to

observations. In order to resolve ethical issues, the instructors interviewed were coded as "ÖE1, ÖE2, ÖE3, ÖE4 and ÖE5" and the students with whom focus group discussion was made were coded as "ÖA1, ÖA2, ÖA3, ÖA4, ÖA5". In addition, with the purpose of making the data obtained while the observation and interview data were reported represent the content knowledge courses, the initials of the courses "ÖE1-F, ÖE3-K, ÖE5-BL, ÖA2-FL, ÖA4-B etc." were added to the coding. Finally, similar descriptions regarding the observation dimensions and which were involved in the observation notes of the researcher and program development specialist were determined and integrated and data set formed relating to observations was transferred to electronic environment (Figure 1).

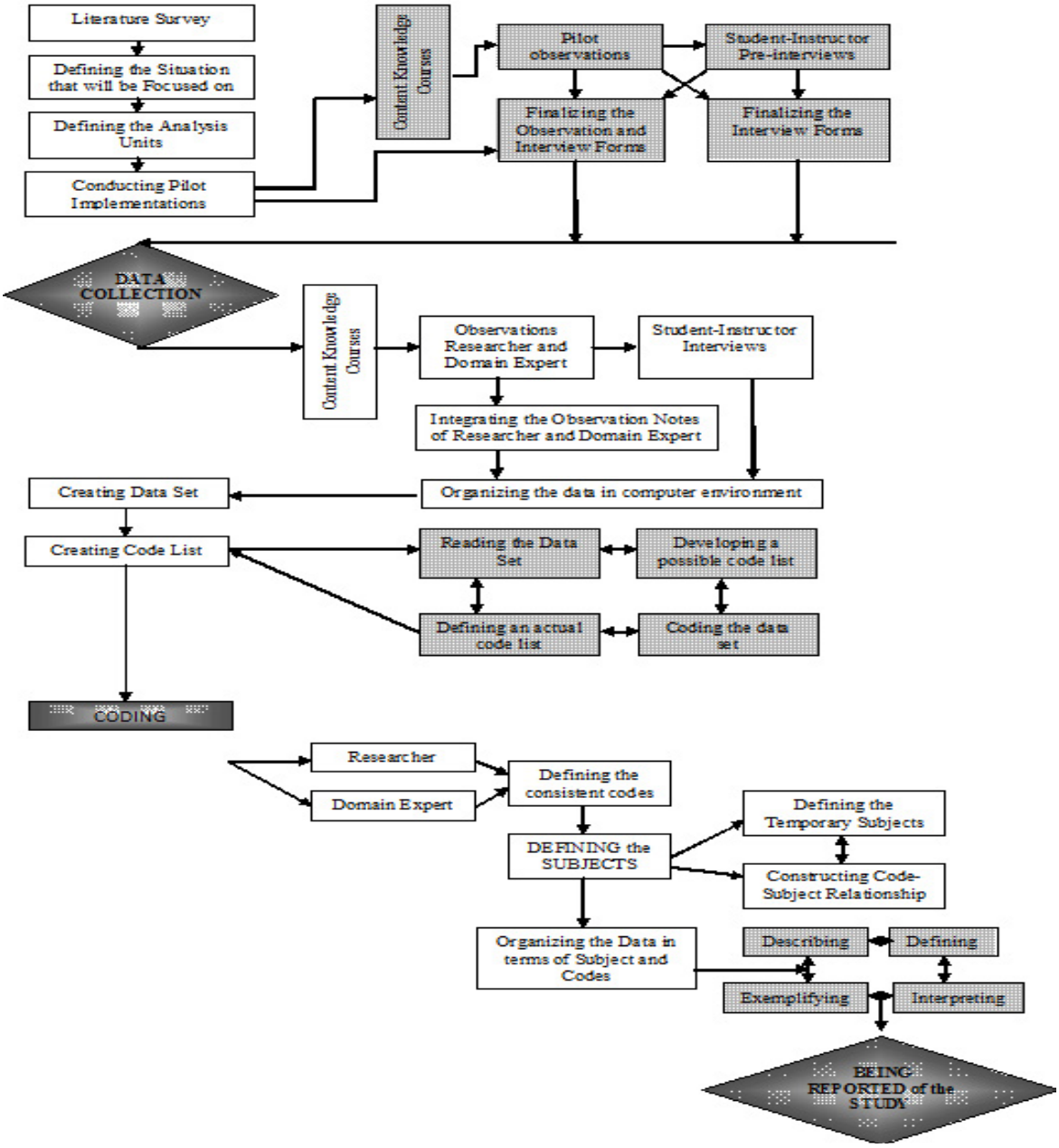

Figure 1. Data Analysis Process

3. Results

The codes and themes given in Table 1 were attained as a result of the content analysis of the data obtained from observations and interviews.

Table 1. Codes and Themes Attained as a result of Content Analysis

Themes	Codes
Active learning environment	giving opportunity for attendance to lesson the value given to the ideas of the students freedom to choose a subject making their own learning decisions providing opportunity for ideas to be shared group work providing student-student interaction
Reflective learning environment	feeling the need to research causing one to think questioning the ideas producing new ideas/ways a change in ideas noticing the existence of more than one truth
Associating with life	noticing the applicability transfer to professional life
Assessment Simultaneous with Teaching	Obtaining content validity course assessments having diary kept having portfolio prepared V-model diagram

As shown in Table 1, the codes attained as a result of the content analysis of the data obtained from observations and interviews were grouped under four themes which are "active learning environment", "reflective learning environment", "associating with life" and "assessment simultaneous with teaching". Quotes from different data sources about this theme are chosen considering the criteria of fitness for purpose, significance, support of different data sources, perception against the explanations in other data sources, frequency in different data sources and presented below.

3.1. Active Learning Environment

As a result of the analysis of the data obtained from the interviews and observations, the codes of "giving opportunity for attendance to lesson", "the value given to the ideas of the students", "freedom to choose a subject", "making their own learning decisions", "providing opportunity for ideas to be shared", "group work", "providing student-student interaction" were attained in relation to the constructivist learning environment and on the basis of these codes, "active learning environment" theme was identified. Quotes from different data sources about this theme are presented below.

"... the instructor asks the students and the students ask the instructor. The questions that the student giving presentation couldn't answer are directed to the class. Why-how?... The questions (related to the topic and general) are examined during the class. The instructor provides opportunity for the content of the questions and the answers to be discussed. Although the instructor makes the majority of the explanations, he encourages students to declare their ideas about the topic beforehand. The instructor acts as a collector of these ideas." (Observation Field Note: F)

"... in the physics lab, we find and analyze the experiments ourselves, so it contributes to our research skills... It both gives us experience, so we know how to do it ourselves and also we tell the class ourselves..., the instructor does not. Indeed, the information that you have obtained yourself is always more permanent. Because it is more effective if the students search with their own means and learn themselves. (Interview Record: ÖA1-FL)

"So a feature of biology is that controversial topics like evolution are really open to express an opinion and thought and make comment. But as I said; if it is a stereotype, then there is nothing to be said about it. For instance, the subject is systematic; this is a flowering plant and this is not; that's it. It has a literature and we follow it as well. There is nothing in this to be commented. You may ask questions at the most; and that's it. For example, I cannot discuss a cell with 30 people, it's ridiculous. A cell is a cell. There are organelles in it. They unite and form textures. In any case, for a student-centred education, I will prefer laboratory for biology. (Interview Record: ÖE5-B)

"... we recommend books to the students at the beginning of the term. We recommend them the first books saying that we'll use books. The students buy the book or not; it's not compulsory. However, our weekly schedule is clear as well." (Interview Record: ÖE1-F)

As a result of the analysis of the data, it was seen that both the instructors and the students expressed that more opportunity for active learning environment was provided to the students especially in applied courses compared to

theoretical courses among content knowledge courses and the data obtained from the observations supported this finding. It can be stated that applied courses are by nature more suitable for active learning environment than theoretical courses, but in theoretical courses in order to activate the student, more effort from the instructor and his skills are needed.

3.2. Reflective Learning Environment

The codes of " feeling the need to research", "causing one to think", "questioning the ideas", "producing new ideas/ways", "a change in ideas", and "noticing the existence of more than one truth" and attained as a result of the analysis of the data obtained from the observations and interviews were combined under the theme: "reflective learning environment". Quotes from different data sources about this theme are presented below.

"*… our sense of wonder and interest further increased; at least when I look around, I feel that my power of questioning increased." (Interview Record- ÖA4-B)*

"... now I question everything in order to understand why it happened so... I learnt things I hadn't known before and associated them. For instance, our first experiment was to know the microscope; I explained the lenses in microscopes with the theory of optics. The instructor liked it, because I not only learnt the working mechanism of the microscope but also introduced it to my friends. That is, I took advantage of both chemistry and physics and saw that they cooperate and all of them benefit from each other. Now, in what area does it have effect in biology as a whole? Could there be an answer of the question? Can I find any theories there? In which field did they produce information? Can we associate with it? We are thinking about it." (Interview Record-ÖA4-BL)

"... They record their learning during the class. After the class, there is a part called scientific claims and in this part I want new information that is the relationships they made sense of. Or I ask them to save their learning logs..." (Interview Record: ÖE4-BL)

The instructor drew attention to the relationships between concepts. She asked contradictory questions, gave examples, directed learners to think. She tried to make the students giving presentation explain the sentences one by one with their own sentences rather than only read what is written in the slides and asked for examples. When she couldn't get any answers from the students, she tried to help the students by asking new questions... "Thermo means heat; does a thermometer measure the temperature? A contradiction." She aroused curiosity by saying "We'll come to that soon"... Original ideas were asked for such as "Which criteria do you think were taken into consideration and were changed when a variety of thermometers emerged? "If you made a thermometer, what kind of thermometer would you make?" The students asked questions to the instructor, as well. "In either case, different results ensued, what do you think is the reason for this? What liquids would you use? What materials would you use to make a thermometer?" They also asked the reasons for the responses given... "What kind of effect could density have?" They compared the positive and negative aspects. Contradictions were too many... Ideas were presented, answers were given, brainstorming was carried out... "What should be the characteristics of a thermometer? Why? (Observation Field Note: F)

"... If I were a teacher, I would do as our biology teacher does rather than read the slides; I think this is the most effective way of learning. Because everybody does research individually, learns something and presents what they have learnt to the class and another student learns the thing that the other student hasn't learnt; so there occurs a sharing environment." (Interview Record: ÖA1-B)

"There are various opinions, they are tested; some are found sensible, some not. I believe this is useful." (Interview Record: ÖE2-FL)

When the data were analyzed, it was found that the learning environment in both the applied and theoretical courses served to reveal the students' reflective thinking by means of questioning, helping them generate ideas, encouraging them to keep diary and to do research. The learning environment provided in content knowledge courses may be stated to be a characteristic of constructivist learning environment.

3.3. Associating with Life

The codes of "noticing the applicability" and "transfer to professional life" attained as a result of the analysis of the data obtained from observations and interviews, were combined under the theme "associating with life". Quotes from different data sources about this theme are presented below

"We write reports on our experiments we did the previous week. The instructor asks questions about that report, but they are not based on knowledge, they go beyond knowledge. That is, she says "tell me what you understood, what you found; don't bring me direct information; bring different things" and she constantly asks us to associate with daily life or other living things or other things." (Interview Record: ÖA2-BL)

"But daily life is very important for us, exemplifications are useful... Once, I associated a value obtained from gravimetric analysis with a water bottle from daily life and gave the example that it was among the information found on the bottles. It considerably aroused their interest." (Interview Record: ÖE3-K)

"I like teacher's teaching method in physics class, because he relates things with real life very successfully and it got permanent in my mind and as he related things with real life, I comprehended physics better... they claim university is all about theoretical knowledge, but we should be able to relate it with real life a little bit, because we should learn first, so we can teach in the future." (Interview Record: ÖA4-F)

"He gave examples from daily life such as the nearest point human eye can see, the best visible light, the fact that our eyes should be improved 2500 times more in order to see an atom... The instructor compared how a person dealing with diamond sees with glasses and how an atom looks through a microscope by making associations with real life... He related with real life by giving the example of the pressure of car tires and made the subject concrete... "He gave equivalents from real life in order to explain the importance and smallness of the minimal values, tried to make them see from different angles by making comparisons. He made his comparison by stating the population of the world is 7 billion and the number of particles in a mole is 1026" and it was highly remarkable." (Observation Field Note: F)

The instructor asked questions to the students about what they would do when they became teacher, she made suggestions, and gave advices; "What's told and the experiments may sometimes not match." "Not everything needs to keep balance, let it be short but to the point." There has to be no misconception, and to be prepared beforehand is needed... She told the students that they needed to take action through

experience in their careers. She gave tactics to them; "You should stall the students until the experiment is implemented!" The experiment was done. She gave examples by saying that 'If there was no equipment, more different apparatus could be prepared by using creativity.' She showed that it could be achieved in spite of the impossibilities." (Observation Field Mark: BL)

"Well, the other day, in class, I told the students that whether you would be sick or not in 10 or 20 years' time became clear with DNA pairs nowadays. They said: 'Wow, how nice!' I said it wasn't so nice in my opinion. Why so? At first, nobody agreed with that. The point we reached by arguing is that, let's say, I'm a health insurance company; I don't provide insurance for you just in case there will be a risk of you getting cancer ten years later. Or I'm a big company, I don't recruit you. You will die because of cancer 10 years later, but you are a person with high capacity, maybe you will not get cancer, only the probability of it coming true is kind of shown. Different viewpoints, of course, come out. (Interview Record: OE5-BL)

When the data are examined, it is indicated that abstract knowledge for students are embodied with examples from real life in courses, that where they will be able to use the knowledge they gain is questioned, that awareness about the situations they may face in their careers is created. It can be said that associating both theoretical and applied science courses with real life, by its very nature, is an expected case.

3.4. An Assessment Simultaneous with Teaching

The codes of "Obtaining content validity", "course assessments", "having diary kept", "having portfolio prepared" and "V-model diagram" attained as a result of analysing the data acquired from observations and interviews are combined in the theme of "an assessment simultaneous with teaching". Quotes from different data sources about this theme are presented below.

"The instructor made a statement about the diaries that students had to keep, had a student read the sample daily questions and answers. She stated that they had to associate what they had learnt with daily life and that they had to write them down to their diaries. As an example, She had the students who wrote as he expected read what they had written. She directed the students to research. She waited for them to comment. She had some examples, too, from those who wrote wrong or incomplete read. He asked the differences to other students and made the students compare them. Finally, he got opinions from the students about whether the type of the final test would be classical or test, and the classical was opted for." (Observation Field Mark: BL)

"...and there's something like that; our exam questions will be with regard to the experiments that we've done... Everyone is responsible for himself or herself in the exam, but it may be like this; if everyone was responsible for each one's experiment, maybe then learning would occur..but the teacher said: "I'll give everyone a paper, and all of you, according to your experimental group, in other words two people, will write the experiment that you have done that day." For example, while they (other sections) are responsible for all of the experiments, everyone among us is only responsible for her/his own experiment. There is this thing; it's a sure thing that we will answer 7 questions as there will be 10 questions. 70 is certain. he will ask 3 different questions and they will be most probably from that book we've bought. Because he said that he would ask theory about thermodynamics. He will ask knowledge after all. If you know, you will answer; if not, you won't answer..." (Interview Record: OA4-FL)

"We didn't have a physics test. What we did was that everyone was responsible for her/his own subject he gave a lecture on before." (Interview Record: OA1-F)

"... we have an active role mostly in biology. While we're kind of preparing a V-model diagram in biology, it has the part of theory and of experiment, and we write anything we've learnt behind it. When we do this, we somehow learn albeit with some difficulty... We're obliged to because we search. For instance, at first, I was drawing a diagram in 7 hours, and I myself was the one to have difficulty most. But I gained, not only the knowledge, how it works also with those plants in daily life as we said before. I mean I know all of them." (Interview Record: OA2)

"The Instructor checked on those who have been doing experiment, told them if it progressed right or not, and what they must do. And he sometimes asked the why and how of their works. He had the students done their experiments again after changing their materials in circumstances that led to unexpected results. He directly told them what they must do, and asked them to write down what they have found out without getting any ideas from them and without waiting for them to offer a solution... The instructor gave directly the correct answer to the students' questions. (How do we find out the volume of the stone? It's simple; the rising amount is the volume as long as it doesn't overflow.) (Observation Field Mark: FL)

"The instructor is ranging through students and checking one by one what they have done, and is guiding them. She is sometimes giving expressions to the whole class. The students are occasionally asking for the instructor's help... She is giving reinforcements to the ones who has found any shapes; "great, very nice, now it's done..." There is an exchange of materials between groups, those who couldn't find an image are looking at the others who found one, and they are helping them prepare the material. The students are quite comfortable. The instructor is leading the other groups to the one that captures a good image, and states that She expects the same image from them, too. The instructor responds to every effort of the students on the subject. The students are constantly asking questions about the activity they do, but mostly they called the instructor as they want her to check it. And the instructor, by commenting on what's done, deals with the process of the students' activity. A group captured a good image related to the subject on the microscope. The instructor directed the class to share this image with the others. (Observation Field Mark: BL)

When the interview and observation data were examined, it was determined that while assessment in theoretical courses are more in the form of ask&answer, lecturing and in-class assessment; in applied courses, the scientific process skills students have are assessed through experiments, and an assessment simultaneous with teaching is carried with the methods of assessment like V-model diagram and "keeping a diary". It may be asserted that using assessment methods like these is the sign of a factual assessment simultaneous with teaching, and this case is suitable for the features of constructivist learning environment.

4. Discussion and Conclusion

Considering the findings acquired in the research, the conclusion of that the learning environment which

includes the properties of "active learning", "reflective learning", "associating with life" and "assessment simultaneous with teaching" occurs is achieved, through the process of learning&teaching of Content Knowledge Courses at Pamukkale University, Science Teaching in sophomore year. This result was compared to the search results which were done to specify the properties that need to be in the environment of constructivist learning. In their work titled as "Monitoring constructivist classroom learning environments", Taylor, Fraser and Fisher (1997) take the qualities of constructivist learning environments as personal interest, scientific uncertainty, shared control, critical voice and student agreement. Also, Tenenbaum, Naidu, Jegede and Austin (2001), in their work, deal with arguments and interviews, conceptual contrasts, sharing opinions with others, solution-oriented materials and sources, motivation for reflection and research for concept, meeting the needs of learner, interpretation and real life examples as the qualities of constructivist learning environments. In Bay, Kaya and Gündoğdu's (2010) research, based on the constructivist approach, learning environments supporting democratic values such as the ones that promote learners' autonomy, appreciation, justice, respect for different ideas, accepting the differences, mutual understanding, cooperative work, responsibility and critical thinking are established. In this regard, it can be said that certain parts of qualities that need to be present in constructivist learning environment are present at the process of learning&teaching in the content knowledge courses which have been examined in the research but that the qualities of "personal interest", "solution-oriented materials and sources", "meeting the needs of learner" are not.

When Content Knowledge Courses in Science Teaching in sophomore year are compared as theoretical and applied courses, the result of that the process of theoretical courses, compared to applied ones, reflects the qualities of constructivist learning environment less in terms of providing an environment for "active learning" and "assessment simultaneous with teaching" is achieved.

5. Suggestions

According to the search results, it appears that the process of learning&teaching in content knowledge courses includes some parts of the qualities of constructivist learning environment. However, it must be designed again in the manner of reflecting the qualities, too, of constructivist learning environment which doesn't include the process of learning&teaching in content knowledge courses.

Thinking that constructivist learning approach is not restricted with the learning environments in which active participation of students are provided, at the same time, it's the environment in which how to construct the knowledge also is gained, the qualities of constructivist learning environment should take place in theoretical courses beside applied ones.

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