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Evaluation of the Problem Based Flipped Classroom Instruction Process in the Framework of Community of Inquiry

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ABSTRACT

The aim of this study is to determine the effectiveness of the instruction process through the use of the PBFC model within the scope of the CN&C course. The evaluation of the PBFC process was made with the qualitative data obtained from the participants within the scope of CoI. Within the scope of cognitive presence, the participants firstly talked about the fact that video-based materials started the learning process. Within the scope of social presence, they talked about the contribution of PBL activities to motivation and a respectful communication environment. Within the scope of teaching presence, participants firstly mentioned the fact that PBL activities deepen the meaning of the subject. Within the scope of learning presence, participants talked about the increase in their self-efficacy regarding course content, the formation of regular study habits thanks to video-based materials, and they stated the fact that their intrinsic and extrinsic motivations stayed alive.

Keywords: Flipped classroom, Community of Inquiry, Problem based learning, Computer Networks and Communications course, Pre-service teacher training.

INTRODUCTION

The instruction process is also a communication process. In the traditional approach, this communication occurs in the form of the teacher presenting the information and the students receiving and absorbing this information. In a more contemporary dimension, the instructional communication process is shaped according to the changing roles of teachers and students. The quality of the communication established in the focus of the

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course content can increase the efficiency of the instruction process at the same rate. Creating an instruction content, goals are determined primarily. Goals shape instructional content. Therefore, the content that is in focus on the instructional communication process can be grouped mainly as cognitive, affective, and psychomotor.

Turkish Council of Higher Education (CoHE) sets the framework of the course content at the higher education level in Turkey. Within the scope of Computer Education and Information Technology department (CEIT) in Education Faculties, students take a Computer Networks and Communications (CN&C) course in their third year. The course content covers the issues related to how communication is provided in the Local Area Network (LAN) and Wide Area Network (WAN) environment (CoHE, 2007; CoHE, 2018). The course content includes cognitive, affective, and psychomotor contents. Within the scope of the course, students encounter new technical terms and abstract concepts. When necessary, they are supposed to practice implementations. Therefore, being prepared for the lesson is one of the important variables for the success of the instruction process.

Flipped classroom (FC) has a flexible structure. In this way, many different models have been developed with different perspectives regarding its implementation (Gómez-Tejedor, Vidaurre, Tort-Ausina, Molina-Mateo, Serrano, Meseguer-Dueñas, ... & Riera, 2020). The starting point here is the idea that in-depth learning can be achieved with active learning (Konijn, Essink, Buning & Zweekhorst, 2018). As a result of the implementation of an appropriate FC model, it has been observed that active learning in different disciplines including theoretical and practical activities becomes easier (Chuang, Weng & Chen, 2018). In order to get effective results at the point of active learning, it is important to have a link between theory and practice. Therefore, it is recommended to prefer appropriate pedagogy in the FC process (Zheng, Bhagat, Zhen & Zhang, 2020). From a pedagogical point of view, students can be directed to collaborative activities in FC processes (Winter, 2018). With the use of collaborative learning, inquiry-based learning (IBL), and problem-based learning (PBL), the effectiveness of the FC process can be maximized (Zheng, Bhagat, Zhen & Zhang, 2020). For instance, as a result of the FC processes performed with PBL where group work was preferred, more effective results were obtained only in favor of the traditional FC process (Chis, Moldovan, Murphy, Pathak, & Muntean, 2018).

Technology integration into the FC process is also easy. Positive results can be achieved with Information and Communication Technology (ICT) tools, which are appropriately used to improve student learning (Rasheed, Kamsin & Abdullah, 2020). These results can be in the form of students' ability to easily access course content and communicate with instructors and friends (Kayaduman, 2020). These technologies to be preferred should be user-friendly as well. Otherwise, the effort to be spent on learning may shift from learning

content to learning the use of technology (Bakla, 2018). Considering today's conditions, social networks should not be ignored at the point of using ICT. Because the use of social networks is an effective way to create a sense of community (Karaoglan-Yilmaz, 2017) and social network content can be easily accessed via smartphones.

The FC process, which is basically based on performing classroom activities at home and doing homework at school, was initially implemented at the high school level (Bergmann & Sams, 2012). Over time, it has been implemented in different education levels. It is recommended to conduct FC processes in various disciplines (Lee, 2018; Jdaitawi, 2020; Yoon, Kim & Kang, 2020) by employing appropriate technological tools and pedagogical methods (Rasheed, Kamsin & Abdullah, 2020), obtaining in-depth data through qualitative research (Sergis, Sampson & Pelliccione, 2018; Lee & Kim, 2018; Karabulut-Ilgu, Jaramillo Cherrez & Jahren, 2018; Martínez-Jiménez & Ruiz-Jiménez, 2020; Park & Kim, 2021), demonstrating the quality of communication regarding the process (Lai, Hsiao & Hsieh, 2018; Jdaitawi, 2020; Kayaduman, 2020; Thai, De Wever & Valcke, 2020), and it is recommended to contribute to the literature.

The conceptual framework in which communication is provided through computers at the higher education level, which contains essential elements for success in the education process, can be named *Community of Inquiry* (CoI). Dewey (1959) stated that the educational process has psychological and sociological sides. From this point of view, CoI was designed with cognitive and social elements. With the responsibility of designing and integrating the cognitive and social dimensions, one core element was also added. These elements can be named as *Cognitive Presence, Social Presence*, and *Teaching Presence* (Garrison, Anderson & Archer, 1999). CoI describes how learning takes place for a group of individual learners through the educational experience that occurs at the intersection of social, cognitive, and teaching presence. This can be used to provide detailed insights concerning the design of the teaching activities. In addition to these elements, *Learning presence* can also be mentioned (Shea & Bidjerano, 2010). CoI occurs as a result of online communication. CoI framework is mainly used for the evaluation of instruction processes in online and blended learning contexts (Garrison, Cleveland-Innes & Fung, 2010). *Cognitive Presence* is concerned with constructing meanings during communication processes (Garrison, Anderson & Archer, 1999). *Social presence* is related to the ability to establish personal and logical relationships (Garrison, 2007), it can be defined as the ability of a person to reflect himself socially and emotionally like a real person in the environment where communication tools are used (Garrison, Anderson & Archer, 1999). *Teaching presence* covers the responsibilities of the teacher in the communication process (Stenbom, 2018). *Learning presence* includes situations related to self-regulation (Shea & Bidjerano, 2010).

Based on the above-mentioned situations, this research has been planned with the idea of ensuring that students come prepared for the CN&C course, which includes technical terms and abstract concepts, and to increase the efficiency of the process with in-class interactive activities. So the aim of this study is to determine the effectiveness of the instruction process through the use of the Problem Based Flipped Classroom (PBFC) model within the scope of the CN&C course. Theoretically, the CoI model taken as reference and the effectiveness of the instruction process evaluated accordingly.

METHOD

Instruction Process

Instruction activities applied through the spring semester of the 2019-2020 academic year. Instruction activities are carried out within the scope of the CN&C course. The course content is intended to develop learners' understanding of the communication process of computers in a network environment. Within the course, many new technical terms and abstract concepts are encountered. Therefore, it is important for learners to come to class be prepared.

In total, 4 weeks of instruction were provided. Face-to-face instruction activities (i.e., PBL activities) are carried out every week. After the face-to-face instruction, the instructional videos of the following week were delivered to learners through WhatsApp. After the video-based instruction materials were sent, the face-to-face lesson process repeated with the PBL method.

PBFC implementation model

In this study combination of FC and PBL was implemented. FC was used for preparation for the PBL activities. PBL was used for reinforcement of learning content. In the FC phase, video-based learning materials were sent to the students. Students got preliminary information from them. After a while instructor asked questions about the video content and then he checked if students watched the videos or not. After the students' replies instructor provided feedback about their answers. The aforementioned activities aimed to prepare for the PBL activities. In the PBL phase, face-to-face communication took place. In total, four problem statements were clarified by the students. In the PBL phase, students conducted group work. In figure 1 all steps of the PBFC are summarised. Step 1 in figure 1 covers the general preparation process carried out by the instructor within the scope of the PBFC model applied in the study. The following steps 2, 3, 4, and 5 cover the implementation model of the FC process, which is implemented weekly within the scope of the study.

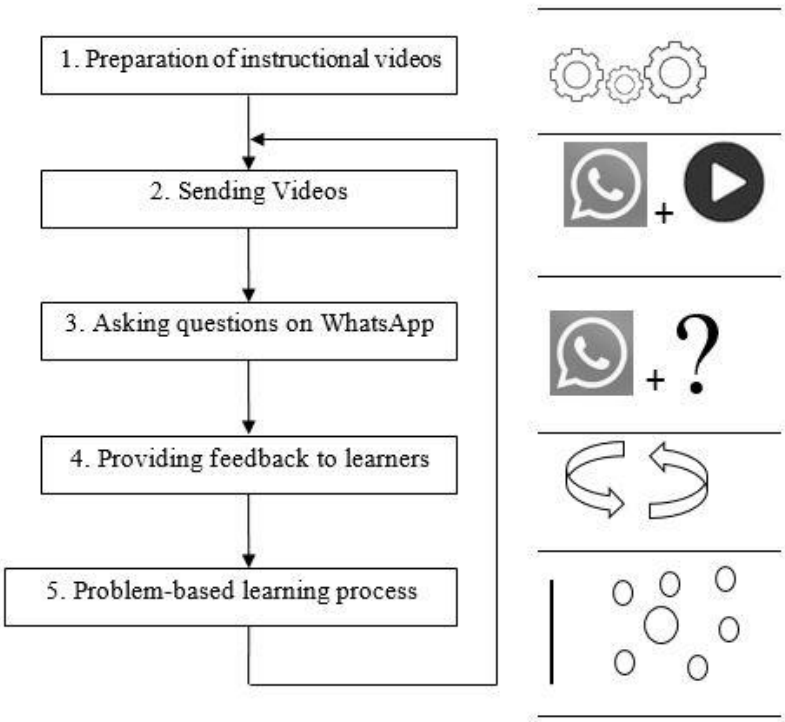

Figure 1. PBFC model applied in the study.

1. Preparation of instructional videos. Video recordings were 5-10 minutes on average. To make the message to be easily understandable, care was taken to use understandable language in the recordings. A total of 13 video-based learning materials were sent for the four-week instruction process.

2. Sending videos. Videos that will be used in the following week are sent to the WhatsApp group on the same day, immediately after the PBL activities.

3. Asking questions on WhatsApp. On average, 2-3 days after the videos were sent, questions about the video contents were asked. The aim is to check whether students are watching the videos shared and to remind learners who forgot to watch.

4. Providing feedback to learners. Feedbacks were provided to learners' answers.

5. Problem-based learning process. During the face-to-face course process, important points of the weekly topics were emphasized by using the PBL. Four problem situations were used and they are listed above:

PBFC Problem statements

PBL and IBL are two kinds of Active learning. They have common properties. PBL is a special type of IBL (Spronken-Smith & others, 2008). Two of the PBFC Problem

statements are examples of the use of IBL, in that they deal with explaining terminology. The others are examples of PBL.

1st week's problem situation: For an educational institution under construction, internet infrastructure will be provided and a computer laboratory will be established. As a subject matter expert and information technologies teacher candidate, you are asked to provide suggestions about the communication environments that may be needed.

2nd week's problem situation: Three computer labs exist in a higher education institution. The first consists of 40 computers built with coaxial cables, the second is 40 computers built with UTP type cables and MAU (Multistation Access Unit), and the third contains 40 computers built with STP type cables and a switch. Management considers allocating one of the laboratories to the students for 1 hour per day, another for the lessons they will need to access the data by using the internet, and the remaining one for the applications they will design through the computer. The institution is in a position to allocate some budget for some new regulations when necessary. At this point, suggestions are requested from you.

3rd week's problem situation: Alican is a high school student who is interested in electronics and computers. Aware of this, his family bought him an Ardunio set so that he can spend his spare time. Alican has started to practice implementations by adding various components to the Arduino board, which has electronic circuits. But there is something that pervades his mind and cannot find an answer. How is the Arduino card, which consists of electronic circuits, able to communicate with its computer via a cable and execute commands? Alican has heard that you are an information technology teacher candidate and would like to consult you on this matter.

4th week's problem situation: Ferhat is a student who takes the computer networks and communication course, however, he does not attend the course regularly for some reasons. He has mislearning about how communication takes place in local area networks. He confuses the purpose of using addresses such as MAC address and IP address and does not fully grasp the logic of which network devices should be evaluated at which layer of the OSI model. The midterm exam is approaching, and as a friend, Ferhat is waiting for your support as he prepares for the exam.

The Study Group

The study group consists of pre-service teachers studying in the Faculty of Education at Van Yüzüncü Yıl University in Turkey. They are juniors at Computer Education and Instruction Technology department in the 2019-2020 spring semester. With four pre-service teachers (i.e., learners) CN&C course was conducted according to the PBFC model.

Data Collection

Because of the small group of pre-service teachers who were enrolled in the course, the qualitative data collection method was preferred. This is a case study. A structured interview form was created with reference to the CoI model and it was used. In the interview form, there are four main questions and 13 sub-questions directed to determine Cognitive, Social, Teaching, and Learning presences (see Appendix: PBFC Interview Questions).

FINDINGS

In this section categories and sample expressions are presented regarding to cognitive, social, teaching, and learning presences. Interviews were conducted in Turkish, then they were translated into English. At this point, maximum attention has been paid to ensure that the meaning does not change.

Findings related cognitive presence

Analyses regarding cognitive presence were conducted within the framework of *Triggering Event, Exploration, Integration, and Resolution* themes, and the relevant categories were determined. The categories for each theme, how many students responded to these categories, and sample expressions are presented in the tables below.

Category	*Frequency*	*Sample expressions (S: Student)*
Pre-lesson preparation	4	S1: I got prepared better for the lesson thanks to the videos provided before the lesson. S3: Our lecturer sends us questions every week the following days after these videos. To find the answers to these questions, we either look at our notes from the videos or watch the video again and answer the questions.
Being active in face to face classroom environment	1	S1: Video-based materials offered the opportunity to be more active in the lesson. It allowed me to understand the lesson more efficiently. It made me love the lesson more and increased my interest in the lesson, and it provided me with the opportunity to see my shortcomings in the lesson and to make up for it.
Positive attitude towards the course content	2	S2: Since the topics to be learned in the videos are presented in a fluent and instructive manner, I was excited about what the topic would be each week. The implementation of an instructional design in this way increased my interest and enthusiasm for the lesson.
Full learning	3	S2: Especially because of using this method, I have been able to re-capture the parts that I might have missed and to realize full learning by watching the videos repeatedly. Thanks to this, I started to learn the subjects better. S4: Video-based materials were accessible. Being accessible at any time played an important role in detecting the missing information about the subject.

Table 1. Categories and Sample Examples concerning to Triggering Event Theme.

Video-based lectures presented before the lesson were used to start the learning process. It is understood from the expressions made within the scope of the *"Pre-lesson preparation"* sub-theme that it has the expected effect on students. In addition, the students also used expressions that videos provided the basis for *"Full learning"* and played a role in *"Being active in face-to-face classroom environment"* and *"Positive attitude towards the course content."*

Category	*Frequency*	*Sample expressions (S: Student)*
Research on unclear issues	2	S2: While watching the videos, I tried to eliminate the question marks in my mind about the subject by doing research in parts I had difficulty in understanding, especially during the note-taking phase.
Research for additional information	4	S1: I did some research for additional information. It was necessary to be prepared for the lesson in order to consolidate what our lecturer told, and I conducted research to understand the topics our lecturer told and to ensure that the lesson was efficient for me. S3: I tried to learn about some subjects by finding visual content and researching it on the internet. In some, I tried to understand it better by finding materials such as implementation videos.

Table 2. Categories and Sample Examples concerning to Exploration Theme.

The students stated that after examining the video-based teaching materials before the lesson, they did research about the subjects on which they could not fully understand. And they did research to obtain additional information.

Category	*Frequency*	*Sample expressions (S: Student)*
I have made progress	4	S1: PBFC process made the lesson enjoyable for me. I think I have made quite a bit of progress. Because I felt like I had listened to the lesson more than once and I completed my shortcomings in the lesson. Also, the lesson has become more permanent for me. I realized that I added a lot of information to my existing knowledge. The subjects started to sound easy and fluent for me. It even allowed me to create projects related to computer networks in other courses. Since it helped me master the subject of computer networks, I made projects related to it. S3: PBFC process absolutely provided me improvements. Some topics and questions wouldn't be in our minds if it wasn't for video-based topics. Even if the solutions to some questions do not come to my mind immediately, I can watch the videos again and get the answers to the questions.

Table 3. Categories and Sample Examples concerning to Integration Theme.

Regarding the integration sub-theme, all the students stated that they made progress when they considered the learning process from the beginning.

Category	*Frequency*	*Sample expressions (S: Student)*
I will use it for teaching	3	S2: Since we aim to acquire a profession in Information Technologies Teaching, the information we have learned and will learn in this course will definitely be useful to us. I will use it to teach students the right information in this area.
I will use it for problem solving	3	S4: Of course, I think that I have acquired useful information that I can use in some problems I may experience in my future life and I believe that I can use this information to solve problems.
I will use method	1	S4: As an informatics teacher candidate, I am thinking of providing my students with problem-solving skills by presenting such problem situations.

Table 4. Categories and Sample Examples concerning to Resolution Theme.

All of the students think that they can use the information they have acquired in the course in their future lives. They stated that they will mainly use the information they have acquired for *"educational purposes"* and *"to solve the problems they encounter with computer networks"*. One student stated that he would use the method he encountered in this course in his lessons when he became a teacher.

Findings related to social presence

Regarding social presence, analyses were carried out within the framework of *Emotional Expression*, *Open Communication*, and *Group Cohesion* themes and, the relevant categories were determined. The categories for each theme, how many students responded to these categories, and sample expressions are presented in the tables below.

Category	*Frequency*	*Sample expressions (S: Student)*
Contribution of group work to learning desire	4	S1: There was a desire to learn the lesson content in a more exciting way because I had the opportunity to understand the lesson and ask questions to my friends with the thought of union makes strength. I wanted to participate in the lesson more enthusiastically. The environment encouraged me to participate more actively in the lesson. S4: By sharing our information even if it was wrong, it enabled us to tell and correct the mistakes that we know as correct without hesitation. So it kind of made us want to improve ourselves.
Positive contribution of the instructor's guidance	3	S1: With the guidance of our lecturer, we had the opportunity to learn more accurately the subjects related to the lesson. The lesson made me more eager to attend. S3: In this process, our lecturer directs us and creates a faster and more effective course scope.

Table 5. Categories and Sample Examples concerning to Emotional Expression Theme.

Within the scope of the emotional expression sub-theme, students mostly used expressions about "*Contribution of group work to learning desire*" based on the communication process with their friends while solving problem situations. In addition, students used expressions reflecting that the instructor's guidance made the learning process more efficient and the satisfaction with it.

Category	*Frequency*	*Sample expressions (S: Student)*
Respectful communication	4	S2: Our communication both with our friends and with our teacher was very level and respectful. S4: Our way of mutual respect, love, and address was at a certain level.
Lecturer's instructions	3	S1: The guidance of our lecturer by asking us made us understand the subjects correctly. It was fine for our lecturer to explain the lesson to us with empathy and to explain our comments with the right words. Our lecturer's empathy towards comments and explanations made us love the lesson more.

Table 6. Categories and Sample Examples concerning to Open Communication Theme.

Within the scope of the open communication sub-theme, they mentioned that there is *respectful communication* with the lecturer and other students within the scope of the course content. In addition, they talked about the lecturer's guiding role and the communication that takes place in this context.

Category	*Frequency*	*Sample expressions (S: Student)*
I was a member of the group	4	S2: In the process of solving a given problem, we can act with the awareness of group work. I consider myself a member of the group because of our communication in the group and the respect we show each other. S4: Some of the reasons why I feel like I am a member of the group is that I see that some friends in the group strengthen the information I have gained through my researches.

Table 7. Categories and Sample Examples concerning to Group Cohesion Theme.

Under the sub-theme of group cohesion, all students stated that they felt like a member of a group.

Findings related to teaching presence

Regarding teaching presence, analyses were carried out within the framework of *"Instructional Management"*, "*Building Understanding"* and *"Direct Instruction"* themes, and the relevant categories were determined. The categories for each theme, how many students responded to these categories, and sample expressions are presented in the tables below.

Category	*Frequency*	*Sample expressions (S: Student)*
Topics were designed to suit the level	3	S1: The topics we cover every week are not too much or too little. The weekly lecture topics were not too much to tire us more than necessary. The planning of the instructional process was in such a way that it would not force us to pass the lesson.
Deepening the meaning of problem situations	4	S3: In this process, by planning the design of a problem solving within the group, the method of solving the problem is more effective. S4: In terms of gaining the ability to solve the problem, I find it very useful for us to identify the problems we may encounter in the future.
Request for more implementation possibilities	1	S2: I think there is a need for a little more practice on some of the topics of this course. Of course, I am aware that the facilities of our faculty are also important in this. For example, the permanence of what has been learned can be increased by practicing implementations on subjects such as network topologies.

Table 8. Categories and Sample Examples concerning to Instructional Management Theme.

Within the scope of the instructional management sub-theme, the students talked about the *deepening of the meaning of the problem situations*, and the *design of the subjects according to the level*, respectively. One student mentioned the necessity of having *more implementation possibilities.*

Category	*Frequency*	*Sample expressions (S: Student)*
Guide role	3	S2: Our teacher is guiding us in establishing the relationship of a subject with another subject. Learning will not take place in the absence of this guidance.
Activating the students	3	S4: The lecturer for this course was our resource provider. Our lecturer would leave us alone with the problem to enable us to cope with the problems we may experience today in our own way.
Instructive role	3	S1: Our lecturer has concretized the lesson subjects by giving concrete examples of the lesson subjects that are formed abstractly in our minds. Our lecturer did his best to make the lessons permanent. The necessary methods and techniques used by our lecturer. S3: The lecturer embodies abstract concepts so that we can learn with the support of our lecturer.

Table 9. Categories and Sample Examples concerning to Building Understanding Theme.

Within the scope of the sub-theme of building understanding, students talked about the *guide role* of the lecturer, *activating the students,* and *the instructive role* of the lecturer with similar rates.

Category	*Frequency*	*Sample expressions (S: Student)*
Fluent and plain language usage	4	S2: The fact that the course contents are presented in a language we can understand has increased our interest in the lesson and enabled us to learn the subjects of the lesson more comfortably. S3: An understandable language was used in this lesson
Provide motivation	2	S1: Our lecturer informed us about how to use the lesson in daily life.
Lack of sample	1	S4: More examples should have been given on the subject.

Table 10. Categories and Sample Examples concerning to Direct Instruction Theme.

Within the scope of the direct instruction sub-theme, students talked about the use of fluent and plain language in the presentation of the course content and the motivational role of the lecturer. One student expressed that the process could be better if more examples were given on the subject.

Findings related to learning presence

Regarding learning presence, analyses were carried out within the framework of Self-efficacy, Motivation, and Change in study habits themes, and the relevant categories were determined. The categories for each theme, how many students responded to these categories, and sample expressions are presented in the tables below.

Category	*Frequency*	*Sample expressions (S: Student)*
Increase in self-efficacy	4	S3: There has been a positive change in self-efficacy towards this lesson. S4: Of course, there was an improvement on the individual side, for example, we were able to recognize some practical problems, and then we learned practical activities on how to deal with these problems.

Table 11. Categories and Sample Examples concerning to Self Efficacy Theme.

Within the scope of the self-efficacy sub-theme, all of the students mentioned an increase in their self-efficacy related to the subject.

Category	*Frequency*	*Sample expressions (S: Student)*
Enjoying the course	2	S1: The lesson was not boring. Therefore, I can say that my willingness to study has increased and I have followed the lesson with pleasure. I think it positively affected my desire to study.
Making motivation externally sustainable	2	S2: As my interest in the course and my desire to learn increased, my desire to study in this course increased at the same rate. The main reasons for me to feel in this way are the way the lesson is taught, the approach of our lecturer, the motivation of the lesson, the training videos prepared by the lecturer himself, and the accessible materials whenever needed, easily understandable language, etc.
Intrinsic motivation	2	S4: Since the content of the course is geared towards our field and also for our own personal development, we cared about the topics of our lesson and did research.

Table 12. Categories and Sample Examples concerning to Motivation Theme.

Within the scope of the motivation sub-theme, students talked about enjoying the lesson, making motivation externally sustainable and intrinsic motivation, at similar rates with each other.

Category	*Frequency*	*Sample expressions (S: Student)*
Learning from video-based materials	2	S4: Preliminary information that we gained through videos before the lesson provided new study habits.
Getting ready for class regularly	2	S1: I watched the videos our teacher sent for the lesson repeatedly. I did research at some points. I tried to be prepared for the lesson and tried to give the most accurate answer to the questions our lecturer sent us. I tried to participate actively and understand the lesson. I made preparations with the thought of how I could get efficiency from the course
Studying by taking notes	1	S3: There has been an effective change in our study habits in general. After watching the videos, we got into the habit of taking notes.
Research habit	1	S4: Our lecturer directed us to make researches on the subject from different sources on the internet and directed us to researches to see possible examples of problems related to the subject.

Table 13. Categories and Sample Examples concerning to Change in study habits Theme.

Regarding the sub-theme of change in study habits, the students made statements that could be expressed as *learning from video-based materials*, *getting ready for class regularly*, *studying by taking notes*, and gaining *research habits*.

DISCUSSION

In this study, the CN&C course, conducted using the PBFC model, was conceptually evaluated concerning to the CoI model. Questions regarding *Cognitive presence*, *Social presence*, *Teaching presence*, and *Learning presence* were asked to the students participating in the instruction process. The answers collected were evaluated by dividing them into themes and categories.

Discussion on cognitive presence

Triggering Event, Exploration, Integration, and Resolution themes were obtained within the scope of cognitive presence. Within the scope of the *Triggering Event theme,* all of the students used expressions that video-based contents initiate pre-lesson learning activities. This was followed by the statements that the instructional videos used were re-examined when necessary and offered an opportunity to learn the whole course content. There were also related statements regarding the contributions of video-based materials in terms of developing a positive attitude to the lesson and being active during the lesson. Similar research results regarding the videos used in the FC process have been reached in the literature. Xiu, Moore, Thompson & French (2019) reported a positive attitude in the way that students can stop and take notes, watch videos by dividing them into sections, and access video-based teaching whenever they want. Fung (2020) stated that the videos presented before the lesson provide students with the knowledge and skills they may need as a prerequisite, thus preparing the ground for practice and discussions during the lesson. The videos used in this study are limited to 5-10 minutes. As a result of the short duration of the videos, it is thought that students develop a positive attitude towards the videos. Because in the literature, it is recommended that videos should not be kept too long to help students learn better (Bergmann & Sams, 2012; Akçayır & Akçayır, 2018; Qiang, 2019)

Within the scope of the *Exploration theme*, the students stated that they did research to find out what they could not understand enough from the video-based instruction material and to obtain additional information. This research was conducted with a small group of four. Conducting the FC process with you in a small class provides convenience at the point of communication (McLean & Attardi, 2018) and teachers can provide more help and explanations thanks to one-to-one communication (Bedi, 2018). As a result of this, it is thought that passive learning tendencies (Hao, 2016), which are the main reason for preparedness for the FC process, have been eliminated, and that students can be activated and tend to do research.

Within the scope of the *Integration theme*, all students think that they have made progress regarding the content of the course. When the expressions related to this were examined, it was seen that the students mostly stated that they reviewed the instructional videos

repeatedly and thus they made the meaning of the content properly. In the literature, it is seen that at the end of the FC process, students make cognitive improvements (Jang & Kim, 2020; Cheng, Ritzhaupt & Antonenko, 2019; Zheng, Bhagat, Zhen & Zhang, 2020) and have a depth of meaning (Yoon, Kim & Kang, 2020). This supports the idea of making improvements in course content.

Within the scope of the *Resolution theme*, the students consistently reflected the belief that they could use the information they acquired in their future lives. Looking at the expressions they made, they stated that they can use the knowledge they have acquired to teach other people and to solve network problems they will encounter in daily life. A student stated that he could use the FC method in the future. Participants are Information Technologies teacher candidates. After graduation, they can work as an Information Technology teacher or work in the information technology sector. The opinions of the participants within the scope of the resolution theme are that they can use their learning content in their professional life. In the literature, it is stated that students have acquired gains such as knowledge deepening at the end of the FC process (Alcaraz, Martínez-Rodrigo, Zangróniz & Rieta, 2019; Yoon, Kim & Kang, 2020), gaining contextual self-confidence (Jang & Kim, 2020), making progress for practical events (Aguilar, Santana, Larrañeta & Cuevas, 2020), improving their problem-solving ability (Lin, 2019). Within the scope of the resolution theme, the idea that students can use the information they have acquired in their professional lives overlaps with the literature.

Discussion on social presence

Emotional Expression, Open Communication and *Group Cohesion* themes were obtained within the scope of social presence. Within the scope of the *Emotional Expression theme*, the students stated that the PBL activities they carried out as a group contributed to the formation of the desire to learn, and the instructor's guidance increased the efficiency of the process. The emotional states of the students within the scope of social presence were realized in the focus of motivation and positive thoughts about the efficiency of the process. In the literature, it is stated that the emotional outcomes of the students during the FC process are quite positive (Jang & Kim, 2020). With FC activities, the engagement of students in class increases (Su & Chen, 2018), and perhaps as a result of this, positive contributions can be obtained to their satisfaction level in the course (Fisher, Perényi & Birdthistle, 2018; Martínez-Jiménez & Ruiz-Jiménez, 2020). Based on this result, it can be concluded that the communication process that takes place in the social environment creates positive feelings in the students.

Regarding the *Open Communication theme*, the students have revealed that they are conducting a respectful communication process both among themselves and with the instructor. In addition, they reflected that their communication with the instructor was mainly focused on the questions asked about the content of the video-based teaching

material. In Lecture-based courses, most students want to interact more with the teacher (McLean & Attardi, 2018). By providing more class time for teacher-student communication in the FC process (Bedi, 2018), this requirement can be reduced. In the FC process, communication with the smaller class can be much easier (McLean & Attardi, 2018), and students can socialize among themselves and increase teacher-student communication with group studies conducted within the scope of PBL activities (Cukurbasi & Kiyici, 2018). This research was conducted with a small group. The teaching process was carried out by integrating FC and PBL. As stated in the literature, under these conditions, these results regarding open communication seem quite reasonable. By the way, a recommendation can be made. Future studies can be conducted by the use of the PBFC model with larger groups through a quantitative approach.

Within the scope of the *Group Cohesion theme*, all students used expressions reflecting that they felt like a member of the group. The group in which the study was conducted has been taking the same courses for three years and getting to know each other. In this result, it is thought that besides the opportunity of exchanging ideas provided by the applied method, the students' getting to know each other and having the course in a class consisting of a small number of people have an effect.

Discussion on teaching presence

Instructional Management, Building Understanding, and Direct Instruction categories were obtained within the scope of teaching presence. Within the scope of the *Instructional Management theme*, the students mentioned that the problem-solving activities carried out in the face-to-face instruction environment deepened the meaning, were suitable for the levels of the weekly designed topics, and the subjects complemented each other. In addition, there is a need for students to practice more. The role of the teacher changes in the FC process (McLean & Attardi, 2018; Wei, Cheng, Chen, Yang, Liu, Dong & Zhai, 2020). In this process, which is carried out by integrating with PBL and with the active participation of students, students are aware of the teacher's role in creating a learning environment and guiding them. However, they also stated that they expected of having the practice done with the direct intervention of the teacher.

Regarding the theme of *Building Understanding*, the participants mentioned that the teacher made an effort to concretize abstract concepts, took the role of a guide by preparing an environment for their individual learning, and enabled students to take their own learning responsibilities by activating them. The purpose of using FC by integrating it with methods such as PBL is to make students active (Konijn, Essink, Buning & Zweekhorst, 2018). Thus, the effectiveness of the process can be increased (Chis, Moldovan, Murphy, Pathak & Muntean, 2018). The thoughts emerging within the scope of this theme are an indication that the idea of integrating FC and PBL is appropriate.

Within the scope of the *Direct Instruction theme*, the students mentioned that fluent and plain language was used in the video-based instruction materials, and their motivation for the lesson remained alive by clearly demonstrating when and where the learning content would be useful. The insufficient number of examples in the video-based instruction materials presented is a deficiency within the scope of this theme. If technology is used effectively in the FC process, it can contribute positively to motivation (Lin, 2019). If interactive and active learning methods such as PBL are used in the process, there may be an increase in learning motivation (Cukurbasi & Kiyici, 2018). Based on the expressions reflected by the students within the scope of this theme, it can be interpreted that video-based instruction materials and PBL activities performed in a face-to-face environment are successful in providing motivation.

Discussion on learning presence

Self efficacy, Motivation and Change in study habits themes were obtained within the scope of learning presence. Within the scope of the *self-efficacy theme*, all students stated that there was an increase in their self-efficacy in terms of the course content. Students think that the increase in self-efficacy occurs with the contribution of video-based instruction materials and in-class PBL activities. In the literature, it is stated that the most important variable for perceived impact on learning in the FC process is self-efficacy (Mohamed & Lamia, 2018) and the FC process provides positive change at the point of self-efficacy (Thai, De Wever & Valcke, 2020). As a result of this research, the thoughts put forward by the students for the increase of self-efficacy are parallel to the literature.

Within the scope of the *motivation theme*, the participants stated that their interest remained alive because they enjoyed the lesson, as well as being motivated externally as a result of the role of the lecturer, that they regularly worked. They also added that they did research to learn the course content and that their intrinsic motivation was effective in this. In the literature, it is stated that the FC process contributes positively to student motivation (Su & Chen, 2018; Qiang, 2019; Zheng, Bhagat, Zhen & Zhang, 2020; Jang & Kim, 2020), and as a reflection of this, students are more eager to attend classes (Aguilar, Santana, Larrañeta & Cuevas, 2020). In addition, it is stated that there is an increase in learning motivation as a result of integrating the FC process with interactive and active learning methods such as PBL (Cukurbasi & Kiyici, 2018). Students' opinions about motivation to learn within the scope of this research also support these situations.

Within the scope of the *Change in study habits theme*, the participants mentioned that they gained the habit of learning mainly from video-based instruction materials and that they gained the habit of studying regularly within this course. This is followed by the habit of studying by taking notes and doing research to obtain information from different sources. It is stated in the literature that some students may have difficulty in adapting to the FC process due to passive learning habits (Chen, Wang, & Chen, 2014; Espada, Navia,

Rocu & Gómez-López, 2020). To overcome this, it is recommended that faculty members leave their traditional roles and plan activities to increase cooperation (Martínez-Jiménez & Ruiz-Jiménez, 2020). At the end of this research, data was obtained that the students got out of passive learning habits. It is thought that the possible reason for this is the low number of students and the fact that the process is carried out in an integrated manner with PBL.

CONCLUSIONS

In this study, the PBFC instruction process was executed. During the four-week instruction process, the five-step implementation model was applied (see Figure 1). To evaluate the effectiveness of the process qualitative data was obtained regarding cognitive, social, teaching, and learning presences. The participants talked about the fact that video-based materials started the process within the scope of *cognitive presence*, they did research to obtain additional information, they made progress in the course content, and that they could use what they learned in their future lives. Within the scope of *social presence*, they talked about the contribution of PBL activities to motivation and a respectful communication environment. Within the scope of *teaching presence*, participants mentioned the fact that PBL activities deepen the meaning of the subject, the guide role of the teacher, and the comprehensibility of the video-based teaching materials. Within the scope of *learning presence*, participants talked about the increase in their self-efficacy regarding course content, the formation of regular study habits thanks to video-based materials, and they stated the fact that their intrinsic and extrinsic motivations stayed alive. The results of this study are very positive.

LIMITATIONS

This research is limited to PBFC activities conducted for four weeks. In this context, the students created a solution to four problem situations by doing group work. A total of 13 video-based instruction materials were shared with the participants via WhatsApp. Necessary studies were carried out with the active participation of four people in total and qualitative data were obtained. The results of this short-term study with a small group are very encouraging. The biggest reason for this may be that the communication was facilitated as a result of the instructor's involvement in the process as if he was a part of the group. In the future research, different results may be obtained if the researchers work with large groups for a longer period.

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List of Abbreviations

CEIT: Computer Education and Information Technology department; CoI: Community of Inquiry; CoHE: Turkish Council of Higher Education; CN&C: Computer Networks and Communications course; FC: Flipped classroom; IBL: Inquiry Based Learning; ICT Information and Communication Technology; PBL: Problem Based Learning; PBFC: Problem Based Flipped Classroom.

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APPENDIX: PBFC Interview Questions

Cognitive presence: Could you give information about your interaction with the instruction content within the scope of this course?
Social presence: How do you find the communication process with your group mates as part of this lesson?
Teaching presence: What do you think about the role of the instructor in this course?
Learning presence: Could you explain your individual learning process within the scope of this course?