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ICT Student Teachers' Pedagogical Content Knowledge: A Case Study

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This study aimed to identify the difficulties that information technology student teachers have in teaching concepts. This qualitative study was carried out with 12 student teachers. The student teachers were fourth-year students enrolled in the Special Teaching Methods II course in the spring semester of the 2010–2011 academic year. The research data were obtained from three types of data resources: lesson videos, lesson plans and reflection reports written by student teachers. The lesson videos, lesson plans and reflection reports were subjected to a descriptive analysis process. In the study, it was determined that some student teachers could not distinguish concept knowledge, had misconceptions and difficulty determining conceptual features and used incomplete or incorrect concept definitions. Moreover, the student teachers did not use examples and analogies effectively during teaching.

Keywords: ICT teaching, pedagogical content knowledge, ICT student teachers, teacher education

INTRODUCTION

Pedagogical Content Knowledge (PCK) was put forward by Shulman (1986) as one of the components of teacher knowledge and has a very important place in teacher training and evaluation practices today. For this reason, it remains an area of active research. There is a need for PCK studies in different fields (Hill, Rowan & Loewenberg Ball, 2005). One of these fields is Information and Communication Technologies (ICT).

Compared to other subjects, ICT is both new (Crawford, 1999; Woollard, 2005) and affected by rapid changes. Rapid change in the field of ICT creates a challenge for teachers (Webb, 2002). This leads to some negative results in relation to teachers' content knowledge and to their PCK. According to Webb and Cox (2004), there are deficiencies in ICT teachers' comprehension levels related to the field and in their content knowledge.

On the other hand, there are findings indicating that novice teachers and student teachers need support in their teaching of communication technologies. Student teachers may have insufficient knowledge about teaching methods (Webb & Cox, 2004; Arıkan, 2009). There was a difference between the approach that student teachers prefer for ICT and the approach that they used in the classroom (Hammond

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& Mumtaz, 2001). In a study evaluating student teachers as they designed student-centered activities, none of the student teachers applied the underlying principles of the recommended ICT teaching method completely during the study. The student teachers regarded such planning activities as challenging tasks that took a great deal of effort and time (Hadjerrouit, 2008).

And yet, in the field of PCK for ICT, one of the components of teaching knowledge was less defined than it was in other fields. PCK is always ignored in ICT. Despite an increase in the number of studies investigating the PCK of teachers and student teachers from different fields, there are still few studies and resources in the literature on ICT teaching (Webb, 2002; Hammond, 2004; Hadjerrouit, 2009). In relation to the ICT teaching and knowledge that learners need, Wood (2001) put forward the idea of woolly thinking. According to Webb (2002), too, the research base related to misconceptions about ICT and students' problems is limited.

The purpose of this study is to examine the PCK of ICT student teachers, taking into consideration what they do in the course of their teaching practices and how they apply it to the teaching profession.

State of the literature

- There is in need of for PCK studies which is one of the main components of pedagogical content knowledge from different fields. One of these fields is Information and Communication Technologies (ICT).
- Rapid changes in the field of ICT lead to some negative results in relation to teachers' and student teachers' PCK.
- Some studies have indicated that students know most about information technologies, but are deprived of the conceptual framework to organize their knowledge. For this reason, it is important to teach the concepts of ICT in accordance with the pedagogical principles.

Contribution of this paper to the literature

- Student teachers have difficulties such as understanding students' conceptual difficulties, determination of conceptual features, creating a concept definition, use of examples and analogies and evaluation. Most of student teachers use student-centered approach but have some difficulties in implementation of the approach.
- Findings of the study resemble with the findings of the researches about student teachers from ICT and other fields.
- This study shows the findings that entail the requirement that the difficulties which student teachers encounter in concept teaching should be considered one by one within the ICT course.

THEORETICAL FRAMEWORK

Shulman first put forth PCK as one of the basic components of teacher knowledge. According to Shulman (1987), "PCK represents the blending of content and pedagogy into an understanding of how particular topics, problems or issues are organized, represented and adapted to the diverse interests and abilities of learners and presented for instruction" (p.8). Teacher knowledge is based on PCK, and thus, it remains a critical component of teacher education (Rowan et al., 2001).

Grouws and Schultz (1996) stated that PCK includes useful demonstrations, combinations of ideas, explanatory examples and counter examples, useful analogies, important relationships and connections between ideas, but it is not limited to this list (p. 443). There have been various studies on the components of PCK. Some researcher defined "knowledge of measurement and evaluation" as a component of PCK (Hashweh, 2005; Magnusson, Krajcik & Borko, 1999; Tamir, 1988; Van Driel, Verloop & de Vos, 1998). Grossman (1990) and An, Kulm and Wu (2004) evaluated knowledge of a "teaching program" as a component of PCK as well. According to An, Kulm and Wu (2004), the other two components of PCK are "content and teaching knowledge". Moreover, according to Grossman (1990), in addition to teaching program knowledge, PCK includes knowledge about students' understanding and comprehension, teaching methods and teaching objectives.

After PCK was put forward by Shulman (1986) as a new component of teacher knowledge, many studies examining the subject from different perspectives were carried out. Some of these aimed to determine the PCK competencies of teachers and student teachers (Çalık & Aytar, 2013; Bal, 2011; Buss, 2010; Can & Akar-Vural,

2011; McCaughtry, 2005; Turnuklu & Yesildere, 2007). Others aimed to compare the PCK competencies of teachers from different countries (An, Kulm, & Wu, 2004; Shkedi, 1997; Shuhua, Gerald & Zhonghewu, 2004). In the literature, in addition to studies examining the effect of the amount and quality of teachers' content knowledge on PCK (Hill, Rowan & Loewenberg Ball, 2005; Käpylä, Heikkinen & Asunta, 2009), there are studies aiming to develop the PCK competencies of teachers and student teachers (Banks, 2008; Goodnough, 2006; Jones & Moreland, 2004). Rohaan, Taconis, and Jochems (2010) stated that although there are many models that focus on different areas of teacher knowledge, there is not sufficient evidence related to the interaction among these areas.

Heller, Daehler, Wong, Shinohara and Miratrix (2012) found that teachers who have both strong content knowledge and content-specific pedagogical knowledge provide a higher-quality education. It was determined that these teachers were better at asking students higher-level questions, providing correct explanations, discussing the content and encouraging students to think about practices, providing guidance to students facing difficulties and having opinions about student performance (Carlsen, 1993; Hashweh, 1987; Hill & Ball, 2009). In addition to in-class teaching, PCK affects teachers' approaches to lesson planning and evaluation as well (Escudero & Sanchez, 2002; Lloyd & Wilson, 1998).

Student teachers' PCK

One can found many researches in the literature from different disciplines relating to the determination the PCK of student teachers. The results of the research are grouped into categories according to the research questions and addressed below.

(1) Determining students' conceptual difficulties

In studies investigating whether students were aware of their misconceptions, it was found that the teachers who were content experts were more aware than those who were novices regarding content (Hashweh, 1987; Käpylä, Heikkinen & Asunta, 2009). Hogan, Rabinowitz and Craven III (2003) determined in a study based on the literature that the novice teachers did not attach importance to possible misconceptions about a phenomenon or a specific concept and failed to evaluate their students' misconceptions during the lesson. Similar findings were obtained from studies carried out with student teachers and beginning teachers from different disciplines (Bal, 2011; Boz & Boz; 2011; Çalık & Aytar, 2013; Özden, 2008; Turnuklu & Yesildere, 2007; Halim & Meerah, 2002; Frederik, Van der Valk, Leite, & Thorén, 1999), including ICT trainee teachers (Hadjerrouit, 2009).

The novice teachers not only had trouble determining students' conceptual difficulties but also had their own misconceptions (Hashweh, 1987; Smith & Neale, 1989). According to Hashweh (1987), student teachers with incorrect and insufficient knowledge might transfer those misconceptions to their students. Similar findings could be found within the relevant literature (Aydın, Demirdöğen, Tarkın, & Uzuntiryaki, 2009; Canbazoğlu, Demirelli & Kavak, 2010; Kaya, 2009; Kılınç & Salman, 2009; Ozden, 2008; Usak, Ozden, & Eilks, 2011).

Additionally, there are research results indicating that novice teachers have difficulty presenting concepts and ideas (Ball & Winson, 1990; Onslow, Beynon & Geddis, 1992). Attrops (2004) determined in a study that the experienced teachers had more depth and breadth of knowledge of teaching concepts than did beginning teachers.

(2) Orientation to teaching

Beginning teachers mainly used teacher-centered teaching approaches, but as they gained experience, they started to use student-centered teaching approaches

(Freiberg, 2002). Similarly, Torff (2003) indicated in a study carried out with novice, experienced and expert teachers that the experienced teachers used the learner-centered approaches more frequently. In a constructivism-related study investigating cognitive change observed in student teachers over time, Hollingsworth (1989) concluded that half of the participants in the study focused more on teacher-centered methods than on student-centered methods.

There are similar findings in the literature for ICT teaching. Hammond and Mumtaz's (2001) research found that the teaching approaches that student teachers preferred were not the same as those on which they focused. In a study investigating how to design student-centered activities, it was found that none of the student teachers could apply the underlying principles of the determined ICT teaching method completely on the first try (Hadjerrouit, 2008).

(3) Use of examples and analogies

In concept teaching, characteristics of examples might lead to correct or incorrect classifications (Karataş Coşkun, 2011). Woollard (2005) suggested that examples and analogies have an important place in training ICT teachers and in their PCK.

According to Bayazit (2011), the mathematics education student teachers had difficulty both using appropriate analogies and establishing semantic relationships between source concept and target concept. Also some science student teachers have difficulty in “the process of establishing the source-target relationship" while they are preparing analogies (Demir, Önen & Şahin, 2011). Likewise, Yerrick, Doster, Nugent, Parke and Crawley (2003) determined that the student selected features that were irrelevant to the target concepts when using analogies and also selected features that did not fit in the given analogies. In a study of ICT student teachers, Kaya and Durmuş (2011) found that the student teachers who were learning to prepare analogies mostly created verbal and picture analogies rather than narrative analogies.

(4) Evaluation

Teachers at the very beginning of their careers have a limited repertoire of evaluation strategies and very little experience with alternative evaluation tactics (Freiberg, 2002). According to findings obtained from studies of student teachers taking education courses at different universities in Turkey, student teachers do not have sufficient knowledge and skills about alternative measurement and evaluation techniques (Baştürk & Dönmez, 2011; Canbazoğlu, 2008; Mıhladız, 2010; Taşdere & Özsevgeç, 2012; Uşak, 2005). In a study of ICT student teachers by Seferoğlu (2004), it was found that the answers given by the student teachers to the competency items related to the measurement and evaluation of success were between "average and good". In another study Sasmaz, Oren, Ormancı and Evrekli (2011) found that although science and technology student teachers' self-efficacy levels in relation to alternative measurement and evaluation methods were high, the student teachers believed that they would have some difficulties applying those methods in practice.

ICT student teachers’ PCK

Teachers' conceptions about the nature and aim of the discipline strongly affect their PCK (Jones and Moreland, 2004; Hadjerrouit, 2009; Papastergiou, 2005). Moreland and Jones (2000) determined that teachers who regarded technology as an applied field could determine appropriate technological tasks for their students, but they had difficulty determining technological learning outcomes and technological knowledge related to those outcomes. Moreover, when they focused on tasks the teachers could not provide feedback to increase the students' performance levels at the conceptual and operational levels (Jones & Moreland, 2004). In a study also of mathematics teachers, it is determined that the teachers

emphasized operational knowledge related to the concept of equality rather than conceptual meaning in "equality concept" teaching (Attorps, 2004).

The concepts of a discipline are the means of that discipline. The teachers should know the nature of their own disciplines and should also understand the concepts relating to their own disciplines (Jones & Moreland, 2004). In addition to being effective technology users, ICT teachers also need to have a command of ICT concepts to be successful teachers (Zendler, McClung & Klaudt, 2012). In this context, Webb and Cox (2004) expressed that ICT teachers have insufficient concepts about the field. According to Hadjerrouit (2009), the focus is still on technical knowledge and reproduction of that knowledge rather than on conceptual understanding of ICT.

However ICT teachers in the field perceive information technologies mostly as a practical subject, they teach from this viewpoint. For this reason, their teaching does not help students to acquire a conceptual framework in relation to information technologies. Regarding the causes of this problem, Preston, Cox and Cox, (2000) pointed to insufficient training of ICT teaching and lack of appropriate content knowledge.

Moreover some studies have indicated that students know a lot about information technologies, but are deprived of the conceptual framework to organize their knowledge (Haberman, 2004; Nishida et al., 2009). Research findings have indicated for that conceptual understanding is a critical factor in both informatics learning and teaching success (Hadjerrouit, 2009). In a study, Jones and Moreland (1998) determined that the difficulties the teachers had in relation to planning and teaching stemmed from a lack of understanding of important basic concepts and practices (Jones & Moreland, 2004). For this reason, it is important both to be knowing concepts and principles and ICT teaching be performed in accordance with these pedagogical principles.

This study aims to determine ICT student teachers' PCK about concept teaching. Within this scope, answers were sought for the following questions:

1. Can student teachers determine concept(s) as a content type?
2. Can student teachers recognize their students' conceptual difficulties?
3. What difficulties do student teachers encounter in determining conceptual features and creating definition(s) of concept(s) they teach?
4. What difficulties do student teachers have when using examples and analogies in concept teaching?
5. What difficulties student teachers encounter in making evaluations?
6. Which teaching approach preferred mostly by student teachers and what difficulties they have in applying that approach?

METHOD

This study is a case study. Qualitative case studies involve investigation of one or a few cases deeply. A case can be an individual, an institution, a group or a situation (Yıldırım & Şimşek, 2013). This study is a case study carried out with a group of ICT student teacher in order to determine the difficulties which they encounter in teaching concept.

Participants

This study was carried out with 12 ICT student teachers. The student teachers were the fourth year students studying at the department of *Computer Education and Instructional Technology* (CEIT) and enrolled in the Special Teaching Methods II course in the spring 2011. Of the student teachers, 3 were female and 9 were male.

Data sources

The research data were obtained from three sources. The first source was the lesson videos that student teachers performed. Each student teacher's lesson has been video-recorded from beginning to end by a friend of his or her. Durations of the recorded lessons varied between 15 and 40 minutes.

Lesson plans of the recorded lessons were another data source. Student teachers prepared lesson plans of a single lesson (40 minutes) for different topics, which they had selected from among those included in the 4th, 5th and 6th stages. Before preparing the lesson plans, student teachers had been told that they would be able to benefit from the Teachers' Guidebooks, but would not be allowed to completely copy the content.

Reflection reports written by the student teachers after lessons were another source of data. The topics to be discussed in the reflection reports were given to the student teachers beforehand. They were asked to write down strengths and weaknesses of the plans they had prepared and what they acquired from the practice they had performed before the teaching practice. However, some student teachers did not follow this structure in reflection reports.

Data obtained from lesson plans and reflection reports were compared to the findings obtained from lesson videos, and used for triangulation purposes.

Data analysis

Video-recordings of the student teachers were transcribed by the researcher prior to the analysis. Then, each recording was subject to descriptive analysis processes by articulating the themes put forward by the research questions. Moreover, the videos were evaluated together with three student teacher groups who had taken the course of Special Teaching Methods II given by the researcher for three years within the framework of research study. This undergraduate level course aims to build student teachers' pedagogical field knowledge. This enabled the researcher to review the lesson videos many times. Moreover, each lesson video was evaluated by both the researcher and another student teacher (other than the one having video-recorded in the lesson) via a developed scale.

Cohen's Kappa, a profound indicator of inter-rater reliability, was calculated between the raters. The Cohen Kappa inter-rater agreement coefficient was found to be 0.92. Finally, the findings obtained from the videos were compared with the statements included in the lesson plans and reflection reports submitted by the student teachers.

RESULTS

The findings are shared under the titles regarding to research questions.

Determination of concept(s)

The first condition of doing a teaching according to content type is to determine the content and content types included in that content. Gagne (1985) classified learning outcomes as verbal information, mental skills, attitudes, motor skills and cognitive skills. According to his study, mental skills can be divided into sub-categories of discrimination, conceptual thinking, rule application and problem solving. Sometimes knowing a content type sets ground for learning other content types as well (Yalın, 2001). Determinability of concepts included in content is important for this reason.

The concepts that the student teachers explored during the study are listed in Table 1. As indicated in the table, while most of the concepts belong to the field of information technologies, others belong to other fields. Because the Information

Table 1. Concepts which the student teachers taught

ICT's concepts	Some concepts to different fields
File, folder, slide, presentation program, site map, computer virus, antivirus, virtual shopping, password and firewall, electronic spread sheet, search button, digital measurement, short cut keys (new line key, end of line key, form feed key, end of page key, right key shortcut menu key).	Publication, publishing and desktop publishing presentation, joker, paragraph

Table 2. The number of concept each student teacher taught

StudentTeacher	The number of concept encountered
Hüseyin, Hamza, Mehmet, Perihan, Ahmet, Döndü	1 concept
Emir, İbrahim, Tülin, Remzi, İskender	2 concepts
Sevgi	3 concepts
Metin	5 concepts

Technologies course program was prepared in accordance with the constructivist approach. Teachers in this program are expected to draw on real-life examples (Irmak, Ince, Senyuzlu & Ugur, 2008). This requires ICT teachers to have mastery over some concepts not only from their own field but also from other fields.

In this study the student teachers were obliged to work with different numbers of concepts. In terms of shedding light to the advancing sections, which student teacher was obliged to work with how many concepts was listed in Table 2.

Student teachers are expected to first of all determine concept(s) in the course content they are preparing and then do teach in accordance with this content type. In their course plans Tulin, Remzi, Iskender, Huseyin, Mehmet and Sevgi listed the objectives that they wanted the students to acquire by the end of the lesson. These objectives are evaluated as to determine of student teachers' concept(s) specifying skills. In this scope, of the student teachers, only Tulin, Remzi, Iskender and Sevgi both taught the concepts they had included the objectives and did concept teaching, albeit with some missing points. Tulin and Remzi prepared activity plans for the same objective. Below are excerpts from the plans of two student teachers, one that included concept knowledge in the objectives and one that did not.

> Tulin's expression (includes concept knowledge):
> "At the end of the lesson, students learned the concepts of presentation and slide."
> Iskender's expression (includes only psychomotor skills instead of concepts):
> "At the end of the lesson, students learned to create a new folder, rename a folder and create a shortcut."

In this study, when preparing their own lesson plans, the student teachers greatly benefited from the content framework of the activities included in the *Teachers' Guidebooks* (hereinafter referred to as the *guidebook*). In this scope, student teachers benefited these books but it was determined that they used different examples, analogies, materials and methods in their activities. Student teachers preferred to design specially the introduction sections of their lessons differently.

Due to the above-mentioned reasons, it was considered that in the study the guidebooks would have an effect on the student teachers' determining concepts. For this reason, besides lesson plans and videos, the activities in the guidebooks were taken into examination as well.

Within this scope, in the activity examples in the guidebooks, three factors which would serve a directive function were determined for the student teachers. First of these is the *explanations* including knowledge headings which the acquisition contains. As it is seen in the following example, explanations in some activities contain knowledge of concept.

Explanations- What the concepts of encryption and firewall are and how they are used is explained.

The second is the concepts included under the heading of *vocabulary knowledge* their *definitions* included in the activity. The last one is, as it is in the following examples, the guiding statements included in the activity flow and related to making concept definitions.

"Explain the concepts of file and folder in computer."

"Explain that there are slides in place of pages in presentation programs and each page is called a slide"

Within this scope, the activity of Tulin and Remzi, who listed the acquisitions in their lesson plans and gave place to concept learning in their acquisitions, included all the factors which we considered to be directive; Mehmet's activity included factors other than explanations; Sevgi's activity included only concept definitions. Moreover, the activities of Huseyin and Iskender not having given place to concept learning in their acquisitions included factors other than explanations. When the plan prepared by Huseyin, it was observed that he benefited greatly from the activity example in the guidebook in his lesson. Moreover, as it can be seen below, he also repeated greatly the acquisition in the guidebook when listing the acquisitions. However, Iskender listed psychomotor skills as the acquisitions in place of the concept included in it. Moreover, it was determined that this student teacher prepared a plan which was different from the activity in the guidebook.

The acquisition statement in the guidebook:

Students give examples in relation to the use of electronic spreadsheet and explain its using advantages.

The student teacher's acquisition statement:

At the end of the lesson, students express the aim, places and advantages of using the electronic spreadsheet program.

Starting from the findings explained until here, it can be stated that four of six student teachers have listed the acquisitions in their lesson plans (Tulin, Remzi, Mehmet and Sevgi) could define the concepts as a type of content. However, at this point, it should not also be ignored the directive effect of the activity examples included in the guidebooks. On the other hand, despite this effect, it can be stated that Huseyin and Iskender could not recognize the concept knowledge, but they did concept teaching by following the activity examples in the guidebook.

The findings in relation to the student teachers not having listed the acquisitions which they had expected the students to reach at the end of the lesson in their lesson plans are as follows. Emir and Metin's activity plans included all the factors related to the activities in the guidebook, but Ibrahim's plan included all the factors except for the explanations. All three student teachers did concept teaching in lessons and resorted to the activity examples in the guidebooks. These traces are clearly seen in the student teachers' plans and videos. This makes it difficult for us to draw a conclusion if the student teachers could tell concepts as a content type. Another interesting finding was that although the activity plan included all the factors which, we consider, were effective, Ahmet did not do concept teaching. In such a case, we can make the speculation that this student teacher was not aware of concepts as a content type.

However, for the two participant student teachers, the situation is different from the above-mentioned ones. In the activity examples in the guidebooks, no factors are available to direct these student teachers to recognize concept knowledge. In such cases, student teachers should determine concept/concepts via starting from the activities in relation to the acquisitions by themselves. Of the student teachers, Perihan could not even recognize the presence of a concept in the lesson which she did. It was determined that in her lesson Perihan, like the other student teachers, mostly followed the flow included in the activity plan in the guidebook. However,

Hamza, another student teacher, determined the presence of a concept in his activity. But he only included concept definition in his lesson.

Starting from all these findings, it can be stated that five student teachers (Tulin, Remzi, Mehmet Sevgi and Hamza) could recognize concept knowledge. Moreover, of these student teachers, only Hamza could achieve this without the directive effect of the guidebook. Again, starting from the research findings, it can be stated that four student teachers (Huseyin, Iskender, Ahmet and Perihan) could not recognize concept knowledge. Moreover, the guidebooks fell short of helping Huseyin, Iskender and Ahmet to recognize the concepts. However, it is difficult to draw a conclusion for the remaining three student teachers. For these student teachers mostly followed the activity examples included in the guidebooks when preparing their lesson plans. Moreover, in every case, it is possible to mention the effects of the activities included in the guidebooks. And at this point, it appears the necessity of preparing guidebooks more carefully and more qualified.

Related to this matter, the relevant literature includes teachers' conceptions about their own fields. These findings state the fact that ICT teachers regard ICT as an applied subject (Hammond, 2004; Webb & Cox, 2004; Hadjerrouit, 2009). It can be mentioned in this research such a possibility just for Iskender. He listed the psychomotor skills as objective instead of the concept in the content.

Similar findings were noted in studies of fields other than ICT. In a study with technology teachers, Jones and Moreland (2004) found that the teachers had difficulty determining learning outcomes and technological knowledge related to learning outcomes. Similarly, Attorps (2004) determined in a study with mathematics teachers that the teachers emphasized the operant knowledge related to the concept of equality rather than conceptual meaning in "equality" teaching.

Determining students' conceptual difficulties

When doing concept teaching, teachers need to determine and correct any student misconceptions. In this study, Sevgi and Hamza could not identify their students' conceptual difficulties. The concepts that both student teachers taught are not in ICT. When Sevgi was teaching the concept of *publication*, her four students gave the following examples related to that concept at different times:

> Sevgi: OK, Do you know any other publication types?
> Sdutent 1: Computer.
> Sevgi: Computer and then.
> Student2: TV.
> Student 3: Phone.
> Sevgi: TV. Yes.
> Student 4: Telegraph.
> Sevgi. That's OK, telegraph could also be accepted as a type of publication.

Some examples that the students gave (telephone, telegram, computer, TV) were not proper for the publication concept. Sevgi used yet the students' incorrect examples when presenting her own concept definitions. Sevgi's statement is given below. In this respect, Sevgi's inability to identify the students' conceptual difficulties might have been related to her own conceptualization difficulty. Naturally, Sevgi could not correct the errors that she could not identify.

> Sevgi: How do we call such tools as paper, journal, TV and radio which used for share information? We say publication.
> Student 1: Publication.
> Sevgi: We say publication.
> Student 2: Publication.

Moreover, Hamza taught the concept of *virtual shopping*. Two of Hamza's students gave incomplete and incorrect concept definitions, as seen below.

Hamza: ……What is virtual shopping?
Student 1: Things which can be made over the Internet without going to supermarkets and bought via credit card so reassignment checks. I mean, virtual shopping means buying something over the Internet.
Hamza: Shopping over the Internet without going to the shops. Yes.
Student 2: Selling products in a shop over the Internet as first-hand, second-hand, third-hand by making promotions.

Hamza did not provide any feedback or correct the students' statements. At this stage, Hamza did not use any activity related to concept teaching other than providing a definition. Rather, he continued the lesson by presenting verbal information about the concept. However, at the same time, the concept provided a basis for learning information that was presented orally. For this reason, it has critical importance. A dialog has occurred between Hamza and his student as seen below when Hamza was providing verbal information about the concept. The student asked a question about how to make payments in virtual shopping, which was considered irrelevant to what was being taught.

Student: Teacher, can I ask a question? How does he make the payment on the computer?
Hamza: He pays by credit card.
Student: Where does he insert the credit card?

Some student teachers' students confused two similar concepts from time to time. Remzi and Iskender were able to identify these types of difficulties, but they only used feedback to point out the mistake during the lesson.

Remzi: ..... Well, what is a "slide"?
Student: A five- or six-page writing composed a picture story about a topic. It is composed of pictures.
Remzi: Is this a slide or a "presentation"? Let's learn the "slide" first. Who knows the definition of "slide"?
Iskender: Who can define a "folder" or what do you think a "folder" is?
Student: For example, we can write about our special days.
Iskender: Do not confuse a folder with a file; a file is different from a folder.

However it is determined, Remzi and Tulin, as their students did, used similar concepts interchangeably from time to time. It can be concluded that the student teachers reflected their own misconceptions to the students.

Example 1 (Remzi):
Remzi: Friends, now we have three nice slides (here the student teacher is using slide instead of presentation).
Example 2 (Remzi):
Remzi: Very well. I mean we call a slide a page and a presentation a big …composed of these pages.
Student: But, teacher, presentations might also be prepared on paper. Do we always have to prepare them on computer?
Remzi: How come? But I'm talking for this program. In this program, a presentation is a window covering all of them. For example, you are presenting your knowledge, aren't you? What is among your knowledge? Aren't there pages, friends? Yes, there are, aren't there? A presentation is the place where we present all of them, and pages are slides. We good?
Example 3(Tulin):

> Tulin: One is prepared in the form of "display" (the student teacher is using "display" in place of "presentation"), and the other is prepared in the form of book.

For example, Remzi mistakenly used the concept of *display* in place of the concept of *presentation*. However, a student in the classroom noticed this and tried to point it out by saying was that presentations can be made in different ways (by reading from sheets of paper or using a slide projector). However, because Remzi had not recognized the mistake he had made, he continued to define the concept of presentation by starting from the concept of a slide in the continuation of the dialogue. The definition he provided was incorrect, and at that point Remzi had to introduce the concept of *display*, which he had not mentioned previously. Trying to teach the same concepts, Tulin did not focus on this concept, either. This example shows us the necessity of teaching the concepts of *slide*, *presentation* and *display* together. It should be noted however that in the activity included in the guide, only the teaching of the concepts of slide and presentation were emphasized; the concept of display was put aside.

The findings above are consistent with the findings relating to both ICT student teachers (Hadjerrouit, 2009) and student teachers from other disciplines (Bal, 2011; Calık & Aytar, 2013; Özden, 2008; Turnuklu & Yesildere, 2007; Halim & Meerah, 2002; Frederik, Van der Valk, Leite, & Thorén, 1999). Some findings of this research points out that student teachers may also have misconceptions. Hashweh (1987) and Smith and Neale (1989) point to similar findings. There are many similar findings in the literature (Aydın, Demirdöğen, Tarkın, & Uzuntiryaki, 2009; Canbazoğlu, Demirelli, & Kavak, 2010; Kaya, 2009; Kılınç & Salman, 2009; Özden, 2008; Usak, Ozden & Eilks, 2011). According to Hasweh (1987) student teachers who have incorrect and insufficient knowledge might be transferring their own misconceptions to their students. Some findings supporting this view were obtained from this study.

Determination of conceptual features and creating a concept definition

In that study, it was determined that the student teachers had four types of difficulties in relation to the determination of conceptual features: Inability to determine conceptual features (Ibrahim and Mehmet); incomplete determination of conceptual features (Remzi, Hamza, Sevgi, Iskender, Huseyin); inability to systematize and emphasize features of concepts (Remzi, Hamza, Sevgi, Iskender, Huseyin, Emir); and inability to demonstrate all the conceptual features with examples (Remzi, Hamza, Sevgi, Iskender, Huseyin, Emir, Ibrahim). Only Tulin was able to determine conceptual features.

In this study, when evaluating the student teachers' concept definitions, the ones based on only one distinguishing feature of concepts were evaluated as incomplete and those that did not provide distinguishing features of concepts clearly were evaluated as ambiguous. The student teachers who used the definitions from guidebooks were excluded. Based on this, it was determined that the definitions given by Remzi and Sevgi, who gave definitions based on the levels of the students were incomplete. Those provided by Mehmet and Iskender were ambiguous. The incomplete definitions belonged to out-of-field concepts and the ambiguous definitions belonged to field concepts. It was observed that when teaching a concept within the field, Iskender shared its relationship to daily life with the students, but Ibrahim did not place the concept definitions in context in the lesson.

The concepts that Tulin, Remzi, Sevgi and Ibrahim taught were from outside the field (presentation, publication, publishing, wildcard), but the concept that Mehmet taught was from the field of ICT (sitemap). It was determined that Sevgi and Mehmet used wrong examples. Sevgi also accepted wrong examples from students and then

used those wrong examples when presenting her own concept definition. In this respect, it can be stated that the student teacher had a conceptual difficulty.

> Example for the incomplete definition:
> We call means which humans use to share their information publication. (Sevgi)
> Example for the ambiguous definition:
> In website, too, there is a roadmap helping us to find our way. We call this sitemap. (Mehmet)

In the study, it was determined that some student teachers also had difficulty in determining, emphasizing and exemplifying the distinctive features of concepts. This may have affected the process by which the student teachers created concept definitions as well. Referencing various publications, Klausmeier (1990, 95-97) concluded that experts determine meanings of words related to their fields of specialization based on descriptive features of concepts, whereas less-experience people do not do this. When experts who have acquired concepts at a certain level are excluded from the analysis, it is observed that knowledge insufficiencies related to descriptive features are common. Novice teachers have difficulty presenting concepts and ideas (Ball & Winson, 1990; Onslow, Beynon & Geddis, 1992). Attrops (2004) determined in a study that the experienced teachers had more depth and breadth of knowledge of teaching concepts than did beginning teachers.

Use of examples and analogies

When examples are used correctly in teaching all content types, they serve as cognitive support (Deryakulu, 2006). However, the quality of the examples might lead to correct or incorrect classifications in concept teaching (Karataş Coşkun, 2011). In this study, it was determined that Tulin, Remzi, Sevgi, Metin, Ibrahim, Hamza and Huseyin made use of examples in concept teaching. Mehmet forgot to demonstrate the examples mentioned in his plan during teaching. All of the student teachers made use of projectors in the laboratory where they performed their lessons when presenting examples.

The mistakes that the student teachers made when using examples were (a) time of giving example, (b) insufficient number of examples, and (c) choosing wrong examples. It was determined that Sevgi accepted two examples that the students gave that did not belong to the concept and Tulin presented examples that did not conform to the concept definition. This makes us conclude that the student teachers did not have sufficient knowledge of concept.

The above-mentioned mistakes are explained in order below along with examples from reflection reports and lesson videos.

(a) Time of giving example

Of the student teachers, Hamza made a bad timing decision when giving examples. For this reason, his examples were not effective.

(b) Insufficient number of examples

Here providing a single example during teaching was evaluated as *presenting an insufficient number of examples*. In this area, Metin, Remzi and Ibrahim provided insufficient numbers of examples during their lesson. Below are some excerpts from their reflection reports.

> ".....I can consolidate what students learn with a few examples instead of a single example". (Metin)
> "Here we may not have been content with a single example but instead could give more examples and discuss differences between these." (Remzi)

> "I should have increased the number of examples which I used for wild cards." (Ibrahim)

Moreover, Iskender who used a single example related to the concept stated the reason for this in his/her report as follows. Contrary to the reason that this student teacher provided, it was determined that he/she only used half of the time which he/she had planned for concept teaching.

> "Many examples from daily life could have been given in relation to the concept of folder, it is impossible when you consider the duration of lesson." (Iskender)

(c) Choosing the wrong example

Of the participant student teachers, Mehmet, Tulin, and Sevgi (the wrong examples given by the student teacher are given above) presented incorrect examples during the lesson. Another finding is that Tulin presented wrong examples though she uses the definition from guide book in her class. This may be caused by her insufficient knowledge of the concept. A student's reaction to the incorrect example presented by Mehmet is given below.

> Student: But teacher, how can we understand where we are on the map?

Mehmet, Emir, Ibrahim, Iskender, and Metin made use of analogies in teaching concepts. The student teachers used 2 simple, 4 picture and 2 story-type analogies in teaching concepts and one simple and one story type analogy in giving verbal information. It was observed that Mehmet and Iskender did not give the students target concept examples even though there was a computer and projector in the classroom. They tried to explain or have the students explain relationships between source concept and target concept verbally. This affected the teaching in a negative way and also indicated that the student teachers could not use the projector in their classrooms effectively.

In the study, Emir, Ibrahim, and Metin used analogies in the warm-up section of the lesson. It was observed that student teachers tried to have the students participate in the lesson by using questions based on the analogies provided.

Examples and analogies have an important place in training ICT teachers and expanding their PCK (Woollard, 2005). Success at using analogies depends not only on using analogies appropriate in terms of content but also on understanding the semantic relationships and similarities between the analogy and the target concept (English, 1997; cited by Bayazit, 2011).

Therefore in this study, the validity of the analogies the the student teachers used was evaluated from two perspectives. First, it was determined whether the analogy represented the target concept (Bayazit & Ubuz, 2008). When looked at from this perspective, it was observed that the source concept examples that Mehmet and Iskender used did not represent the target concept accurately. For this reason, Mehmet had difficulty helping the students set up relationships between the concepts and understanding the concept definition. Moreover, Mehmet did not show the students the concept examples after the analogies as planned. Because the second concept example that Iskender demonstrated using the projector was not suitable for the level of the students and could not be easily seen by the students in the laboratory environment because of the light-colored curtains, it was not a valid example for the source concept.

Second, the validity of the analogies were examined in terms of the knowledge transfer process from the source concept to the target concept and the extent to which the student teachers used semantic relationships between these two structures (Bayazit & Ubuz, 2008). When looked in from this perspective, it was observed that all the student teachers except for one were not successful.

These findings are similar to those obtained from studies of student teachers in different disciplines (Bayazit, 2011; Demir, Önen & Şahin, 2011; Yerrick et al., 2003).

Difficulties that student teachers face when using analogies might affect students' learning achievements as well. It determined in a study by Yerrick et al. (2003) that student teachers matched inappropriate features in analogies they provided to their students. In this context, Treagust, Harrison and Venville (1998) pointed to the fact that teachers should do careful and systematic pedagogical planning to use analogies effectively during their teaching career.

Evaluation

A teacher should determine whether concepts have been learned correctly and sufficiently at the end of the concept teaching process. In the study, it was concluded that Mehmet, Remzi, Iskender, and Sevgi, when teaching psychomotor skills together with concept knowledge, evaluated only the psychomotor skills and excluded concept knowledge when evaluating their lessons. In order to evaluate the learned concepts, the ones who teach concept, Huseyin, Tulin and Metin conducted verbal assessments, Emir and Ibrahim used yet written evaluations. In the evaluations, the students were asked to repeat only their verbal knowledge related to the concepts. From this perspective, the evaluations that the student teachers conducted aimed to measure the rote knowledge, leading to the conclusion that the student teachers had difficulty evaluating concept knowledge.

In the study carried out by Seferoğlu (2004) with ICT student teachers, it was determined that the means of the answers given by the student teachers to the competency items related to the measurement and evaluation of success varied between "average and good". Similar findings were obtained from studies made in Turkey with student teachers from different disciplines as well (Baştürk & Dönmez, 2011; Canbazoğlu, 2008; Mıhladız, 2010; Taşdere & Özsevgeç, 2012; Uşak, 2005).

According to Freiberg, very beginning teachers have a limited repertory of evaluation strategies and very little previous experience about alternative evaluation. In the study made by Sasmaz et al., (2011), although the self-efficacy levels of the science and technology student teachers related to alternative evaluation methods were determined to be high, they believed that they would have difficulty practicing some of the mentioned approaches. In this respect, having theoretical knowledge and the skill of putting theory into practice should be evaluated as different things.

Orientation to teaching

One of the basic approaches followed in concept teaching is the order of presentation. In this approach, the teaching strategies used and the presentation order of activities that are a part of these strategies are taken into consideration. There are two common approaches: inductive and deductive. The steps followed in the inductive approach are: (a) The teacher provides students with examples; (b) Students determine conceptual features; (c) Students create definitions; (d) The teacher gives different and counter examples; (e) Students associate the basic features they determined with superordinate concepts; (f) The teacher supports learning by consolidating new examples. This approach is also called a "student-centered approach". The steps in the deductive approach are: (a) The teacher gives the definition verbally or writes on the board; (b) The teacher explains ambiguous and confusing terms included in the definition; (c) Students determine features; (d) Students associate the given definition with examples. This approach is also called a "teacher-centered approach" (Şimşek, 2006).

In this study, it was determined that Tulin, Remzi and Sevgi started the lesson by giving concept examples and Iskender, Mehmet, Ibrahim and Emir started the lesson by giving analogy examples relating to the concept. In the inductive approach, after the teacher provides students with concept examples, students determine

conceptual features and from those features they create concept definitions. In this study, it was determined that these student teachers could not perform the steps of the inductive approach as required. In the steps following the example demonstration, things that were the responsibility of students were actually performed by the student teachers. Moreover, although there was a projector in the classroom, the student teachers using analogy examples did not show pictures and/or examples belonging to the concepts learned during teaching. In the study only Tulin performed the steps of the inductive strategy correctly. Tulin explained how he performed this strategy in the lesson in his reflection report as follows:

Tulin: "In order to activate the students' high level thinking skills and have them associate knowledge, I tried to use the method of discovery learning. Instead of giving the students information directly, I tried to emphasize important points on examples and then have created definitions by themselves via these examples."

In the study, it was determined that Huseyin and Hamza started concept teaching by giving concept definitions, which is the first step of the deductive approach. Hamza presented concept definitions verbally, whereas Huseyin did so in writing. The student teachers mentioned features of the concepts indirectly after they had provided the concept definitions and then gave examples for the concepts.

All the lesson plans and observations of teaching evaluated in this study were first attempts by the student teachers. The majority of the student teachers resorted to the inductive approach in their work, but they had difficulty employing the approach. For this reason, the teaching conducted by the student teachers moved away from student-centered approach and toward the teacher-centered approach. This finding is consistent with that obtained by Hadjerrouit (2008). In a study where Hadjerrouit (2008) taught how to design student-centered activities, none of the student teachers could apply the underlying principles of the ICT teaching method completely on the first try. Hammond and Mumtaz (2001) determined in a study that the teaching approach that the student teachers preferred and the one that they used in the IT lesson were different.

Freiberg (2002) stated that beginning teachers mostly use teacher-centered approaches, but as they gain experience over time, they learn to use student-centered teaching approaches. In a study of novice, experienced and expert teachers, Torff (2003) showed in this context that the expert teachers employed learner-centered approaches more frequently. In a constructivism-related study investigating cognitive change observed in student teachers over time, Hollingsworth (1989) concluded that half of the participants in the study focused more on teacher-centered methods than on student-centered methods**.**

CONCLUSIONS

First of all, it can be stated that some ICT student teachers had difficulties in pedagogical content knowledge. It is stated in the literature that ICT teachers regarded ICT as an applied subject (Hammond, 2004; Webb & Cox, 2004; Hadjerrouit, 2009). Not enough data could found in the current study to support the literature; however, the possibility should not be ignored. According to Jones and Moreland (2004), teachers' understanding and conceptions about the discipline (field) strongly affect their PCK. For that reason, when training ICT teachers, their conceptions related to the field should be taken into consideration.

In this scope, concept knowledge and content types should be taught separately at the undergraduate level courses aiming to teach ICT. Jones and Moreland (2004) utilized a plan to draw technology teachers' attention to the conceptual, operational, social and technical aspects of technology. Such frames of plan can be used during the teacher training programs. Difficulties faced by student teachers should be

judged and eliminated one by one also through the teacher training programs. Furthermore, opportunities should be created for students to put into practice what they learned.

It is found in this study that the student teachers have difficulties such as understanding students' conceptual difficulties, determination of conceptual features, creating a concept definition, use of examples and analogies and evaluation. Researches carried out with the student teachers in the field ICT are yet very limited. It is needed more research in order to determine in full the relevant difficulties. The results acquired from such researches should be taken into consideration in the courses of ICT teaching. It should be in this respect noticed especially to make more practice with the student teachers. The difficulties related to ICT student teachers listed above under tree sub-heading are valid for novice and student teachers from other fields (Attrops, 2004; Bal & Winson, 1990; Bal, 2011; Bayazit, 2011; Çalık & Aytar, 2013; Demir, Önen & Şahin, 2011; Onslow, Beynon & Giddis, 1992; Yerrick, Doster, Nugent, Parke, & Crawley , 2003). There are some other agents out of experience that constrain the ICT students in teaching concept. One of these constrain is to have to being in teaching some concepts form out of his/her field. The second one is being introduced the new concept because of the rapid changed in the field. That is why the relevant institutions should update their courses contents in accordance with the changes in the field.

The other finding concluded from this research is that most of student teachers use student-centered approach but have some difficulties in implementation of the approach. In Hadjerrouit (2008) research by which he intended to develop student-centered activities any student teacher could not apply exactly the underlined principles of the ICT teaching method in their first experiment. The students should have much occasion by which they could practice more sample cases in the courses of ICT teaching throughout their undergraduate learning.

Another finding of this study relates to the effects of guide books. Student teachers in this study followed the examples in the guide books when preparing course plans. This study shows that such guide books should be prepared more carefully and eligibly.

On the other hand, this study was carried out with a limited number of student teachers and concepts. Future studies are due plunging more into the difficulties student teachers face in the field of ICT teaching. Findings obtained from such studies can be useful in enhancing teacher training programs. Similar research should also be encouraged about ICT teachers.

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