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Comparing the Feedback of University Supervisor and Cooperating Teachers for Preservice Science Teachers within the Scope of Pedagogical Content Knowledge

Fen Bilimleri Öğretmen Adaylarına Uygulama Öğretmenleri ve Uygulama Öğretim Elemanı tarafından verilen Geribildirimlerin Pedagojik Alan Bilgisi Kapsamında Karşılaştırılması

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ABSTRACT: To comprehend the perspectives of school and university mentors in evaluating practicum experiences based on educational reform, this study aimed to investigate the feedback, within the framework of pedagogical content knowledge, provided by two cooperating teachers and a university supervisor to preservice teachers. Observation and document were used for data collection. Data collected within the context of the Teaching Practice course were analyzed deductively, considering the components of pedagogical content knowledge. Findings showed that although feedback given by mentors was positive or corrective, specific changes suggested by mentors about the preservice teachers' teaching practices were rather corrective. Although mentors' feedback seems to be concentrated in the fields of 'instructional strategies and representation' and 'pedagogy,' the majority of feedback provided in other PCK components points out those mentors focused on student learning within the knowledge of 'student understanding'. Feedback indicated that mentors especially attached importance to students' understanding of the subject and active participation in the learning, which are the goals of a science teaching program. The other aims of teaching based on inquiry and students' self-responsibilities in learning seemed to be in the background. Although mentors' feedback pointed out some differences in the categories of curriculum and assessment, they were consistent in general.

Keywords: Feedback, pedagogical content knowledge, university supervisor, cooperating teacher, science, preservice teacher, teaching practice.

ÖZ: Reformlara dayalı öğretmenlik uygulamalarını değerlendirmede okul ve üniversite danışmanlarının bakış açılarını anlamak amacıyla bu çalışma ile iki uygulama öğretmeni ve bir uygulama öğretim elemanının fen bilimleri öğretmen adaylarına pedagojik alan bilgisi kapsamında verdikleri geribildirimlerkarşılaştırılmıştır. Gözlem ve doküman veri toplama araçları olarak kullanılmıştır. Öğretmenlik uygulaması dersi kapsamında toplanan veriler pedagojik alan bilgisi (PAB) bileşenleri dikkate alınarak tümden gelimli içerik analizi ile çözümlenmiştir. Bulgular danışmanların hem negatif (düzeltici) hem de pozitif geri bildirimler vermelerine karşın, adayların öğretimlerine ilişkin detaylı önerilerinin çoğunlukla düzeltici yönde olduğunu göstermiştir. Danışmanların geri bildirimleri 'öğretim yöntemleri ve sunum' ile 'pedagoji' bileşenlerine odaklanmış gibi görünse de, tüm kategorilerdeki geri bildirimlerin 'öğrenci anlaması' bileşeni çerçevesindeki öğrenci öğrenmesine odaklandığı sonucuna varılmıştır. Geri bildirimlerin fen öğretim programının amaçlarından özellikle öğrencilerin konuyu anlamaları ve öğretim sürecine aktif olarak katılmaları ile ilgili olduğu, sorgulamaya dayalı öğretim ve öğrencilerin kendi öğrenmelerinden sorumlu olma amaçlarının geri planda kaldığı görünmektedir. Danışmanların geri bildirimleri, program ve değerlendirme bileşenleri için bazı farklılıklar gösterse de genel olarak uyumlu görünmektedir.

Anahtar kelimeler: Geribildirim, pedagojik alan bilgisi, uygulama öğretim elemanı, uygulama öğretmeni, fen, öğretmen adayı, öğretmenlik uygulaması.

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Developments in science and technology, changing needs of individuals and society and improvements in learning/teaching approaches require changes in expectations from students, preservice teachers, teachers, and teacher educators. Students are expected to grow up as individuals who can use information functionally, solve problems, and inquire. The science curriculum requires primary school teachers to ensure the active participation of students in the learning process as they are responsible for their own learning and to use learning strategies based on inquiry and knowledge transfer (Ministry of National Education [MoNE], 2018a). The reflection of reforms/innovations in the field of education to the learning environment is closely related to the qualifications and competencies of the teachers who guide this process. Teachers who will train students with these qualifications have to design the education process effectively and have professional skills as well as deep knowledge in their field. MoNE (2017), which has the feature of reference text in the regulation of the curriculum of higher education institutions that train preservice teachers in Turkey, in the preservice teacher training process and in the candidacy processes such as teaching practice, is defined as 'professional knowledge', 'professional skills' and 'attitudes and values'.

Pedagogical content knowledge (PCK) in the field of professional knowledge is seen as a teacher's ability to organize the concept or the subject according to the characteristics of learners and learning environments. PCK was described by Shulman (1987) as a special amalgam of content and pedagogy, and his definition includes two components: knowledge of instructional strategies and knowledge of students' understanding of the topics. This classification was extended by various research with other components, i.e., pedagogical knowledge, curriculum knowledge, and assessment knowledge (Jing-Jing, 2014). According to general competencies for teaching profession (MoNE, 2017), teachers should have professional knowledge and exhibit the knowledge and skills to deliver instruction effectively.

It is expected that preservice teachers (PTs) would develop and integrate their knowledge, skills, and attitudes gained in theoretical courses in the teacher training programs. The practicum field experience in teacher education is one of the major steps and influential factors in the preparation of preservice teachers (Badger, 2012; Steadman & Brown, 2011; Vertemara & Flushman, 2017). It gives PTs an opportunity to apply the theoretical concepts learned in the university classroom to the primary/secondary school classroom (Eck & Ramsey, 2019) and establish collaborative contexts for interactions among preservice teachers (PTs), cooperative teachers (CTs) and university supervisors (USs) who are putting into practice the ways of thinking, doing, and speaking advocated by reform documents (Van Zee et al., 2003). Throughout this experience, the PTs interact with the CT and the US, forming a cooperative triad that has a corrective role in implementing educational reform (Asplin & Marks, 2013). PTs are in a position to function as agents of reform, and mentors have a noticeable role in determining whether novices enact desired reform-based teaching practices and help spread these practices in their schools (Davis et al., 2006; Koballa & Bradbury, 2012). Because mentors are especially important in helping PTs to reflect upon their teaching and in providing access to a range of knowledge areas to assist PTs in their professional development, mentoring has come to be viewed as a means of reforming science teaching (Clarke et al., 2014; Koballa & Bradbury, 2012; Sandvik et al., 2019). USs

who serve as mentors share the responsibility of guiding PTs with CTs about reform-based science teaching and creating a connection between the practice schools and the university by visiting the schools (Vertemara & Flushman, 2017). They are expected to support PTs' implementation of theories learned in coursework with appropriate feedback to provide and enrich learning and skill development opportunities in the final stage of teacher preparation (Fernandez & Erbilgin, 2009; Hudson, 2014; Steadman & Brown, 2011). Although each group in the cooperative learning triad has a distinctive and complementary role to play in the teaching experience, the working relationship between them should be a close one that embodies parity of esteem and respects the contributions of all the partners (González-Toro et al., 2020). However, the practicum field experience is generally criticized (Grudnoff, 2011; Wilson, 2006) about the lack of partnership contacts between CTs and USs (Portelance et al., 2016; Sim, 2010), how theory and practice are reconciled in field experience (Allen et al., 2010; MacDougall et al., 2013) and a relative consensus between USs and CTs over what constitutes proper performance, professionalism and practice for maintaining professional consistency (Darling-Hammond, 2006). For example, even if PTs enter the classrooms with reform-based ideas about teaching and guided by CTs who rather value traditional notions of science teaching, the guidance constrains innovation and shapes the new teacher to fit the norms of the school (Bradbury & Koballa, 2007; Wilson, 2006). A few of the reasons for this are that PTs believe that classroom teachers have more realistic experience than their education faculty tutors, who are viewed as inspectors rather than collaborative partners (Asplin & Marks, 2013). For these reasons, it can be said that science teaching orientations of PTs affected shaped in the direction of reform-based approaches in teacher training programs are open to changes under the influence of CTs not meeting the expectations of reform-based science curriculum (Bates & Burbank, 2008; Hanuscin et al., 2011). On the other hand, it is emphasized that the role of the CT within the triad is secondary because the university is the final authority in the PTs' success (Clarke et al., 2014; Van Zee et al., 2003). Although the roles CTs and USs are distinct and/or changing, they are complementary in that the combination of their respective specific characteristics allows for consistency in student training (Burns et al., 2016; Portelance et al., 2016). For this, in a practicum experience, professional consistency is important for USs and CTs to share a relative consensus over what constitutes proper performance, professionalism, and practice (Darling-Hammond, 2006; Smith & Lev-Ari, 2005).

Regulation on the Teaching Practice of PTs in Educational Institutions affiliated with the Ministry of National Education requires each PT to receive teaching practice at the appointed school under the guidance of an experienced teacher by means of 'Teaching Practice' courses taken. When the Teaching Practice course is completed, PTs will be able to reach the competencies of the teaching profession by teaching classes with various levels in the practice school. PTs are evaluated at least four times each semester under the supervision of the CT and the instructor (MoNE, 2018b). The number of PT must be a maximum of four for school teachers and a maximum of eight for instructors. The CT evaluates the performance of the PTs in teaching experience with a weight of 70% and by the US with a weight of 30%. Although this regulation aimed to obtain coordination between CT, US, and PT in practice school activities, research studies on teaching experience in Turkey pointed out a lack of communication

and cooperation between the CTs and USs (Arkün-Kocadere & Askar, 2013; Polat et al., 2020; Topkaya et al., 2012) and PTs' concerns arising from gaps between supervisors and mentors' expectations (Paker, 2008). Inconsistency between the CTs and the USs and multiple perspectives suggested during the teaching experience by mentors can lead to conflicting messages for the PTs (Hudson, 2016; Tillema, 2009; Yayli, 2008). It is clear that to reinforce the reform-based teaching practices espoused in the preservice program for the school context, there should be close partnerships between universities and schools (Bradbury, 2010). Despite the emphasis on the need for harmonization between the interventions of CTs and USs (Portelance et al., 2016), certain obstacles, such as summative examinations consisting of memory recall, are inconsistent with learner-centred education with its origins in constructivism advocated by changed science curricula causes inconsistencies between them (Hume & Coll, 2007; Ranade, 2008). However, even if educational reforms match assessment methods, adequate teacher professional development is required to implement new curricula (Coll & Taylor, 2012). For instance, CTs need to know how to continue with the teaching practice in the new curriculum, i.e., what learner-centered education actually means in terms of teaching practice. Becoming a CT in the triad partnership provides an opportunity to reach new knowledge and tenets of reform-based science teaching as a result of interaction with faculty tutors (Clarke et al. 2014). This is an important aspect of the professional development of experienced science teachers who agree to serve as CTs but who might not be well-versed in the tenets of reform-based science teaching (Koballa & Bradbury, 2012).

One of the most effective ways to investigate the efforts of mentors to promote reform-based science teaching would be by examining feedback from CTs and USs following a teaching episode (Burbank et al., 2016; Sim, 2010; Tarekegn et al., 2020). PTs value feedback from CTs and USs within the frame of practicum field experience because they contribute to their perception of instruction, subject matter, and student learning and may affect a PT's decision to change or develop a practice (Hudson, 2016; Smith & Lev-Ari, 2005). With effective scaffolding and feedback, PTs can move from simplistic perspectives about the causes of classroom events to more expert understandings of how aspects of teaching and student development influence learning (Badger, 2012). Performance-based feedback to PTs is especially directly related to observed actions, and they are effective in practicum field experience, which improves teaching activities (Cornelius & Nagro, 2014). In spite of feedback providing is claimed to be useful in developing the teaching skills of PTs and making them competent (Chawla & Thukral, 2011; Hattie & Timperley, 2007; Tarekegn et al., 2020), some USs and CTs participating in mentoring did not supply enough feedback (Polat et al., 2020; Saka, 2019). Studies on feedback from USs and CTs (Nguyen, 2009; González-Toro et al., 2020; Tillema, 2009; Puttick & Wynn, 2020; Won et al., 2019) emphasized that the importance of training USs and CTs on how to effectively provide feedback. For example, Nguyen (2009) showed that the triad members were able to create a supportive environment when they communicated their areas of strengths and improvement to preservice teachers in a timely manner. Because immediate feedback reduces the practice of errors and provides correction before it is forgotten (Scheeler, 2008), examining feedback from school-based and university-based mentors concomitantly in teaching placement suggests that collect data of various triad meetings to more deeply

examine the giving/receiving of feedback by each member (Won et al., 2019). In this scope, while some studies focused on the feedback of cooperating teachers (Eck & Ramsey, 2019; Gurl, 2019; Jones et al., 2014; Matsko et al., 2020), others on university supervisors (Asplin & Marks, 2013; Bunton et al., 2002; Holbrook, 2022; Kastberg et al., 2020; Ritter et al., 2011). Research focusing on mentors' feedback pointed out that differences in mentor feedback can be a mismatch in mentors' expectations (Bradbury & Koballa, 2007; Hudson, 2014, 2016; Soares & Lock, 2007; Tillema, 2009). For instance, Soares and Lock (2007) demonstrated the differences in feedback provided by supervisors, with classroom management as a stronger focus than content knowledge or references to the lesson objectives. Kahan et al. (2003) compared the feedback profiles of CTs supervising the same PT and revealed different reasons for divergent feedback profiles. Because feedback influencing PTs' professional development reflects mentors' ability to review lesson plans, observe teaching, and provide constructive criticism about the teaching process (Hudson et al., 2005; Tarekegn et al., 2020), investigating the lesson observation feedback will give insight into the perspectives of CTs and USs. Therefore, this study aimed to investigate what feedback based on observation from CTs and the US provided for PTs to understand the perspectives of school and university-based mentors. Therefore, answers were sought for the following research questions:

1. What kind of feedback within the scope of PCK components did cooperating teachers and university supervisors provide to science preservice teachers?
2. To what extent is the feedback provided by cooperating teachers and university supervisors consistent?

Method

Because the aim of qualitative research is to examine natural environments without any special arrangement (Patton, 2014), in this work, a case study is adopted where an event is examined within its borders without any external interference and related behaviours (Yin, 2003).

Setting and Participants

The study was conducted in collaboration with two CTs in a state primary practice school and a US from the Faculty of Education. The CTs were assigned by the school administration, and the US was the mentor responsible for six PSTs who attended the Teaching Practice course of this practice school in the last semester of the training program. Because the US guiding PSTs were appointed by Faculty management and CTs were assigned by the school administration, the participants were selected using the convenience sampling method. One of the cooperating teachers, CT1, graduated from the faculty of education and had 12 years of teaching experience in state schools. The other, CT2, who completed his master's degree in science education and continued his Ph.D. studies in biology education, had 11 years of teaching experience in state schools. The US, who was also the researcher of this study, possesses 12 years of teaching experience in various state schools. This includes roles as a physics teacher in high and vocational high schools, a science teacher in primary schools, and five years of experience in the faculty of education. The PSTs in group CT1 were PST1, PST2, and

PST3, and those in group CT2 were PST4, PST5, and PST6. The teaching practices of the PSTs occurred at CTs' lecturing sessions and 5th, 6th, 7th, and 8th grade levels.

Data Collection

Observation and document were used as data collection instruments. The researcher, US, and two CTs observed the teaching practices of PSTs simultaneously during the lesson. Although the Faculty of Education recommended the use of structured observation forms for mentors, including some competencies such as presentation skills, subject matter, use of technology, and diversity in teaching, in this study unstructured observations was preferred to obtain flexibility for participants to emphasize the professional knowledge areas such as subject matter, pedagogical, curriculum. The participants took field notes during their observations and gave comments and feedback on PSTs' instructions. Each PST's instruction was observed for two lesson hours by the responsible CT and US. Table 1 shows the subjects taught and the teaching styles of PSTs.

Table 1

Observed Teaching Styles and Subjects of PSTs

PSTs	Subjects	Description of Teaching
PST1	Central nervous system	She started a discussion on a case using a question-answer method, presented the subject via lecturing, had students do an activity of creating a nervous system model in the elaboration, and used a worksheet in evaluation.
	Reproduction and growth in animals	She made an introduction by giving an example from life, had students play a game on amphigenesis in the exploration stage, presented the subject via lecturing, had students use drama in the elaboration, and requested students to write a related poem in evaluation.
PST2	Sense organs	In the beginning, she had a few students perform an activity, started a discussion on this activity in the exploration, explained the subject via lecturing, played a video in the elaboration, and organised an instructional game in evaluation.
	Refraction of light	She made an introduction using a material, had students experiment with the exploration, discussed the results with students, presented a video in the elaboration, and requested students to write a related poem in evaluation.
PST3	Lenses	She had an introduction with examples from life, did an experiment first by herself and then with groups of students, discussed the data and results with students, explained the subject, presented a video in the elaboration, and used an instructional game in evaluation.
PST4	Refraction of light	He made an introduction with question-answers, had a group of students perform experiments, requested students to develop arguments about results and make discussion, explained the subject via video, made a demonstration experiment in the elaboration, and used worksheets in evaluation.
	Electric Circuit Elements	Following the solution of the questions in the worksheet together with students, he continued answering the evaluation questions in the computer environment with students.

PST5	Bio-diversity	He started the lesson with question-answers and discussion, activated an instructional game in the exploration, and presented the subject via lecturing. The lesson expired.
	Growth and Development of Plants	He started the lesson with question-answers. He did a demonstration experiment on germination in the exploration but was not able to complete it due to failure in planning and shifted to the smart board for the explanation, elaboration, and evaluation cycles.
PST6	Agamogenesis and Amphigenesis	He started by exposing a model of a flower, allowing student groups to explore the model, explaining the subject with examples, having students use drama for pollination in the elaboration, and urging students to solve a puzzle in evaluation.

The other data collection instrument was the documents of field notes, including feedback provided to PSTs by the CTs and the US. Field notes consisting of two parts, descriptive and reflective information taken during observations, are widely recommended in qualitative research as a means of documenting the needed contextual information (Phillippi & Lauderdale, 2018). Field notes mentioned in this study were records of PTs' activities and their evaluation by the CTs and the US. Because CTs here generally preferred giving verbal feedback to PTs, the researcher requested the CTs give written feedback following lesson observation (Kastberg et al., 2020; Puttick & Wynn, 2020; Schwartz et al., 2018).

Data Analysis

Whether a deductive or an inductive approach is used in the analyses of data depends on the research questions and the general aim of the study (Elo & Kyngäs, 2008). Inductive approaches are often used when there is little knowledge about the phenomenon, while deductive approaches are used on the basis of previous studies and knowledge. In this study, data were analysed with deductive coding. Firstly, the statements in documents 'she talked to a certain group of students, other students were left on her backside causing some feeling of distraction' or 'while solving problems on the blackboard let us talk to the whole class, not to a few students' was coded as 'concentrating on specific students' and therefore were labelled as positive or corrective feedback. Positive feedback (PF) increases supervisees' confidence by pointing out their knowledge and skills, thus contributing to the competence perceived by those supervisees (Komiskey & Hulse-Killacky, 2004). Corrective feedback (CF), sometimes referred to as negative, is a term that clearly indicates a desire for a specific change in the student teachers' practice (Bjørndal, 2020). Then, these codes were associated with professional knowledge categories, i.e., subject matter knowledge, pedagogical knowledge, and curriculum knowledge. Through these codes, six professional knowledge categories corresponding to components of PCK were generated. For example, 'selection of efficient and appropriate activities (IS14)' was categorized in instructional strategies and representation, and 'classroom management (P5)' was in pedagogy, as seen in Table 2. Table 2 shows the six PCK components: subject matter, pedagogy, assessment, curriculum, student understanding, and instructional strategies.

Table 2

PCK Components and Feedback Codes

Subject Matter	SM_1	Giving incorrect knowledge	Instructional Strategies and Representation	IS_1	Preparing an effective lesson plan
	SM_2	Being unable to answer student's question or fudge		IS_2	Teaching in accordance with the lesson plan
	SM_3	Confusion of concepts		IS_3	Using educational technology
	SM_4	Satisfactory subject matter knowledge		IS_4	Using the course book
	SM_5	Deficient concept mapping		IS_5	Using the blackboard effectively
Pedagogy	P_1	Tone of voice		IS_6	Summarizing the subject
	P_2	Calling the student by name		IS_7	Daily examples
	P_3	Concentration on specific students		IS_8	Organizing various activities
	P_4	Standing at a specific place in the classroom		IS_9	Effective use of visuals or videos
	P_5	Classroom management		IS_{10}	Doing or promoting experiment
	P_6	Monotone speech		IS_{11}	Presenting the subject in a prescribed time period
	P_7	Consistency in behaviour		IS_{12}	Having students take notes
	P_8	Walking around the class		IS_{13}	Clear activity/experiment directives
	P_9	Being fair to students		IS_{14}	Selection of efficient and appropriate activities
	P_{10}	Turning back to the class		IS_{15}	Group working
Student Understanding	SU_1	Present the subject fast	Assessment	A_1	Preparation of materials for assessment
	SU_2	Speaking fast		A_2	Using materials for assessment
	SU_3	Emphasizing important points		A_3	Asking for information, not commenting during teaching
	SU_4	Examining students' prior knowledge		A_4	Involving all students in the assessment
	SU_5	Giving enough time to students		A_5	Suitable assessment
	SU_6	Giving contradictory knowledge			
	SU_7	Present concepts not included in the subject	Curriculum	C_1	Lesson plan incompatible with curriculum
	SU_8	Presenting the subject in the correct order		C_2	Teaching incompatible with curriculum
	SU_9	Giving explanation during the examination of the prior knowledge			

Role of the Researcher

The researcher is the US who is one of the participants in this study, and she was the complete participant contributed to the internal validity by taking on the role of an insider, becoming a member of the group being studied, and spending a sufficient but not too long to cause bias a time with PSTs (Christensen & Johnson, 2004). Because she is a member of the natural environment, it is believed that the effects of the researcher's existence are limited. At the same time, her long-term experience as a science teacher in public schools contributed to her communicating effectively with CTs.

Researchers have taken some measures to ensure the trustworthiness of this study. Observations were made in different parts of the classroom so that the CTs and the US could independently reflect their own interpretations without being influenced by each other's thoughts. To mitigate the interpretive bias of a single researcher, the analysis of data was started after all data were gathered (McAlister et al., 2017). The researcher returned to the data at other times for intracoder reliability, which refers to consistency in how the same person codes data at multiple time points and transparency in the process of coding and creating thematic structures (O'Connor & Joffe, 2020).

Ethical Procedures

The search was approved by the Ethics Committee of Giresun University (Approval No: 2021/14-23).

Results

Findings on mentors' feedback are presented below as two subsections titled 'Feedback from the Cooperating Teacher 1 and the University Supervisor' and 'Feedback from the Cooperating Teacher 2 and the University Supervisor'. Table 3 and Table 4 show the feedback given by CTs and the US to all PSTs and their categories of PCK components.

Feedback from the Cooperating Teacher 1 and the University Supervisor

In this section, feedback from the cooperating teacher 1 (CT1) and the university supervisor (US) for preservice teachers (PST1, PST2, and PST3) are presented.

Table 3

Feedback of CT1 and US to PST1, PST2, PST3 and Related PCK Components

PST	Category of PCK Component	Feedback Type of Cooperating Teacher 1		Feedback Type of University Supervisor		Feedback Frequency
		Positive	Corrective	Positive	Corrective	
PST1	Subject Matter		SM_1, SM_5		SM_2	3
	Pedagogy	P_1, P_2	P_3, P_4, P_8	P_1, P_2, P_3	P_4, P_5	10
	Instructional Strategies and Representation	IS_1, IS_2, IS_4, IS_6, IS_8	IS_3	IS_1, IS_2, IS_4, IS_6, IS_5, IS_7	IS_3	13
	Student Understanding		SU_1, SU_3, SU_4		SU_1, SU_2	5
	Assessment	A_1	A_5	A_2		3
PST2	Subject Matter		SM_2, SM_3		SM_1, SM_2	4
	Pedagogy	P_1, P_2	P_3, P_5, P_6	P_1, P_2	P_3, P_4, P_5	10
	Instructional Strategies and Representation	IS_1, IS_8	IS_{13}	IS_2, IS_5, IS_6, IS_8, IS_9	IS_3, IS_{13}	10
	Student Understanding		SU_4			1
	Assessment		A_3	A_1		2
PST3	Subject Matter	SM_4		SM_4	SM_2	3
	Pedagogy	P_1, P_2, P_3, P_5, P_9	P_4	P_1	P_2, P_4, P_5, P_7	11
	Instructional Strategies and Representation	IS_1, IS_2, IS_9, IS_{10}	IS_{11}, IS_{12}	IS_1, IS_2, IS_3, IS_6, IS_8, IS_{10}	IS_5, IS_{13}	14
	Student Understanding		SU_5		SU_5	2
	Assessment	A_1, A_4		A_1		3
Total Feedback Frequency		24	22	27	21	

According to Table 3, the feedback of CT1 and US was positive and corrective in type. Although the number of feedback given by the two mentors was the same on average, the number of positive feedback supplied by US was higher than that of CT1. It is seen that feedback from the supervisors was concentrated in the categories ‘instructional strategies and representation’ and ‘pedagogy.’

The Category of Instructional Strategies and Representation

In this category, while CT1 gave positive feedback to PSTs on preparing an effective lesson plan, teaching according to the lesson plan, using the course book, summarizing the subject, effective use of visuals, and doing the experiment, the US

gave positive feedback (PF) also on using educational technology and blackboard effectively, talking on daily examples and organizing various activities:

> At the end of an inquiry-based experiment carried out on the refraction of light, PST2 wrote the comments on observations of each group on the blackboard and compared the results. She explained and summarized the correct result attained (US, PF, IS_6).
>
> PST1 used the blackboard and the textbook; it was positive (CT1, PF IS_4, IS_5).

CT1 and US gave the same corrective feedback on using educational technology and clear activity/experiment directives:

> For PST1, using computer-stored figures would be better since she was not good at drawing figures. Unrealistic figures may lead to incorrect learning for students (US, CF, IS_3).
>
> PST2, by giving deficient information about how the presentation and activities would be done, hindered students' effective participation in and enjoyment of the activity (CT1, CF, IS_{13}).

Different corrective feedback provided by the supervisors were on presenting the subject in the prescribed time period, having students take notes during lessons, and using the blackboard effectively:

> PST3 did not have students take notes in their notebooks (CT, CF, IS_{12}).
>
> PST3 drew three different figures of lenses side by side and asked students what kind of lens each figure represents. She did not name the figures as 1, 2, or 3, so the students had to refer to them as 'this,' 'that,' etc., causing confusion (US, CF, IS_5).

The richest feedback supplied by mentors was seen in the category 'instructional strategies and representation,' and the category of pedagogy followed this.

The Category of Pedagogy

The feedback in the category of pedagogy was concerned with monotone speech, tone of voice, calling the student by name, being interested in specific students, standing at a specific region in the classroom, classroom management, consistency in the behavior, walking around the classroom and being fair to students. Positive feedback of CT1 and US was mostly related to the tone of voice and calling students by name:

> Tone of voice of PST2 was good (CT1, PF, P_2)

The positive feedback given by CT1 in this category, who gave more positive feedback than the instructor, was related to 'concentration on specific students' and 'being fair to students':

> PST3 gave students the right to speak as equally as possible (CT1, PF, P_9)

Supervisors gave corrective feedback to PSTs, especially about concentration on specific students, standing at a specific place in the classroom, and classroom management:

> While PST2 talked to a certain group of students, other students were left on her backside, causing some feeling of distraction (CT1, CF, P_3).
>
> PST1 spent much of her time near the table and the blackboard without walking in the classroom (US, CF, P_4).

Feedback from CT1 and the US to PST2 and PST3 about clear activity/experiment directories in the instructional strategies and representation category are also related to pedagogy. US emphasized that the reason for the trouble PST3, who was generally successful in classroom management in lab activities, was that she did not provide clear experimental directives:

> Before starting an activity… you can explain each stage of it and write down some steps… Thus, you don't have to repeat the same explanation to every group; also, other students will not be idle when you're busy with a group (US, CF, IS_{13}).

The Category of Subject Matter

The feedback in the category of subject matter was about giving incorrect knowledge, being unable to answer student's question or fudge, confusion of concepts and satisfactory subject matter knowledge. All feedback in the category 'subject matter' to PSTs, except PST3, was corrective because mentors reported that PSTs did not have rich subject matter knowledge:

> PST2 was not able to satisfactorily answer the student's question, 'where is the eardrum exactly?'. Similarly, she said, 'we would have seen objects in two dimensional if we had only one eye' (US, CF, SM_1, and SM_2).
>
> PST1 made some explanations that would cause misunderstandings among students. For example, she said that the bat was a bird. A bat is a mammal. She had difficulty in answering students' unexpected questions because she probably learned by reciting (CT1, CF, SM_1).

CT1 and US gave the same positive feedback for PST3:

> Subject matter knowledge of PST3 is satisfactory (US, PF, SM_4).

The Category of Assessment

Mentors gave a small amount of feedback in the 'assessment' and 'student understanding' categories. While the US focused on preparation and use of materials for assessment and only gave positive feedback in the category 'assessment,' CT1 added feedback about 'involving all students in assessment.' The corrective feedback in the category of 'assessment' was supplied only by CT1:

> PST1 prepared a worksheet for evaluation, but the questions in the worksheet are of lower level. She had to ask selective and specific questions (CT1, PF, CF, A_5).

The Category of Student Understanding

All feedback in the student understanding category was corrective, and two mentors supplied similar corrective feedback to the PTSs. For example, both of them stated that quick presentation of PST1 affected student understanding negatively:

> Presentation of the subject has to possess integrity and hierarchy. PST1 shifted from one concept to another, and this created confusion in student's minds (CF1, CF, SU_1).
>
> In the presentation of the subject, a procedure from simple to complex should be followed. PST1 implemented his lesson plan and prepared for two hours within one hour; she was speedy (US, CF, SU_1).

In sum, the amounts of positive and negative feedback of CT1 and US are close to each other; the largest amount of feedback was in the category of instructional strategies, and the majority of this feedback was positive. Mentors especially appreciated PTs for using visuals and conducting activities and experiments in which students were active. The second largest amount of feedback occurred in the category of pedagogy, and mentors supplied similar positive and corrective feedback for all PSTs, except for PST3. Almost all feedback, with small amounts in the categories of subject matter knowledge and student understanding, was corrective. While the US supplied completely positive feedback in the category of assessment, the CT gave corrective feedback as well.

Feedback from the Cooperating Teacher 2 and the University Supervisor

In this section, feedback from the cooperating teacher 2 (CT2) and the university supervisor (US) for preservice teachers (PST4, PST5, and PST6) are presented.

Table 4

Feedback of CT2 and US to PST4, PST5, PST6 and Related PCK Components

PST	Category of PCK Component	Feedback Type of Cooperating Teacher 2		Feedback Type of University Supervisor		Feedback Frequency
		Positive	Corrective	Positive	Corrective	
PST4	Subject Matter		SM_1, SM_2		SM_1, SM_2	4
	Pedagogy	P_2	P_3, P_7, P_9	P_1, P_2	P_2, P_4	8
	Instructional Strategies and Representation	IS_{15}	IS_1, IS_5, IS_6, IS_7, IS_{12}, IS_{14}	IS_8, IS_{10}	IS_1, IS_2, IS_3 IS_6, IS_9, IS_{13}	15
	Student Understanding		SU_7		SU_6	2
	Assessment	A_1		A_2	A_5	3
	Curriculum		C_2			1
PST5	Subject Matter		SM_4		SM_3	2
	Pedagogy		P_3, P_9, P_{10}	P_1, P_5	P_2, P_4	7
	Instructional Strategies and Representation	IS_{15}	IS_1, IS_2, IS_4, IS_5, IS_7, IS_{13}	IS_3, IS_5, IS_{11}, IS_{12}	IS_1, IS_2, IS_6, IS_9	15
	Student Understanding		SU_7		SU_2	2
	Assessment		A_1	A_1	A_5	3
	Curriculum		C_1, C_2			2
PST6	Subject Matter		SM_3		SM_3	2
	Pedagogy		P_3, P_5	P_{10}	P_1, P_2, P_5	6
	Instructional Strategies and Representation	IS_5, IS_{15}	IS_1, IS_9	IS_9, IS_5, IS_{11}, IS_{15}	IS_1, IS_2, IS_9, IS_{14}	12
	Student Understanding		SU_1, SU_3, SU_8	SU_4, SU_5	SU_1, SU_9	7
	Assessment		A_1, A_2	A_1		3
Total Feedback Frequency		6	37	20	31	

Table 4 shows that although feedback from CT2 and US was positive and corrective in type, the corrective feedback numbers of both mentors were greater than those of positive feedback. The amount of feedback supplied by the US was more than that of CT2, and it seems that this difference was due to the amount of positive feedback, with CT2 giving only six positives in total. It is seen that feedback from the

supervisors was concentrated in the category 'instructional strategies and representations.

The Category of Instructional Strategies and Representation

Feedback from the supervisors was concentrated in the category of 'instructional strategies and representation,' similar to Table 3. In this category, while CT2 supplied positive feedback on using the blackboard effectively and group working, US gave feedback on using visuals and technology, organizing various activities, doing or promoting experiments, group work, using the blackboard effectively, and having students take notes. The corrective feedback of US was on preparing an effective lesson plan, teaching according to the lesson plan, using educational technology, summarizing the subject, effective use of visuals, clear activity/experiment directives, and selecting efficient and appropriate activities:

> The drama used by PST6 to explain the parts of a flower was not a suitable instructional strategy (US, CF, IS_{14}).
>
> PST4 was not able to operate the smart board during teaching… he probably did not practice its usage before (US, CF, IS_{3}).

CT2 gave corrective feedback similar to those of US, except feedback on teaching according to the lesson plan and using educational technology:

> It would be better for PST5 to write on the blackboard what each group should do during the activity; disruption happened, and the students were not able to understand (CT2, CF, IS_{13}).
>
> PST4 did not choose an activity complying with the subject (CT2, CF, IS_{14}).

But CT2 also gave additional corrective feedback on using the course book and blackboard, daily topics, and having students take notes:

> It would be better for PST2 to write on the board what the group would do in the activity (CT2, CF, IS_{13}).

Supervisors appreciated PSTs for planning and carrying out various activities:

> Group working activity of PST4 was good (CT2, PF, IS_{15}).
>
> PST6 used a flower model and a video in his explanations (US, PF, IS_{9}).

However, they gave corrective feedback emphasizing that the final results following discussion and observations were not clarified well:

> PST4 used empty and water-filled glasses and water mixed with vinegar in the experiment and asked students to observe the appearance of the fork. The students explained their ideas, but the result was not clearly stated… He did not present a clear summary (US, CF, IS_{6}).
>
> PST4 did not give any explanation following the activity. What was the reason why light is refracted differently in water, vinegar, and air? An explanation should be made because concluding a result following the experiment is not easy for every student (CT2, CF, IS_{6}).

The Category of Pedagogy

The category of pedagogy follows, in frequency, that of instructional strategies. Although CT2 gave positive feedback on PST4's about calling the student by the name, US gave positive feedback for every PT on tone of voice, calling the student by the name and turning back to the class:

> PST4 knew students and called them by their names (CT2, PF, P_{2}).

While the corrective feedback of US concentrated on calling the students by name and standing at a specific place in the classroom, the feedback of CT2 paid

attention to the code's concentration on specific students, consistency in the behavior, fair treatment to students and turning back to the class:

> PST6' tone of voice is too low; the speech is not heard and understood, which weakens his classroom management (US, CF, P_1).
>
> PST5, while solving problems on the blackboard, let us talk to the whole class, not to a few students. Otherwise, students will become busy with other businesses (CT2, CF, P_3).
>
> PST4 has to be consistent and fair in the class. Fair treatment is vital; otherwise, the teacher will lose esteem (CT2, CF, P_9).

The Category of Student Understanding

The third, in frequency order, category includes feedback essentially on student understanding. Most of this feedback was corrective and on presentation or speaking in a fast mood:

> PST6 presented the subject rather quickly… (CT2, CF, SU_8).
>
> PST6 presented all concepts in a furry in the first session and was short of teaching material for the second session, so he had to make repetitions (US, CF, SU_1).

While corrective feedback supplied by the CT2 was on emphasizing important points, presenting concepts not included in the subject, and presenting the subject in the correct order, US concentrated on giving contradictory knowledge and giving explanations during the examination of the prior knowledge:

> PST6 submitted some information before examining the prior knowledge of students on the subject (US, CF, SU_9).

The Category of Subject Matter

Feedback in the category of subject matter about all PTs was corrective, perhaps because supervisors wrote that PTs did not have rich subject matter knowledge:

> PST4 answered the student's question 'what is the distance from the earth to the sun' as '8 light years', indicating that his subject matter knowledge was poor (CT2, CF, SM_1).
>
> PST4 said to the student who claimed that the brightness increases with the number of cells the opposite, but later, he repeated what the student claimed to the class. His explanations were not consistent (US, SM_1).

The Category of Assessment

In the assessment category, supervisors paid attention to the preparation and use of materials for assessment. CT2 stated that PSTs except PST4 did not carry out the evaluation, and he appreciated the assessment activities of PST4:

> The evaluation activity (worksheet) chosen by PST4 was quite good (CT2, PF, A_1).
>
> PSTs generally did not assess students' understanding; if they had some time left, they asked questions written at the end of the chapter; they did not take students' questions into account because they focused mainly on presenting the subject (CT2, CF, A_1).

Similarly, US gave positive feedback to the PSTs about preparing and using assessment activities and also focused on the quality of the assessment questions used by them:

> PST5 prepared an assessment worksheet and used it in the classroom, but the selected questions were not suitable (US, CF, A_5).

The Category of Curriculum

Feedback in the category of curriculum was supplied only by CT2, drawing attention to inconsistency between the lesson plans/activities and curriculum targets for 2 of 3 PSTs:

> PST4's activity, in which laser light illuminates the water stream flowing through the hole at the side surface of a bottle, is related to total internal reflection. The students have not learned this subject yet (CT2, CF, C_2).
>
> PST5 talked about concepts, such as dormancy and anaerobic respiration, not included in the learning objectives, thus causing confusion in student's minds (CT2, CF, SU_7, C_2).

In sum, there were noticeable differences between the numbers of positive and corrective feedback of CT2 and US. The number of corrective feedback from both mentors was more than their positive feedback, and only 15% of the CT2's feedback was positive. The largest number of feedback was in the category of instructional strategies, and the majority of this feedback was corrective. While CT2 appreciated PTs only for the group working in this category, the US gave a number of positive feedback. All feedback from mentors in the category of subject matter knowledge was corrective. Feedback from US for this PST group in the assessment category was positive and negative, similar to those of CT2. Although the feedback of CT2 in the pedagogy and student understanding categories was mostly corrective, those of the US were positive and corrective. Feedback in the curriculum category was supplied only by CT2 and was corrective.

Discussion and Conclusion

The first research question in this study was what kind of feedback CTs and US provided to PSTs. Findings showed that although feedback given by mentors was positive as well as corrective, the corrective ones were more than the positives, contrary to some others' studies (Bullough, 2005; Kahan et al., 2003), emphasizing that all CTs' feedback was more positive than corrective. This corrective feedback showed that mentors required specific changes in the PTs' teaching practices (Bjørndal, 2020). Because mentors providing feedback were also responsible for the final assessment of the teaching practice activities, giving corrective feedback may be considered to be challenging for both PTs and mentors (Bjørndal, 2020; Tang & Chow, 2007). However, in the teacher education context of this study, CTs and USs tended to give high final grades to PSTs for their teaching practices. Most USs do not participate in PTs' teaching because of claimed time restrictions or, as CTs asserted, of neglect (Andrew, 2007; Hellison, 2003; Topkaya et al., 2012). As a result, these types of USs either give high grades to all PSTs or leave the decision to the initiative of the CT, who becomes decisive in assessing (Weiss & Weiss, 2001). Another type of university supervisors who observe the teaching of PTs abstains from giving realistic assessment grades, which would create negative emotional reactions among PTs (De la Cruz et al., 2015). Similarly, CTs think that the number of PTs per CT is too high because they already have much work to do, thus providing limited teaching experience opportunities for PTs (Saka, 2019), so their assessments, although free-handed, may not be fair enough (Arkün-Kocadere & Askar, 2013). In this study, informal conversations about PSTs between CTs and US showed that if PSTs were rigorous and willing in the teaching experience process, CTs would not take deficiencies of PSTs into account in grading.

These circumstances may clarify why mentors did not worry about giving corrective feedback, a crucial part of mentoring in teaching placements (Amobi, 2005; Crasborn et al., 2008; Crutcher & Naseem, 2016). Although satisfactory final grades of the triad are generally expected, the corrective feedback items and dozes point out that mentors intended to improve PSTs teaching and enhance their thinking ability beyond teaching to analyse, reflect, and reconstruct their teaching (Range et al., 2013).

Mentors are ideally expected to provide feedback in both content-specific and general pedagogies (Schwartz et al., 2018) because PCK is an amalgam of content and pedagogical knowledge (Shulman, 1986) and closely related to 'the ways of representing the subject that make it comprehensible to others' (Shulman, 1987). The importance of representing the subject may explain the concentration in the categories of 'instructional strategies and representation' and 'pedagogy.' Similarly, Won et al. (2019) found that both CTs and USs mainly provided feedback on key areas such as student engagement, more effective use of instructional norms, and application of content-based pedagogies. Subject planning and presentation by PSTs provided insight to mentors not only about PSTs' knowledge of instructional strategies but also about other professional knowledge categories, i.e., subject matter, student understanding, curriculum, and assessment. Although feedback from the mentors seems to be concentrated in the fields of instructional strategies and pedagogy, the majority of feedback in all knowledge categories points out that the mentors focus on student understanding, meaning that the transfer of knowledge is important. In reform-based science curricula for elementary and secondary schools (MoNE, 2018), a holistic perspective has been adopted in terms of learning-teaching theories and practices based on knowledge transfer, inquiry, and active participation in the learning process where students are responsible for their own learning. Teachings of PSTs based on the constructivist approach showed that they made efforts to put into practice what they learned in theoretical courses about the inquiry approach. Feedback indicated that mentors especially attached importance to student's understanding of the subject and active participation. Issues on teaching based on inquiry and student's self-responsibilities in learning seemed to be in the background as Bradbury and Koballa (2007) reported that dialogues between CTs and PTs focused on general pedagogical knowledge instead of the nature of science, scientific inquiry, and literacy issues which are the central elements of reform in science teaching. Although mentors provided corrective feedback to PSTs helping novices match classroom practice with reform-based views of teaching, including an emphasis on inquiry (Bradbury, 2010), they neither criticized any PST for not particularly using inquiry teaching (Furtak et al., 2012) nor did they appreciated any other for practicing this sort of teaching. The mentors' statements about PSTs' inquiry teaching, such as 'concluding a result following the experiment is not easy for every student,' may give an idea about persistence in making and dictating a summary of observations, experiments, and discussions. CTs seemed to think that students did not have skills for interpreting information and drawing conclusions; thus, they may not prefer to provide feedback on the development of procedural and epistemic inquiry (Furtak et al., 2012).

The second research question asks to what extent feedback from the CKs and US are consistent. This research shows that mentors provided very specific feedback more effective in contributing to the improvement of PSTs' teaching than general classroom

practices (Getachew et al., 2020; Moore, 2003; Scheeler et al., 2004). Although mentors' feedback points out some differences in the categories of curriculum and assessment, they were consistent in general. Because CTs were more engaged with the curriculums and national exams than the USs (Chaliès et al., 2004), it can be considered that CTs gave more detailed feedback in these categories. Similarly, positive and corrective feedback from CTs concentrated on nearly the same professional knowledge area. One reason for the difference in the feedback of the two CTs was that PSTs under the guidance of CT1 and CT2 were different. The fact that the US gave more corrective feedback to PSTs under the guidance of the CT2 also seems to support this situation. It does not seem possible in this study to claim anything about other reasons for differences in the feedback of CTs (Hudson, 2014).

This study was conducted with a limited number of participants, revealing CT and US's feedback, which was consistent and similar, but the reason for this consistency was that the professional experience of US as a science teacher in primary schools was similar to CTs and gives in general science lectures with lab works not teaching methods courses in the teacher training program. It is clear that another study to be conducted with USs having different science teaching orientations may reveal different findings. As a matter of fact, feedback from US who conduct instructional teaching courses having an impact on PST's argument-based teaching plans would be mainly based on understanding the nature of science by designing investigations, collecting data, and using evidence to support findings through collaboration and discourse (Bradbury, 2010).

Another limitation of the study was that the feedback from the mentors was given during the initial teaching practices of the PSTs. Because feedback may affect the subsequent teaching of PSTs, the distribution of feedback given by mentors in categories may change, and feedback concentrated in the categories of instructional strategies and pedagogy may shift to different knowledge categories. Next, a longitudinal development research design will contribute to understanding how mentors' feedback changes throughout the Teaching Practice course.

The researcher's experiences indicated that CTs are open to cooperation and communication with university supervisors. They care about the thought of the US and want to give importance to the thought of themselves (Shantz, 1995). In this study, the most important reason for the effective/close relationship offering opportunities for sharing knowledge and skills between US and CTs (Allen et al., 2010) was the US' attitude due to the common corporate culture. Through empathic communication, thoughts CTs about problems as there is not enough information about the implementation of the inquiry-based learning approach and not enough examples and explanations for the learning outcomes (Bekmezci & Ateş, 2017) or CTs having little experience in planning and conducting inquiry-based science activities with their students and may be unwilling or unable to model that strategy for a novice can change.

Conflicts of Interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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