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Types of Feedback in Inquiry Science Learning Classroom in Secondary Education*

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Abstract

Although an inquiry-based approach has been adopted in science lessons in recent years, the characteristics of this approach have been ignored in determining teacher feedback. In this study, it is aimed to determine teacher feedback by considering the cognitive and affective components inherent in inquiry. This study, based on qualitative research, was conducted with an instrumental case study design. The types of verbal feedback given by the teacher were followed during the inquiry-based science lessons. With the content analysis of the collected data, the feedback was classified according to their method and function. In this study, the place of the feedback types determined in the environment where inquiry-based learning is taken into account, in the literature is discussed by comparing them with the existing feedback types.

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INTRODUCTION

In recent years, science curricula have been prepared taking into account the Inquiry-based learning (IBL) approach. Students learn both how to do science and the nature of scientific inquiry in learning environments with scientific inquiry (Strippel & Sommer, 2015). Students experience the scientific process that scientists go through as they seek answers to questions about the nature. In this process, they use the skills of asking questions, designing and conducting research, using appropriate tools and techniques to collect data, thinking critically and logically about the correlation between evidence and explanations, creating and analysing alternative explanations, and communicating scientific arguments (NRC, 2012). At the same time, they learn science concepts, principles, and theories in a meaningful way (Abd-El-Khalick et al., 2004). It is necessary to examine IBL not only in terms of cognitive development in students, but also in terms of the characteristics of the social environment. Teacher feedback is one of the most important predictors of balance in the learning environment (MacIsaac & Falconer, 2002).

Feedback that directs students to competition and grades in the classroom, which is a social environment, can focus on getting high grades and being the best in the eyes of teachers and students, instead of focusing on the development of students' inquiry skills and discovery of knowledge (Jagacinski & Strickland, 2000). Feedback that directs meaningful learning, sharing, discussion, and monitoring the improvement in their own knowledge and skills focuses students on increasing their own knowledge and expertise. Teacher feedback plays a key role in creating a learning environment based on a solid cognitive and affective basis. For this reason, teacher feedback that is effective on students' cognitive and affective characteristics (Hattie, 2009; Chi, Wang & Liu, 2021) should be determined and classified by taking into consideration the characteristics of the learning environment. While making this classification, the course content, the learning approach used in the course and the affective characteristics of the students should be brought into account.

Although there are many studies in the literature in which feedback is defined and classified, in these studies, feedbacks were made for quite different lessons rather than a specific field, without considering the specific characteristics of the lesson. However, due to the nature of both science and scientific inquiry, feedback in the science lesson is expected to differ from other lessons. Feedback may lead to the continuation or discontinuation of inquiry in the lessons, the participation of the student in the inquiry process or their avoidance. For this reason, it is important to define and classify feedbacks according to science courses in which scientific inquiry is taken into account. In this study, it is aimed to identify and classify teacher feedback in inquiry-based science lessons. It is thought that this definition and classification will guide practitioners and researchers in conducting science lessons in accordance with the nature of scientific inquiry.

CONCEPTUAL FRAMEWORK

WHAT IS FEEDBACK?

In the literature, it is seen that the definition and function of feedback are closely related to learning theories. Researchers (Hattie et al., 2007; Sadler, 1989; Tunstall et al., 1996) defined learning as information provided to shape students' behaviours and close the gap between real and desired performance and understanding, and classified feedback with expressions such as punishment and praise. In this approach, feedback directly affects the learning outcome (Thurlings, Vermeulen, Bastiaens, & Stijnen, 2013) and is provided to the learner in order to analyse and organize their own cognitive patterns (Jonassen, 1991).

Considering the development of cognitive processes to the extent that students interact in appropriate experience environments, theorists have defined feedback as the communication established with the student in order to improve the learning capacity of the student. Bloom (1984) defined feedback as all the messages that the teacher presents in the learning process to support the students' work in the process of achieving their learning goals. Shute (2008), on the other hand,

defined feedback as the information presented by the teacher that aims to change the student's thoughts and behaviours about learning. He stated that this information may include the difference between the student's current performance and the targeted performance. Voerman, Meijer, Korthagen and Simons (2012) added to this definition of feedback the difference between the initial level of a performance and the current level. Feedback is a tool that shows improvement in a performance or target performance to be reached. According to the theorists who think that interaction among environment, individual characteristics and behaviour is effective on learning, aims and expectations are important source of motivation (Schunk, 2014). When teacher feedback is provided to the students according to students' learning aims, it will provide a motivation for learning. In this case, teacher feedback coming from learning environment will affect the students' learning aims. Therefore, teacher feedback gains both a cognitive and affective dimension (Wisniewski, Zierer & Hattie, 2020).

LITERATURE REVIEW

While classifying teacher feedback in the literature, there are differences in the criteria. Voerman et al., (2012) classified the feedback of Science, Mathematics, Language and other subject teachers in vocational education and high schools as specific positive feedback, nonspecific positive feedback, specific negative feedback, nonspecific negative feedback and other interventions. They divided specific feedback into progress feedback and discrepancy feedback. Progress feedback highlights the difference between initial performance and current performance. Discrepancy feedback, on the other hand, emphasizes what needs to be done, taking into account current performance, in order to reach the targeted performance level. Carless and Winstone (2020) examined teacher feedback in terms of design, relational, and pragmatics dimensions. In the first dimension, teacher feedback is designed for students to make self-assessment. In the second dimension, feedbacks were arranged by considering interpersonal relations. In the last dimension, the feedback of the teachers involved in the management of the learning process was evaluated.

Tunstall et al., (1996), on the other hand, classified the feedback given by 8 teachers teaching at primary school 1st and 2nd grade levels as descriptive, evaluative and socialization feedback. Descriptive feedback explains student behaviour and provides information on how these behaviours can be improved. Evaluative feedback reports conclusions about the student's behaviour. Socialization feedback is about classroom rules, values, and attitudes. Unlike the others, Hattie et al., (2007) also considered the task variable while classifying the feedback. Task feedback can provide information about the accuracy of a task or product, as well as instructions given to students to succeed in the task. Task processing feedback is the feedback used in the process of creating a complex task or product. This type of feedback is directly aimed at learning the process of obtaining information, processes that require understanding, or completing a task.

The number of studies in the literature that makes the identification and classification of feedbacks taking into account the nature of science lessons is limited. Özkale et al., (2021), classified the feedback in science lessons as "expressions of praise", "effort-based feedback", "negative feedback" and "ability-based feedback". Cengiz and Ayvacı (2017), on the other hand, classified teacher feedback in secondary school science lessons by considering only the feedback presented for the mistakes made by the students. His classification includes stating "wrong", giving another student the right to speak, asking the question again, giving the answer directly, explaining the answer, questioning the reason for the mistake - asking a question about the mistake, correcting-completing the missing-wrong part of the answer, giving hints-directing the student, repeating the student's answer exactly, ignoring the student's answer. On the other hand, Chalmers, MacCallium, Mowat, and Fulton (2014) examined the feedback given to the laboratory reports of students in university biology courses. These are classified as identifying errors, praising, correcting errors, explaining misunderstandings, demonstrating good practices, suggestions for future studies, approach suggestions for future studies, and justifying marks. Although feedback in science lessons has been

classified by researchers, studies that consider the nature of science lessons and scientific inquiry are limited in the literature. Chin (2006) classified teacher feedback in inquiry-based science lessons as confirming when the student gives a correct answer, focusing the student by expanding the subject with many questions about the answer when some part of the answer is correct and some part of it is wrong, explaining the answer when the student gives a wrong answer, and rejecting the student's answer by changing the question when the student gives a wrong answer. Eckes and Wilde (2019) classified the feedback given by 165 prospective biology teachers to student groups while working on the experiment in IBL settings in German secondary schools as lesson-specific informative feedback and basic feedback. The basic feedback is the teacher's superficial directions for the students to reach the result in the learning process. Informative tutoring feedback specific to the lesson is that the teacher supports the students in completing a task, homework or solving a problem in the IBL environment. Rinehart, Kuhn, and Milford (2020) categorize the dialogic feedback that 8th grade teachers present in science lessons at the kindergarten level in the USA. In lessons where argument-based inquiry method is used, dialogic feedback is defined as feedback that directs students to participate in discussion cycle. Feedback is classified as reframing, elaboration, reflection, construction, and criticism. In these studies, although the feedback was determined by considering the characteristics of scientific inquiry in science lessons, the social and affective dimensions of scientific inquiry were not considered sufficiently.

In this study, feedback was determined and classified by considering the IBL approach which based on socio-cognitive learning theory and students' achievement goal orientations in the context of science lesson.

THE IMPORTANCE OF THE STUDY

Each lesson has its own unique content and characteristics. For this reason, the feedback to be used in each lesson should be suitable for the structure of that lesson. In addition, feedback is also affected by the learning approaches adopted in the lessons. For example, a teacher who provides feedback (Rinehart et al., 2020) for students to criticize each other's ideas during argumentation-based science lessons may offer task-related feedback (Van den Bergh, Ros, & Beijaard, 2013) during active learning. Inquiry Based Science learning has conceptual, social, procedural and epistemological dimensions (Furtak, Seidel, Iverson & Briggs, 2012). For this reason, it is necessary to include these dimensions when determining the feedback in these courses. In order for the inquiry process to continue, the feedback that should be provided to a student who does the experiment incorrectly, or the feedback that should be provided to a student who has difficulty in converting the table into a graphic should be different. Examining the feedback provided during inquiry-based science lessons is important to identify feedback specific to the type of lesson and the learning approach used. Another important point is the affective characteristics of the students. Teacher feedback will affect affective properties and cognitive properties as well. This study focuses on success-goal orientation, the importance of which has been recognized in recent years. Achievement goal orientation is a theory that deals with the reasons for students' goals for the course (Dweck & Leggett, 1988). The type of feedback given by the teacher also has the potential to set students' goals.

In this study, it is aimed to determine the verbal feedback of the teacher by considering the inquiry environment in science lessons. The research problem has been determined as “What are the types of verbal feedback provided by the teacher in the IBL environment within the scope of the Science Lesson?”.

METHOD

RESEARCH DESIGN

In this study, instrumental case study, one of the qualitative research methods, was used. The case in the study is teacher feedback in the IBL environment.

STUDY GROUP

In order to determine teacher feedback in the IBL environment, the data was collected in a public school in Turkey in two classes at the 5th grade, for nine weeks (37+37 class hours) of science lessons. The total number of students in the classes is 32 (15+17). In these classes, science lessons are conducted by a teacher who has a master's degree and has seven years of experience. The teacher taught his lessons in both classes by taking the IBL into account. It is thought that the characteristics of the students who make up the learning environment, as well as the approach adopted by the teacher, will be effective on teacher feedback. For this reason, the Scientific Process Skills Test (SPST) and Achievement Goal Orientation Scale (AGOS) were applied to the observed classes in order to determine the student characteristics. Mann-Whitney U Test was conducted for science process skills, and it was determined that the students in both groups had equal scientific process skill scores (U=106.50, Z=- 0.251, P=0.802> 0.05). The Mann-Whitney U Test was also used for achievement goal orientation, and it was determined that the achievement goal orientation scores of the students in both groups were equal (U=75.50, Z=-1.538, P=0.124> 0.05).

DATA COLLECTION

In order to determine the student characteristics in the classrooms to be observed, the scientific process skill test and the achievement goal orientation scale were applied. In order to determine the types of feedback, regular observations were made in both classes, and the data were collected with lecture audio recordings and researcher lecture observation notes. In addition, observations were made with the Reformed Teaching Observation Protocol in order to determine the level of inquiry.

SCIENTIFIC PROCESS SKILL TEST (SPST)

The test was developed by Burns, Okey and Wise (1985) and adapted into Turkish by Özkan, Geban and Aşkar (1992). It is revised by Çakar (2008) considering scientific process skills that is appropriate for 5th grades. The test is composed of 24 items and KR-20 reliability for the test is calculated 0.86.

ACHIEVEMENT GOAL ORIENTATION SCALE (AGOS)

It is a 5-point-Likert type scale developed by Ames and Archer (1984) and adapted into Turkish by Demir (2011). The 33-item scale consists of performance goal orientation and mastery goal orientation dimensions. The α reliability coefficient of both sub-dimensions of the scale is 0.89. According to the results of the principal components factor analysis, the factor loads of the first component vary between 0.69 and 0.48, and the factor loads of the second component vary between 0.37 and 0.63.

CLASSROOM OBSERVATION NOTES OF THE RESEARCHER (CONR)

It is aimed to determine the feedback given by the teacher in this process with classroom observations. The researcher observed the lessons taught by the practice teacher in both classes for nine weeks. CONR consists of objective notes of teacher feedback, course content, students' experiments and activities, and discussions in study groups.

REFORMED TEACHING ORGANIZATION FORM (RTOP)

Observation form is developed by MacIsaac and Falconer (2002) to determine the level of inquiry in lessons. The form consists of 25 items and three dimensions (lesson planning and implementation, content and classroom culture). Items are scored between 0 and 4. After observing inquiry-based science lessons, a reasoned scoring is done for each item in the observation form. A maximum of 4 points can be obtained from each item of the 25-item scale. If the score of a lesson is less than 20 points, it indicates that the observed lesson is taught in a traditional way, in which students are passive. If it is lower than 45 points, it refers to traditional lessons with student questions in the lesson. If it is lower than 55 points, it indicates that most of the lecture is done by the teacher, even if

there are group studies. The 65–75-point range describes the class in which the students create their own personal response system and have a medium level of questioning. A course with a score between 65 and 99 refers to the courses with the highest level of inquiry, which varies according to the amount and quality of speeches.

VOICE RECORDINGS OF THE LESSONS

During the observations in the classrooms, a voice recorder was placed in 4 learning groups, one for each. The reason for placing voice recorders in each group is to detect the verbal feedback given by the teacher in each group.

CHARACTERISTICS OF THE LEARNING ENVIRONMENT, DATA COLLECTION PROCESS AND THE ROLE OF RESEARCHERS

Teacher feedback was determined by the researchers by following the units "Let's Solve the Riddle of Our Body", "Measurement of the Magnitude of Force" and "Change of Matter". Science lessons were conducted by the teacher in groups of 4 in each class. The teachers stated that they formed the groups according to the academic achievements of the students, and that they paid attention to the presence of students at all levels in each group. The science lesson was carried out as 4 hours a week, and the teacher also gave a guidance lesson for 1 hour every week. Within the scope of the guidance, the teacher directed all students to design experiments within the scope of their research and provided the necessary materials for the experiment they designed. At the same time, he directed the students who came without research to complete their research and design experiments until the next lesson. The teacher conducted his observed lessons at the level of open inquiry. In order to ensure questioning, the course contents used by the teacher were reviewed by researchers before each lesson and feedback was given to the teacher. The lessons were taught by the teacher according to the 5E learning model. In step 1E, a problem situation was created that students would be curious about, and the students were asked to identify the problem as a group, conduct research about this problem, collect data, and prepare an experiment or activity for the solution of the problem. After the 1E step, a guidance hour was done to support the students in designing activities or experiments in line with their research. In the 2E step, the experiments, or activities that the students prepared as a group were presented to the class and a class discussion was made. In cases where the students did not design activities or experiments, alternative activities prepared by the teacher were implemented. In the 3E stage, they made explanations and created models based on their observations and experiments. At the 4E stage, the subjects were deepened according to the achievements, and the students had the opportunity to use the knowledge and skills they acquired in the 2E and 3E stages at this stage. In the 5E stage, the students individually answered the activities prepared using the knowledge they had acquired. The questioning level of the learning environment was determined by the RTOP form. The lessons observed by the researchers were analysed according to the RTOP form and a score was created for each lesson. Thus, it was possible to comment on the inquiry level of the observed lesson. Researchers attended the lectures as unattended observers, took audio recordings of the lectures and kept lecture observation notes. After the observation, the observation notes were read to the teacher and the participant's confirmation was received. The lowest RTOP score of the observed lesson was calculated as 74 and the highest as 100. For this reason, the level of inquiry in all of the observed lessons is high.

ANALYSIS AND INTERPRETATION OF DATA

Participation in the research was carried out on a voluntary basis and ethical principles were fully complied with. Ethical permission (90864724-605-E.13527033) was obtained from the Ministry of National Education of the Republic of Turkey before the study. Before collecting data, students were informed about the study and data were collected from volunteer students.

In order to determine teacher feedback, notes and lecture audio recordings of lecture observations were analysed by content analysis. Before the research started and throughout the research process, the literature was constantly read and provided an idea about the analysis of the data. At the end of the research, all the data were brought together in written form in the computer environment and the whole of the research was seen. During the analysis process with the inductive method, the written documents were analysed separately by the researchers simultaneously. Then, the results of the analysis were compared by coming together. In the comparison, the differences in the analysis were discussed one by one and re-coded. As the analysis process progressed, the number and detail of the codes constantly changed. Before the classification and the process of reaching the themes, the meanings of some of the codes were renewed, and the codes that were determined to be irrelevant to the research were excluded from the scope of the study. The codes and themes along with sample feedbacks were presented to the opinion of two experts who had research on feedback. The themes, which were rearranged in line with the opinions of the experts, were finalized. The determined codes were placed in the finalized themes. The research question was associated with the theme, and the themes were defined and exemplified. Finally, the results reached in the qualitative data analysis process were made into a report. In order to determine the inquiry level of the learning environment, the notes of the lesson observation and the lesson audio recordings were analysed with descriptive analysis. The lessons were scored by the researchers, taking into account the criteria in the RTOP form. The researchers made the scoring independently of each other. By comparing the results with each other, the situations that disrupted the harmony were determined and the analyses were reviewed again. The results of the analysis were presented to the opinion of an expert who has studies on IBL, and it was finalized.

FINDINGS

In this section, verbal feedbacks are handled separately for each category. Verbal feedback was exemplified and explained with the help of teacher-student dialogues taken from the lesson audio recordings. There are situations where the teacher uses more than one type of feedback in the sample dialogs given. While explaining each type of feedback, all these feedbacks are given together to ensure the integrity of meaning in the dialogues, but only the type of feedback to be explained is discussed.

In this study, the feedbacks are grouped under two categories called the method and function of the feedback. These categories are also classified within themselves. Feedbacks have eight subcategories by method and four by function (Table 1).

Table 1. *Feedback Categories*

Categories of feedback	
Method	Function
Giving or not giving opportunity	Supporting the mastery goal orientation
Expressing personal negative feelings	Supporting the performance goal orientation
Foregrounding the individual or group	Continuing the inquiry process
Explaining the process	Ending the inquiry process
Reflection	
Feedback about peer relations	
Not Giving Feedback	
Comparison feedback	

FEEDBACK METHOD

The feedback method is the teacher's way of presenting feedback to students during the lesson. During the lesson, the teacher can follow different ways in communicating with the students. It may or may not allow students to express themselves, monitor their own learning, and think about different questions about the subject. He may get angry with students, bring a student to the forefront in the class as a result of his positive behaviour, direct a student to the class by repeating a thought expressed

by a student, make a statement about the learning process, or give no reaction to student behaviour. All these behaviours shown by the teacher during the lesson are within the scope of the feedback method. Feedback method: It consists of eight sub-categories as giving/not giving opportunity, expressing personal negative feelings, foregrounding the individual or group, explaining the process, reflection, peer relations, not giving feedback and comparison. Each sub-category of method feedback is presented with codes and sample dialogues belonging to the relevant category.

GIVING OR NOT GIVING OPPORTUNITY

Giving/not giving opportunity feedback is about the teacher creating or preventing a classroom atmosphere that will enable students to express themselves, to be encouraged for learning, to think, to relate to daily life. Encouragement / self-expression, self-monitoring, giving the opportunity to think and not giving the opportunity to think were used for this feedback. The teacher created learning opportunities by encouraging the students to learn and making them think about their own learning.

In table 2, teacher encouraged students to make guesses by asking questions in lines 1, 3, 5 and 7 within the scope of the discovery activity on the subject of "Measurement of the Magnitude of Force" and encouraged students to design and present an experiment or activity in line 9. In line 11, he stated that students can choose the necessary materials from the materials brought to the classroom so that they can design experiments or activities. In this way, he used the *giving opportunity feedback* six times.

Table 2. *Giving Opportunity Feedback*

Line	*Utterance*
01	*Teacher: Ayşe, which string of yours is more flexible?*
02	*the thin one.*
03	*Teacher: The thin one. 1st Group, which string of yours is more flexible?*
04	*thin.*
05	*Teacher: thin one. 3rd Group, which string of yours is more flexible?*
06	*the thin one.*
07	*Teacher: 4th Group?*
08	*thin.*
09	*Teacher: thin. Well, who can show me this with an activity, which one is more flexible?*
10	*We can show my teacher. I can show my teacher please, my teacher.*
11	*Teacher: Well then, let's sit down. Equipment is here. Look at these materials, there are green strings here. Come and see if it works for you. Show which string is more flexible.*

On the contrary, the teacher did not give the students the opportunity to learn by directly telling the deficiencies and mistakes in their studies, explaining the learning goal or the reason for the student's mistake.

Given in table 3, the teacher poses questions to the students within the scope of the evaluation activity on the subject of "Change of State". In the 1st, 3rd, 5th, 7th, 9th, 11th and 13th lines, teacher used to give opportunities feedback for students to express themselves. However, when the teacher made a wrong explanation about the concept of frosting in the 14th line, the teacher made the definition himself by interpreting the mistake in the student's answer in the 15th line. For this reason, the feedback provided by the teacher on line 15 is within the scope of *giving no opportunity feedback* in the subcategory of giving/not giving opportunity.

Table 3. *Giving No Opportunity Feedback*

Line	*Utterance*
01	*Well last question. On cold days, in the morning at work, let there be fruit or ice crystals on the grass. In fact, what do the farmers say, frost shot, right? What is this event? Yes, tell me.*
02	*frost over.*
03	*Teacher: frost over. What do you say Mehmet?*
04	*frost over.*
05	*Teacher: Selin what about you?*
06	*frost over.*
07	*Teacher: Ali, Ali what do think?*
08	*frost over.*
09	*Teacher: Ahmet?*
10	*frost over*
11	*Teacher: Serhat you tell me.*
12	*This is called frost over because the gas turns to solid.*
13	*Teacher: OK. Selin what did you write?*
14	*Because grass also breathes and dew forms. With the cold of the air, the dew freezes and frost forms.*
15	*Teacher: It must be dew and then it should freeze. Hıı. If dew freezes, condensation occurs first and then freezing. It should freeze immediately without dew, that is, without liquefying.*

EXPRESSING PERSONAL NEGATIVE FEELINGS

This feedback was defined as the teacher's destructive expression of negative feelings about students' behaviour. In this type of feedback, the teacher reflected the negative feelings he felt towards the students by getting angry with the students loudly, reproaching them, or downplaying the answers and behaviours of the students.

In table 4 in the worksheet 2E level about the subject of “State Changes” students are doing an experiment to discover the characteristics of pure substances. The teacher scolded the student in line 10 for the wrong answer of one of the students and asked him to give his opinion after careful observation. This feedback is within the scope of the teacher's feedback of *expressing personal negative feelings* by raising his/her voice to the student and scolded the student.

Table 4. *Expressing Personal Negative Feelings*

Line	*Utterance*
01	*Hundred*
02	*Teacher: Did it get to 100?*
03	*Yes it did.*
04	*Teacher: Has it been 101?*
05	*Yes.*
06	*No.*
07	*No my teacher, it hasn’t been.*
08	*Teacher it is getting over it.*
09	*What then!*
10	*Teacher: How did it happen? Look and then tell me. (Loudly).*
11	*Teacher, it will be a little later.*
12	*Teacher: Look, if you lean on the water, it's not from me. You'll get burned, don't go to the hospital and then say teacher or something. Is it 101?*
13	*Teacher it is 100*
14	*Teacher: Isn’t it going to be 101 ever?*
15	*It will be.*
16	*Teacher: It won’t be. Because it started to boil. After the liquids boil their temperature does not change, OK? Well, when the ice is melting, did its temperature continue to change?*
17	*No.*

FOREGROUNDING THE INDIVIDUAL OR GROUP

The teacher's appreciation of a student's or group's response and work and showing an example to the class is called " Foregrounding the individual or group ". Teacher comparing the answers of

students or groups, asking the student who gave the correct answer during the discussion to repeat the answer, asking the student whose work he likes to show the work to the class are the codes of this feedback type.

Teacher emphasized that the answer of one student is more qualified than the answer of the other students by comparing the thoughts shared by the students during the class discussion in the 1st and 3rd lines of table 5. For this reason, he provided feedback foregrounding the individual or group in lines 1 and 3.

Table 5. *Foregrounding the Individual or Group*

Line	*Utterance*
01	*Teacher: All right. Let's move on to the other view. Hasan directly diagnosed the patient. He said "Uncle Ahmet, is a kidney patient.*
02	*Is that right my teacher?*
03	*Teacher: I don't know. What do you think? You know, you said that smoking and alcohol may have caused, that's why you said that it may have been cancer. You said he is a dialysis patient. Some of your views have remained the same, some have changed. But Hasan made the diagnosis just like a doctor. He said that Uncle Ahmet has kidney disease.*

EXPLAINING THE PROCESS

The teacher's explanation about what is expected from the students in the learning process, the process steps of the study, or the safety precautions is called "process-related feedback ". The codes for this feedback are the teacher's explanations below; explaining the point to be reached, saying that the task needs to be reviewed, reminding the target or problem, stating that it is not related to the subject, explaining the process steps or working method related to the study to be done, asking the students for the names of the research sources, making explanations about the safety precautions, asking them to do it clean and tidy, explaining about the supply of test materials.

Given in Table 6, questions were asked to all students and a classroom discussion was held so that the students could make an analogy between the discharge of the ashes formed by the burning coal in the stove in step 2E of the worksheet on the subject of "Excretion". After the students set up the analogy, teacher asked them to describe the excretion as in the 1st line. When one of the students mentioned the events that help with the excretion in the 11th line, the teacher reminded the target to the student who went out of the topic by using the expressions in the 12th line. The teacher's statement on line 12 is within the scope of the *explaining the process feedback.*

Table 6. *Explaining the Process*

Line	*Utterance*
01	*Teacher: Well, was there a situation similar to cleaning this stove in our body?*
02	*Yes.*
03	*Teacher: Where does this event take place?*
04	*In our muscles.*
05	*In our organs.*
06	*Teacher: All right. What is the name given to the removal of waste material accumulated in our muscles from the body? Say it Deniz.*
07	*excretory system.*
08	*Teacher: "Excretion". Beautiful. Well, let's define discharge. Let's combine the words you have learned so far and make a sentence, let's see what is "Excretion"? Tell me, Defne.*
09	*The removal of waste materials from our body.*
10	*Teacher: He talked about waste matter, he talked about getting away from the body. Any other ideas?*
11	*Sweating.*
12	*Teacher: That's not exactly our topic, is it? We are talking about waste materials inside the cell now. Another*
13	*Urine.*

REFLECTION FEEDBACK

The teacher's submission of student answers or group work to the approval of the class and getting ideas from the students about the answer or study is called "reflection feedback". The codes of this feedback are that the teacher presents the students' answers for the approval of the class, the students direct their ideas to the other students, the students ask the reasons for their agreement or not, and the students get their ideas about the study after the group work is presented to the whole class.

In the activity related to the subject of "Measurement of the Magnitude of Force" in table 7, a problem situation was presented to the students and questions were asked about the problem situation. In the first line, teacher directed the answers of the 3 students who were doing research to the post-research questions to the class and asked the students' ideas about these answers. In the 3rd line, the teacher directed another student's research to the class and asked their opinions. In lines 1 and 3 of this dialog, teacher uses *reflection feedback*.

Table 7. *Reflection Feedback*

Line	*Utterance*
01	*Teacher: Hmm. Well, then guys, let me ask you all a question. Now you all had an estimate of the unit of the magnitude of your force. Hasan's guess was the dynamometer. Then he found a dynamometer again. Defne's guess was degrees, which Newton found after research. Ali's guess was the weight of the crate, and after research, he found the weight of the crate again. What do you say? Three people did research, and all results are different. Ayse, you have said that you did research as well, do you remember what was the unit for the magnitude of force?*
02	*Newton.*
03	*Teacher: Did you find Newton? Hmm. There are four research. Two of them are Newton, one is dynamometer, and one is the weight of the case. What do you say?*

FEEDBACK ABOUT PEER RELATIONS

The behaviour of the teacher towards the disagreements between the students is classified as "peer relations" feedback. The codes of this feedback type are that the teacher ignores the disagreements between the students, bypasses them, offers solutions for the disagreements or warns the students.

In Table 8, the students try to do the activity in the 3E step of the worksheet on the topic "Distinguishing Properties of Matter" by discussing it as a group. In line 1, one of the students states that she is uncomfortable with her groupmate. The teacher asked questions about the disagreement between the students. Teacher shows in line 12 that this situation bothers him. In line 14, he warned the student who was disturbing his friends. On line 14, where he warns about in-group disagreements, teacher presented feedback about peer relations feedback.

Table 8. *Feedback About Peer Relations*

Line	*Utterance*
01	*My teacher Ahmet passes the pencil box and takes it back.*
02	*Teacher: Selin, Is Ahmet only messing with you like this? Is he messing with Ali and Duygu?*
03	*Yes, my teacher he has taken my pencil case.*
04	*Teacher: Is Ahmet messing with others?*
05	*Sometimes he messes with.*
06	*Teacher: Sometimes. Is he messing with you more?*
07	*No.*
08	*Teacher: What does he do, does he take your pens?*
09	*No teacher.*
10	*Teacher: What does he do?*
11	*He hits me.*
12	*Teacher: Off…*
13	*My teacher Ali also goes, lifts and does not give.*
14	*Teacher: Ahmet don't do it don't disturb your friends.*

NOT GIVING FEEDBACK

Failure of the teacher to respond to student questions or answers or giving another student the right to speak is classified as "not giving feedback". The codes of this feedback type are that the teacher remains silent in the face of the student's answer or gives another student the right to speak. In the 2E step of the worksheet on the subject of "Friction Force" in table 9, the students designed an experiment and presented it to the class. The teacher asks the students about the controlled variables of the experiment. In the 5th and 6th lines, when the students mixed up the independent variable and the controlled variables, teacher explained why he did not accept the students' answers in the 7th line. When the wrong answer he explained in the 8th line was repeated by another student, the teacher did not respond to the student. He continued the lesson by asking the experimental group what the control variables in their experiments were. It is within the scope of *not giving feedback* if the teacher remains silent on the 9th line and then directs the question to the students in another group on the 10th line.

Table 9. *Not Giving Feedback*

Line	*Utterance*
01	*Teacher: So, what are your variables that you control?*
02	*Control variable.*
03	*Car.*
04	*Teacher: Let's evaluate the car as a whole, another car, what else did you not change?*
05	*My teacher, board.*
06	*Tile.*
07	*Teacher: No look wood and tiles, we have changed the floor, haven't we?*
08	*My teacher the floor.*
09	*Teacher: …. (No answer).*
10	*Teacher: What else might not have changed? The second group, the first group, the first group, you did such an activity, what could be the variable you controlled in this activity? Other than the type of another car?*

COMPARISON FEEDBACK

The teacher's comparison of answers or work to enable students to discuss different situations is classified as "comparison feedback". The teacher can enable students to compare two experimental setups, ideas or studies. The teacher of this feedback compares the students' predictions with the observations made during the research process, compares the answers of the students or groups, compares two predictions of a student, compares two situations/experimental setups.

In the 4E step of the worksheet on the subject of "Heat Exchange" in table 10, the students were provided to compare the two arguments. In line 1, the teacher presented these arguments and asked the students to decide which one is correct by having a group discussion. Teacher provided *comparison feedback* by allowing students to compare two different arguments.

Table 10. *Comparison Feedback*

Line	*Utterance*
01	*Teacher: In the 3rd activity, you are given two sentences, look, they gave you a sentence, not a question. He says that the temperature of every substance that receives heat increases. The other thing is that the temperature of every substance that receives heat does not increase. Which one do you think is correct?*
02	*Second one*
03	*Number two.*
04	*Teacher: Decide that as a group. Write your reason for why you think so, let's find out.*

FUNCTION OF THE FEEDBACK

It is the feedback given by the teacher in order to affect the inquiry behaviours and achievement goal orientations of the students in the learning environment. The feedback provided by the teacher during the inquiry process can lead students to increase their knowledge, learn to improve themselves,

to prove their ability to others, to be appreciated, to learn to win the competition. At the same time, teacher's feedback can lead students to research, use scientific process skills, think, discuss, or become the recipient of information conveyed by others and learn by rote. Function of feedback; It consists of feedback sub-categories that support mastery goal orientation, performance goal orientation, continue the inquiry process, and ending the inquiry process.

FEEDBACK SUPPORTING THE MASTERY GOAL ORIENTATION

It is the feedback provided by the teacher to ensure that students learn about a subject in order to increase their own knowledge, give importance to effort and enjoy learning. The codes of this feedback type are not to leave the student in a difficult situation, to focus the students on the target, to increase the self-efficacy of the students, to enable them to make self-evaluation, and to approve the student's effort in the process.

In table 11, the worksheets related to the subject of "Excretion" are discussed about the burning of coal in the stove in step over all the examples, so that they can make an analogy with the subject of " Excretion" and emptying the containers of the burning coal. After the students made the analogy, the teacher asked questions as in the 1st line so that the students could establish a relationship between cleaning the ash in the stove and " Excretion". In the 8th line, the students emphasize that they have learned many things before and ask them to define the excretion event by using what they have learned, thereby increasing the self-efficacy of the students. For this reason, the teacher's statements on the 8th line are included in *the feedback to support mastery goal orientation*.

Table 11. *Feedback Supporting the Mastery Goal Orientation*

Line	*Utterance*
01	*Teacher: Well, was there a situation similar to cleaning this stove in our body?*
02	*Yes.*
03	*Teacher: Where is this happening?*
04	*In our muscles.*
05	*In our organs.*
06	*Teacher: All right. What is the name given to the removal of the waste material accumulated in our muscles from the body? Let's give it a name. Tell us Deniz.*
07	*Excretory system.*
08	*Teacher: Excretion. Good. All right, Let's define this excretion. What are you going to say? Let's combine the words you have learned so far and make a sentence. What is excretion? Tell us Defne.*
09	*Removal of waste materials from our body.*
10	*Teacher: He talked about waste matter, he talked about getting away from the body. Any other ideas?*

FEEDBACK SUPPORTING PERFORMANCE GOAL ORIENTATION

Teacher's feedback that causes students to compete with each other, try to show others that they are talented, avoid appearing incompetent, and work for grades is classified as "feedback that supports performance orientation". The codes of this type of feedback are that the teacher evaluates the students with a grade, blames the students, threatens not to let them do the experiment or not to share their research with the class, says negative words about the self-efficacy of the student, shows the students who did the task as an example to the students who could not do the task, and mocks the answers of the students.

In table 12, students fill in the excretion event in the relevant sections of the worksheets by making use of the model they previously created as a group in step 5E of the worksheet on the subject of "Excretion". In the meantime, when the voice rose, teacher explained that this evaluation activity made by the students would be evaluated with a grade and focused the students on the grade. In line 1, teacher provided *feedback supporting the performance orientation.*

Table 12. *Feedback Supporting Performance Goal Orientation*

Line	*Utterance*
01	*Teacher: OK guys, now I will distribute one evaluation sheet to you. You will receive points for these studies you have done, and this will be added to your grades along with the exam grade. How much did you learn? We will have a written exam. But we'll see how much we learned from the measurements on these papers, okay guys? You do your work by paying attention to these. If there is anything you do not understand, you can ask.*

FEEDBACK THAT CONTINUES THE INQUIRY PROCESS

The feedback provided by the teacher in order to direct the students to identify a problem situation, to produce solutions by making predictions, observations, research, experiments, discussions, comments, and to share with the class is classified as the *feedback that continues the questioning process*. The codes of this feedback type allow the teacher to focus the students on the target, emphasize the contextual feature of the information, direct the students to discuss, rethink and research, compare the prediction with the observation, reveal the foreknowledge, deepen the explanation, enable the students to look at the problem from different angles, make inferences and share, and prevent in-group disagreements. Waiting for a solution from the students, offering a solution to the disagreements within the group, and revealing different ideas.

In the 4E step of the worksheet on the topic "Distinguishing Properties of Matter" in table 13, an experiment was conducted for students to observe that the boiling point is not constant for impure substances. Two different setups were designed for this experiment. The students made observations while equal amounts of water were added to the first and second experimental setups and heated with identical heaters. They guessed what could be done to stop the boiling. By focusing the students on the target in the 1st line; with the expressions in the 8th, 11th and 13th lines, he provided *feedback that continued the inquiry process* by allowing the students to compare their predictions and observations and make comments.

Table 13. *Feedback that Continues the Inquiry Process*

Line	*Utterance*
01	*Teacher: So, I'm asking you. I took the water from here without turning off the fire of these boiling waters. Can you stop it boiling without adding water to it?*
02	*Teacher by adding salt.*
03	*By adding salt.*
04	*Yes*
05	*My teacher I think, its temperature drops.*
06	*Teacher: Really?*
07	*Yes.*
08	*Teacher: By adding salt, let`s add some salt.*
09	*Teacher: Yes, is it ok if I add that much salt?*
10	*It is OK my teacher.*
11	*Teacher: Look, it's 100 degrees, but I'm adding salt. What happened to boiling?*
12	*It stopped.*
13	*Teacher: The other one continues, let's see the temperature.*
14	*100.*

FEEDBACK THAT ENDING THE INQUIRY PROCESS

Feedback that causes the students to be in the position of the recipient of the transferred subject without thinking by the teacher by directly transferring the subject to the students, trying to manage the students' learning, interpreting the correct and incorrect answers of the students, is classified as "feedback that ends the inquiry process". The codes of this feedback type are the teacher's approval of his/her answer, the explanation of the target, the direct answer, the explanation of the wrong or correct reason in the student's answers, the approval of the information from the student,

the use of the information from the student as well as adding an explanation, directing the student to the information source.

In Table 14, in the 2E step of the worksheet on the subject of "Heat Exchange", teacher learned that the students did not conduct research. In line 5, he asks the students who do not do research to do the 2E (Exploring) activity as a group and gives the students time. In the speech of the 1st group, it is understood that the students' knowledge is not sufficient to carry out the relevant activity and they are indecisive about the questions since they do not conduct research on the subject. Teacher provided feedback that *ends the inquiry process* by leaving the students who did not do research alone during the questioning process, not producing a solution, and directing the students to complete the relevant activity only. The presentation of this feedback caused the students not to be able to complete the deficiencies in their prior knowledge and to continue questioning.

Table 14. *Feedback that Ending the Inquiry Process*

Line	*Utterance*
01	*Teacher: Guys, you should have researched these "Heat Exchange" concepts because of the first activity. Who did the research?*
02	*(No response).*
03	*Teacher: Didn't anyone do it? What is heat, what is temperature? Is not there anybody who did?*
04	*(No response).*
05	*Teacher: Yes, the term is ending, look, there is 1 more week after this week ends. You still haven't gotten into the habit of doing the activities. All right let's discuss heat and temperature as a group, as far as you know. Complete it into the star with that triangle. As a group. (1st group speech).*
06	*Does the thermometer belong to heat or temperature?*
07	*Heat*

DISCUSSION, CONCLUSION AND IMPLICATIONS

In the literature, feedback is classified according to the course content, approach to learning, grade level, focus, relationship with the target and method. In addition, feedback has been defined within the scope of more than one course (Tunstall et al., 1996; Voerman et al., 2012, Berg et al., 2013). However, it can be thought that the feedback determined independently of the nature of the course and the learning strategy used will not provide enough detail about that course. There are studies in the literature that examine feedback in science lessons and even within the scope of inquiry. However, in these studies, they only focused on the following types of feedback: student mistakes (Cengiz et al., 2017), laboratory reports (Chalmers et al., 2014), discussion loops (Rinehart et al., 2020), student experiments (Eckes et al., 2019), correct and incorrect answers (Chin, 2006). The social and affective dimensions of scientific inquiry have not been adequately studied. Although feedback has been examined in the literature as a variable that affects achievement-goal orientation, this variable has not been included in their classification. In this study, the teacher's verbal feedback was handled within the framework of cognitive, affective and social dimensions of IBL, different from the literature, and classified according to its method and function. Reflection, comparison feedback in the method category; In the function category, feedbacks that continued the inquiry process and ending the inquiry process were determined.

Continuing inquiry in science classes can be challenging for teachers (Quigley, Marshall, Deaton, Cook, & Padilla, 2011). If teachers know the feedback, they need to provide in the IBL environment, it can be easier to guide learning, motivate students to the lesson, and support their academic success. It may not be enough for the teacher to focus only on the experiment, the level of openness of the experiment, the readiness of the students, the structure of the subject in the questioning environment. Reciprocal determinism forms the center of Bandura's social learning theory. In this concept, the environment, individual characteristics and behaviour mutually affect each other (Bandura, 1977). Teacher should also take into account the correlation between these affects.

Because all the variables that make up all the components of the learning environment, such as the individual characteristics of the students, the teacher's approach, and the method he uses, affect each other (Bandura, 1977). The relationship between these variables is provided through feedback. Every feedback (environment-individual) given by the teacher to a student actually creates a criterion in the classroom environment. According to this criterion, the student who is given direct feedback and other students may be affected by this criterion by showing a behavioural change (environment-behaviour).

Feedback presented in the IBL environment is related to the teacher's role in the learning environment. Considering the feedback of the method and function categories (Table 1), the teacher can predict how to apply the inquiry and how the feedback he/she presents may affect the students emotionally. In class where a teacher is unaware of the method or function of the feedbacks, it may not matter why the query is interrupted. Teacher can prevent students from inquiry by making direct corrections when students make mistakes. A teacher who is aware of the feedback method, on the other hand, can continue inquiry by supporting students with different feedback such as reflection (Table 7), comparison (Table 10), and opportunity (Table 2) in the face of mistakes. A teacher who is aware of the function of feedback can predict how the feedback he provides may affect students cognitively and emotionally. Instead of focusing on the notes, it directs the students to effort and learning together and prepares the students to learn emotionally. The fact that feedback is handled independently of questioning in the literature has caused the situations mentioned here to be overlooked. This study has attempted to fill this gap.

Strippel et. al., (2015) determined that in the application of inquiry-based science lessons, the components related to the nature of scientific inquiry were ignored and focused more on skill and concept teaching. For this reason, teachers' feedback in science lessons has been limited to teaching skills and concepts (Chin, 2006; Chalmers et. al., (2014; Cengiz, 2015; Eckes et. al., 2019). Another limitation here is how consciously teachers give feedback. A teacher who does not recognize the feedback can lead his students to undesired goals in the program in terms of cognitive and affective sense. However, the teacher who uses the feedback consciously will contribute more to learning. For example, by consciously presenting the comparison feedback (Table 10) , it can make students feel that different experiments can be done for a subject, that is, scientific research can be done by following different paths (Lederman, Lederman, Bartos, Bartels, Meyer and Schwartz, 2014). In scientific research, students can try the experiments more than once (Osborne et. al., 2003) by providing opportunity feedback (Table 2). It can be emphasized that the data collected with the comparison feedback and the research questions should be consistent (Lederman et. al., 2014). With reflection feedback (Table 7), the results obtained can be shared and ideas can be discussed (Schwartz, Lederman, & Lederman, 2008).

Feedback provides students with information about which tasks the Teacher values. Teacher, who uses the feedback consciously, can direct his students to the goals determined by the program with these messages. For example, it uses process feedback (Table 6) to draw attention to course-related procedures, while using opportunity feedback (Table 2) to elicit students' ideas. But the unconscious use of feedback can cause students to lose their way in the process. It can also emotionally lead to undesirable targets. For example, positive feedback given only to getting high grades can push students towards results and performance goal orientation (Table 12). However, the feedback presented to the development in the process will enable the students to turn to the learning goal orientation (Table 11).

Feedback is also a determinant of the criteria in the classroom. Doing research, working collaboratively, considering the opinions of others, presenting reasons, revealing different ideas, and having a class discussion about an idea are important criteria in the IBL environment (Lederman et. al., 2014). For example, while teachers provide insufficient feedback on the tasks that students have accomplished, they provide more feedback on deficiencies (Voerman et. al., 2012), which may cause students to focus more on not making mistakes. However, in this case, it is overlooked that there are

errors in the nature of scientific inquiry. The teacher's presentation of comparison feedback (Table 10) on an experiment may provide an opportunity for students to realize their mistakes in the experiment and to review the results of the experiment with giving feedback. When the teacher gives the opportunity to the student by asking additional questions without interrupting the inquiry when the student makes a mistake, the students may realize that making mistakes is an acceptable situation in the inquiry environment and even an important opportunity for learning. In this case, the student can take a more active part in the learning environment instead of avoiding making mistakes.

Continuity of inquiry is related to keeping students cognitively active in the learning environment. Students must be motivated to question in order to be cognitively active. Feedback plays a key role in ensuring the continuity of inquiry in science lessons. The types of feedback that interrupt (Table 14) or continue the inquiry (Table 13) determined in this study play a decisive role in the continuation of the inquiry. At the same time, it is expected that the feedback supporting the learning (Table 11) and performance orientation (Table 12) determined in this study will direct student motivation in order to maintain the inquiry.

In the inquiry environment, teacher may cause students to focus on research, discussion, asking questions or learning, gaining knowledge, attention to the importance of effort or showing the best performance that they will undertake during the inquiry process. In this way, students are affected emotionally by the feedback. In addition to the way the teacher's feedback is presented in the IBL environment, how it affects students cognitively and affectively is also important (Geitz et. al., 2013). When students are given the opportunity (Table 2), they are affected positively emotionally, and inquiry can continue. However, if the teacher reflects their negative feelings (Table 4), highlights a student (Table 5) or does not provide feedback (Table 9), students may be negatively affected, and inquiry may be interrupted .

Considering that the feedbacks cannot be independent of the strategy used and the lesson, in this study, the science lessons in which the inquiry was applied were observed, reflecting (Table 7) and comparing (Table 10) the feedback types available in the literature in the method category; In the function category, feedback types that continue the inquiry process (Table 13) and interrupt the inquiry process (Table 14) have been added.

The limitation of this study is the determination of feedback in a classroom where inquiry is at a high level. Researchers can identify the types of feedback in different levels of IBL settings. The effect of inquiry-oriented feedback on cognitive and affective characteristics in the learning environment can be examined with experimental studies. Considering that the feedback is specific to the field and the strategy used, applied training on inquiry-based feedback and its types can be given in the pedagogical field trainings given to teachers in the field of science. At the same time, the types of feedback should be taken into account in the preparation of course resources. For example, these types of feedback can be used consciously in the dialogues in the text.

AUTHOR CONTRIBUTIONS

The first author contributed to data collection, literature review, and preparing the discussion and conclusion sections. The second author contributed to determining the theoretical framework of the study, analyzing the data, and preparation of the methodology. Both authors critically reviewed the article and approved the final version.

REFERENCES

Abd-El-Khalick, F., Boujaoude, S., Duschl, R., Lederman, N. G., Mamlok-Naaman, R., Hofstein, A., Nıaz, M., Treagust, D & Tuan, H. L. (2004). Inquiry in science education: International perspectives. *Science Education*. *88*(3), 397-419. https://doi.org/10.1002/sce.10118

Ames, C., & Archer, J. (1988). Achievement goals in the classroom: Students' learning strategies and motivation processes. *Journal of Educational Psychology*, *80*(3), 260-267. https://doi.org/10.1037/0022-0663.80.3.260

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review*, *84*(2), 191. https://doi.org/10.1037/0033-295X.84.2.191

Bandura, A. (1986). The explanatory and predictive scope of self-efficacy theory. *Journal of Social and Clinical Psychology, 4*(3), 359-373. https://doi.org/10.1521/jscp.1986.4.3.359

Bloom, B. S. (1984). *The Search for Methods of Group Instruction As Effective As one-to-one tutoring.* Educational Leadership, *41*(8), 4-17. https://doi.org/10.3102/0013189X013006004

Burns, J. C., Okey, J. R., & Wise, K. C. (1985). Development of an integrated process skill test: TIPS II. *Journal of Research in Science Teaching*, *22*(2), 169-177.
https://doi.org/10.1002/tea.3660220208

Carless, D., & Winstone, N. (2020). Teacher feedback literacy and its interplay with student feedback literacy. *Teaching in Higher Education*, 1-14. https://www.tandfonline.com/doi/full/10.1080/13562517.2020.1782372

Cengiz, E., & Ayvacı, H. Ş. (2017). Analysing the feedback that secondary school science teachers provide for student errors that show up in their lessons. *Journal of Turkish Science Education, 14*(3), 109-124.

Chalmers, C., MacCallum, J., Mowat, E., & Fulton, N. (2014). Audio feedback: Richer language but no measurable impact on student performance. *Practitioner Research in Higher Education*, *8*(1), 64-73. https://ojs.cumbria.ac.uk/index.php/prhe/article/view/150

Chin, C. (2006). Classroom interaction in science: Teacher questioning and feedback to students' responses. *International Journal of Science Education, 28*(11), 1315-1346. https://www.tandfonline.com/doi/abs/10.1080/09500690600621100

Chi, S., Wang, Z., & Liu, X. (2021). Moderating effects of teacher feedback on the associations among inquiry-based science practices and students' science-related attitudes and beliefs. *International Journal of Science Education, 43*(14), 2426-2456. https://www.tandfonline.com/doi/abs/10.1080/09500693.2021.1968532

Çakar, E. (2008). *Determination the level of students' achievement of the science process skills acquisition of 5th grade science and technology programs* [Unpublished Master Thesis]. Süleyman Demirel University, Isparta. https://tez.yok.gov.tr/UlusalTezMerkezi/tezSorguSonucYeni.jsp

Demir, T. (2011*). Study of the relationship between the creative writing skills of primary school students and their self-efficacy perception and types of achievement goal orientation.* [Unpublished doctoral dissertation]. Gazi University, Ankara. https://tez.yok.gov.tr/UlusalTezMerkezi/tezSorguSonucYeni.jsp

Dweck, C. S., & Leggett, E. L. (1988). A social-cognitive approach to motivation and personality. *Psychological Review, 95*(2), 256–273. https://doi.org/10.1037/0033-295X.95.2.256

Eckes, A., & Wilde, M. (2019). Structuring experiments in biology lessons through teacher feedback. *International Journal of Science Education*, *41*(16), 2233-2253. https://www.tandfonline.com/doi/abs/10.1080/09500693.2019.1668578

Furtak, E. M., Seidel, T., Iverson, H. & Briggs, D.C. (2012). Experimental and quasi-experimental studies of inquiry-based science teaching: A meta-analysis. *Review of Educational Research*, *82*(3), 300-329. https://doi.org/10.3102/0034654312457206

Geban, Ö., Askar, P., & Özkan, Ï. (1992). Effects of computer simulations and problem-solving approaches on high school students. *The Journal of Educational Research*, *86*(1), 5-10. https://www.tandfonline.com/doi/abs/10.1080/00220671.1992.9941821

Hattie, J., & Timperley, H. (2007). The power of feedback. *Review of Educational Research, 77*(1), 81-112. https://doi.org/10.3102/003465430298487

Hattie, J. (2009). The black box of tertiary assessment: An impending revolution. Tertiary assessment & higher education student outcomes: *Policy, Practice & Research,* 259, 275. https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=ef18bd57b49bf1cb99b4b7fd150c893e607c6b6b

Jagacinski, C. M., & Strickland, O. J. (2000). Task and ego orientation: The role of goal orientations in anticipated affective reactions to achievement outcomes. *Learning and Individual Differences, 12*(2), 189-208. https://doi.org/10.1016/S1041-6080(01)00037-1

Jonassen, DH (1991). Evaluation of constructivist learning. *Educational Technology*, 31 (9), 28-33.

MacIsaac, D., & Falconer, K. (2002). Reforming physics instruction via RTOP. *The Physics Teacher*, *40*(8), 479-485.https://doi.org/10.1119/1.1526620

National Research Council. (2012). *A framework for K-12 science education: Practices, crosscutting concepts, and core ideas.* National Academies Press. https://nap.nationalacademies.org/catalog/13165/a-framework-for-k-12-science-education-practices-crosscutting-concepts

Osborne, J., Collins, S., Ratcliffe, M., Millar, R., & Duschl, R. (2003). What "ideas-about-science" should be taught in school science. A Delphi study of the expert community. *Journal of Research in Science Teaching*, *40*(7), 692–720. https://doi.org/10.1002/tea.10105

Özkale, U., & Kanadli, S. (2021). An investigation of feedback strategies used by science teachers in the classroom setting: A mixed-methods research*. International Journal of Progressive Education*, *17*(1), 439-457.

Pekrun, R., Cusack, A., Murayama, K., Elliot, A. J., & Thomas, K. (2014). The power of anticipated feedback: Effects on students' achievement goals and achievement emotions. *Learning and Instruction*, *29*, 115-124. https://doi.org/10.1016/j.learninstruc.2013.09.002

Quigley, C., Marshall, J. C., Deaton, C., Cook, M. P., & Padilla, M. (2011). Challenges to inquiry teaching and suggestions for how to meet them. *Science Educator*, *20*(1), 55-61. https://files.eric.ed.gov/fulltext/EJ940939.pdf

Rinehart, R. W., Kuhn, M., & Milford, T. M. (2020). The relationship between epistemic cognition and dialogic feedback in elementary and middle school science classrooms. *Research in Science & Technological Education,* 1-18. https://www.tandfonline.com/doi/full/10.1080/02635143.2020.1799779

Sadler, D. R. 1989. Formative assessment and the design of instructional systems. *Instructional Science*, 18, 145–165. [Crossref], [Web of Science ®], [Google Scholar]

Schwartz, R., Lederman, N. G., & Lederman, J. S. (2008*). An instrument to assess views of scientific inquiry: The VOSI questionnaire.* [Conference presentation]. Paper presented at the annual meeting of the National Association for Research in Science Teaching. Baltimore, MD. https://www.researchgate.net/publication/251538349_An_Instrument_To_Assess_Views_Of_Scientific_Inquiry_The_VOSI_Questionnaire

Schunk, D. H. (2014). *Learning theories from an educational perspective.* [Öğrenme teorileri-Eğitimsel bir bakışla]. (Translation from 5nd ed.). (M. Şahin (Trans. Ed.). Nobel.

Shute, V. J. (2008). Focus on formative feedback. *Review of Educational Research, 78*(1), 153-189. https://doi.org/10.3102/0034654307313795

Strippel, C. G., & Sommer, K. (2015). Teaching nature of scientific inquiry in chemistry: How do German chemistry teachers use labwork to teach NOSI?. *International Journal of Science Education, 37*(18), 2965-2986. https://www.tandfonline.com/doi/abs/10.1080/09500693.2015.1119330

Tunstall, P., & Gsipps, C. (1996). Teacher feedback to young children in formative assessment: A typology. *British Educational Research Journal, 22*(4), 389-404. https://www.tandfonline.com/doi/abs/10.1080/0141192960220402?journalCode=cber20

Thurlings, M., Vermeulen, M., Bastiaens, T., & Stijnen, S. (2013). Understanding feedback: A learning theory perspective. *Educational Research Review,* 9, 1-15. https://doi.org/10.1016/j.edurev.2012.11.004

Van den Bergh, L., Ros, A., & Beijaard, D. (2013). Teacher feedback during active learning: Current practices in primary schools. *British Journal of Educational Psychology, 83*(2), 341-362 https://doi.org/10.1111/j.2044-8279.2012.02073.x

Voerman, L., Meijer, P. C., Korthagen, F. A., & Simons, R. J. (2012). Types and frequencies of feedback interventions in classroom interaction in secondary education. *Teaching and Teacher Education, 28*(8), 1107-1115. https://doi.org/10.1016/j.tate.2012.06.006

Wisniewski, B., Zierer, K., & Hattie, J. (2020). The power of feedback revisited: A meta-analysis of educational feedback research. *Frontiers in Psychology*, *10*, 3087. https://www.frontiersin.org/articles/10.3389/fpsyg.2019.03087/full