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Teachers' Views on the Effects of Inquiry-Based Science Education on the Learning Process of Bilingual Students

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ABSTRACT

New learning methods have been applied every day regarding education and training, and these methods have been used for students to better understand and structure knowledge. As one of these methods, inquiry-based learning is used in primary school science teaching. Turkiye has a rich and diverse cultural structure. Thanks to this diversity, different languages are spoken in various regions apart from Turkish as the official language in Turkiye. In our study, it is aimed to benefit from teacher views about the learning processes of bilingual students who are applied inquiry-based science teaching. The experiences of teachers who have bilingual students in their class were questioned. The study used the phenomenological research model, one of the qualitative methods. The research group consists of 7 teachers who are chosen voluntarily from teachers with bilingual students in the classroom. A semi-structured interview form developed by the researcher was used to collect the research data. While these forms, which included open-ended questions, were applied, the interviews were recorded. These collected data were analyzed by content analysis method. Research findings indicate that inquiry-based science teaching positively affects the learning processes of bilingual students. It has been determined that students' conceptual understanding, participation and interest in the lesson, group working and cooperation skills, science lesson attitudes, problem solving skills and permanent learning are increased.

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INTRODUCTION

In this time when the world is experiencing the information period, many things have changed, including people's needs and views. Although the need for knowledge and learning is crucial in every period of humanity, it has become much more important in the century we live in. In this sense, it has gained importance to train literate individuals in order to be able to think scientifically and to follow developments closely. The aim of science education is rasing individuals, can produce solutions for problems that individuals constantly encounter, who can closely follow the developing and changing world, and who can transfer the knowledge and values they learned at school to their lives (Çepni & Çil, 2009). The way of accessing information today is different from the methods used in the past. While information was given directly to students in the past, John Dewey advocated using inquiry-based teaching in science education, and suggested that students should be active at every stage of the process and that the teacher should be guiding (Barrow, 2006).

In the most general sense, inquiry-based teaching is to develop research on situations that arouse curiosity in individuals and to express the results they reach in this process by showing evidence. Inquiry-based learning is also called inquiry-oriented learning and inquiry-questioning based learning in the literature. Inquiry-based learning approach has been used since the first years of the 20th century. Between 1940 and 1960, the idea of using inquiry-based teaching as a learning approach continued to be increasingly discussed and consulted (National Research Council [NRC], 2000).

Inquiry-based learning approach includes a process, problems are created and then students try to solve these problems by creating questions (Wood, 2003). The responsibility of the subject to be learned in inquiry-based science teaching rests entirely with the student. Because students are responsible for all research processes such as the selection of materials to be used and the creation of research problems (Karamustafaoğlu & Havuz, 2016). Since science is intertwined with nature, students associate the science concepts they encounter in the process with daily life. This approach allows students to discover knowledge directly on their own. When the definition of inquiry-based learning is examined in general, students' research processes are similar to the working systems of scientists.

Inquiry-Based Teaching

Inquiry-based learning is divided into various classes from teacher-centered to student-centered. Keller (2001) classified inquiry-based teaching as directed research, structured research, and unlimited research. Chin and Chia (2006) analyzed it under two headings as guided research and fully open research. When the literature is examined, various classifications are seen. However, in the most general sense, science educators divided inquiry-based learning into three: Structured inquiry, Guided (Directed) inquiry, and Open-ended (Limitless Discovery) inquiry.

Structured Inquiry

Although this type of inquiry is suitable for younger age groups, it is a type of inquiry suitable for traditional classrooms. It puts the teacher in the center. The selection of the questions, the activities to be done and the planning are made by the teacher, and the student is only trying to find the result. The teacher presents many things to the student (material, method of solution of the problem, etc.) ready. In structured inquiry, students focus on finding the result and they are usually not given the opportunity to be active (Çalışkan, 2008).

Guided (Directed) Inquiry

In guided inquiry, the teacher determines research problem and transfers it to students. Students create their own data collection methods and the teacher guides the students in the remaining process (Bayır, 2019). In guided inquiry, the teacher should pay attention to the question that the teacher will ask at the beginning of the lesson, to attract the attention of the student and to encourage them to investigate by arousing their curiosity. It would be more appropriate for students who have experienced structured

inquiry to apply guided inquiry. Likewise, guided inquiry prepares students for open-ended inquiry. In guided inquiry, the teacher ignores the direct disclosure of information, but according to open-ended inquiry, he/she can direct students' assumptions more and guide students in the process (Lim, 2001, as cited in Demirci, 2015). In summary, guided inquiry is a process, teacher is guide and student conducts inquiry, experiments and activities to solve problem given to him/her.

Open-ended (Limitless Discovery) Inquiry

This type of inquiry is the type in which the student is the most responsible and the teacher is the most passive. It is more suitable for students who have practiced structured and guided inquiry. Since students conduct their own inquiry, they need to use higher-order thinking skills. In this sense, open-ended inquiry is more suitable for older age groups. In open-ended inquiry, students identify their own problems, apply their own methods, and make their own inferences (Llewellyn, 2002). Open inquiry is similar to guided inquiry, but students also prepare the research problem themselves (Colburn, 2000). Students carry out all processes themselves, such as identifying the problem, collecting data, making analysis, and reaching a solution by making inferences. In this sense, open inquiry is known as the closest type of research to the work of scientists (Çalışkan, 2008).

Language and Bilingualism

The dictionary meaning of language is defined as "*the agreement people make with words or signs to say what they think and hear, language*" (Turkish Language Association [TLA], 2005). Language is a natural tool that provides agreement between individuals, a living entity that has its own rules and develops only within the framework of these rules, a system of secret agreements whose foundation was laid in ancient times, a social institution woven from sounds (Ergin, 2009). Many definitions of language have been made from the past to the present. Although the definitions are different, common feature between them is that they emphasize that language is a means of communication. Language is also an important tool used to perform cognitive functions such as thinking, perceiving and remembering.

Communities have to learn a language other than their mother tongue for some reasons. Syrian students studying in the official languages of the countries they took refuge in as refugees from the civil war in their country can be given as an example to this situation. Although their mother tongue is Arabic, they have to learn a second language according to the country they took refuge in. Students in this situation are called bilingual. In other words, they can use other languages other than their mother tongue. Such societies are called bilingual.

Bilingualism in Turkiye differs according to regions. There are societies that speak languages such as Kurdish, Arabic and Balkan languages as their mother tongue. There are many different definitions of bilingualism. For instance, when students start school, they start as monolingual and become bilingual by studying in a different language. Again, students may start as bilingual and with the education they receive, their second language may become atrophied and disappear (Yılmaz, 2014). According to Aksan (2009), individuals learning or using more than one language for different reasons and under different conditions or learning a second language at a level close to their mother tongue is called bilingualism.

Inquiry-Based Teaching and Bilingualism

Inquiry-based teaching is a teaching method that aims to develop students' scientific process skills (Martin, 2009). Communication skills are the basis of skills such as observation, classification, measurement, data recording, and hypothesis formation. Students frequently use the research process to work with their friends, listen to others, and transfer the data they have obtained to someone else, thus improving their communication skills (Mortimer & Scott, 2003). This development, which is provided by communication between students in inquiry-based teaching, is further strengthened by the teacher-student relationship. Because in this teaching method, the teacher cares about the ideas of all students and takes time to listen to them. Students who see that their ideas are patiently listened to are encouraged to

talk more (Scott et al., 2006). This situation causes them to talk frequently in class and to communicate with their friends and teachers. Bilingual students usually have difficulties in expressing in a language other than their own, which is the main reason for the problems they experience. This is a situation that has negative effects on their academic and social lives. Considering all these situations, answers to the following sub-problems were sought in the study in order to evaluate the opinions of teachers about the effects of inquiry-based science teaching on the learning process of bilingual students:What are the teachers' views on the effect of inquiry-based science teaching on the conceptual understanding, classroom interaction structures, participation and interest, science attitudes, problem-solving skills, group working and collaboration skills, permanent learning of bilingual students?

METHOD

This research was carried out using the phenomenology pattern, one of the qualitative research methods, suitable for the purpose and questions of the study. Phenomenology is based on the meanings revealed by experience. Any human experience (event, phenomenon, happiness, accident, relationship, situation, thought, feeling, etc.) can be a subject in phenomenological inquiry (Van Manen, 2014). Phenomenology, which seeks to explore phenomena that manifest in many ways in the world we live in, such as events, experiences, perceptions, inclinations, concepts, and circumstances, focuses on the phenomena that we do not fully and thoroughly understand (Yıldırım & Şimşek, 2006). In this study, the phenomenology design was preferred because it includes teachers' opinions and teachers' experiences about the learning processes of bilingual students in lessons taught with inquiry-based science teaching.

Study Group

The study group of the study consists of 7 teachers who work in different cities of Turkiye and have bilingual students in their classes. Participating teachers were determined by snowball sampling method. Snowball sampling is the process of determining other participants by learning from that person after reaching a participant who has experienced the phenomenon (Ersoy, 2019). Particular attention was paid to the experience and volunteering of the participants in the selection of the sample. All of the participating teachers are classroom teachers working in public schools. The demographics of the participants are presented in Table 1.

Table 1. *Demographic Characteristics of Participating Teachers*

Participants	Seniority	Gender	Age
Participant 1(T1)	0-3 Years	Female	26
Participant 2(T2)	0-3 Years	Female	24
Participant 3(T3)	0-3 Years	Female	26
Participant 4(T4)	4-7 Years	Male	28
Participant 5(T5)	8-11 Years	Female	30
Participant 6(T6)	0-3 Years	Female	32
Participant 7(T7)	0-3 Years	Female	24

Examining Table 1, it can be shown that the professional seniority of the participating teachers is mostly in the range of 0-3 years, and the most senior teacher is in the group of 8-11 years. Six of the participating teachers are female and 1 is male. Again, examining Table 1, it can be shown that that the ages of the participating primary school teachers vary between 24 and 32.

Data Collection Tool

The researcher created a semi-structured interview form that was used to collect the study's data. Three experts in the field of primary school education were asked to comment on the semi-structured interview form after it had first been created as a draft. Necessary adjustments were made according to the feedback from the specialist, questions about different ethnic origins were excluded from the form as they could cause misunderstandings and the final interview form became available. Before starting to collect data, a pilot study was conducted with a teacher and it was tested whether the questions were clear

and understandable. The interviews lasted for an average of 20-30 minutes. A voice recorder was used to capture the responses to the questions, which was followed by transcription. Data loss is thus avoided.

Analysis and Interpretation of Data

The content analysis method, which is one of the qualitative analysis methods, was used to analyze the opinions of teachers about the learning processes of bilingual students in inquiry-based science education. In the qualitative study, the data are analyzed in 4 stages. Content analysis is a coding job and is done to convert raw data into standard formats (Babbie, 2006). First of all, coding was done. Then, the extracted codes were transformed into themes and sub-themes. Then, the themes and sub-themes were tabulated, and the data in the tables were supported by direct quotations from views of the teachers. These codes were used in the analysis of the data and in the direct quotations from views of the teachers. The codes and themes obtained in the analysis of the data were presented in a tabular form in the findings section. Likewise, the codes and themes obtained by the content analysis method were turned into frequency and frequence tables and presented in the findings section.

Validity, Reliability and Ethics

After the preparation of the semi-structured interview form used in the study, an expert opinion was obtained from three experts in their field, and the necessary arrangements were made according to the suggestions. A pilot study was conducted with a teacher to test the suitability of the interview form (clearness and clarity of the questions, etc.). While determining the participant teachers, they were chosen from among the teachers who had the conditions to know inquiry-based science teaching, to have bilingual students in their class, and to have teachers volunteer for study. A voluntary consent form was also obtained from the participating teachers, stating that they were volunteers. The names of the teachers participating in the study were never shared at any stage of the study and were kept confidential. The participants were given codes as T1, T2, T3.

During the coding of the collected data, assistance was obtained from an auditor who was out of the study. The data were evaluated together by taking the opinions of the external auditor. Apart from the coding made by the researcher, a second coding was made and the compatibility between the two codings was calculated with Miles and Hubberman (1994) formula.

Reliability Coefficient = Number of Consensus / (Total Consensus + Disagreement)

The percentage of coding compliance was found to be 87%. In addition, before starting the study, necessary permissions were obtained from the Bartin University Social and Human Sciences Ethics Committee, indicating that the study was in compliance with ethical rules by number 2021-SBB-0245.

FINDINGS

In this section, the themes and codes compiled from the answers given by the participating teachers to the semi-structured interview form are presented, supported by the opinions of the teachers.

Conceptual Understanding of Inquiry-Based Science Education and Bilingual Students

When teachers were asked to provide comment in an inquiry-based science lesson to learn more about bilingual students' conceptual understanding, their responses are shown in Table 2.

Table 2. *Theme, Sub-theme, Sample Statements and Sample Opinions of Participant Teachers on the Opinions of Inquiry-Based Science Education on the Conceptual Understanding of Bilingual Students*

Theme	Sub-theme	Example Statements on Sub-Themes	*f*	%	Sample Expressions from Teachers' Opinions
Conceptual Understanding Difference Against	Differences between languages	Difference in Meaning Between Languages	3	30	*"Yes, I think there is a difference. We explain the concepts in Turkish, because they translate them directly into Kurdish in their minds, so they have*

Bilingual Students		Incorrect Translation into Mother Tongue	1	10	*difficulties in their conceptual understanding."* T2
		Word Association	1	20	*"Of course I do. Because they speak Turkish as a second language. They don't speak as clearly as we do. A concept has different meanings in both languages. Therefore, it can lead to differences in their conceptual understanding."* T7
					"Conceptually, there is a significant difference between word deficiencies and associations. Turkish students somehow encounter those concepts. Students can identify a word they have heard before, especially in science-related concepts." T6
	Misconceptions	Incomprehensibility	3	30	*"... So there are concepts between the two that can cause such confusion. That's why there is a difference."* T1
Conceptual Understanding Difference in Favor of Bilingual Students	Full Concept Learning	Encountering the Concept for the First Time	1	10	*"I think the effect of conceptual understanding is in favor of foreign students. To give an example from the concepts of heat and temperature, our non-bilingual students have a certain concept, a certain framework in their minds. So it's pretty hard to change that. However, since foreign students will learn for the first time, it is easier to teach them. Because it is very difficult to change a concept that is learned incorrectly."* T5
		Not Having Misconceptions	1	10	

Teachers stated that inquiry-based science teaching has results both in favor and against bilingual students between the conceptual understanding of bilingual students and the conceptual understanding of students receiving education in their mother tongue. Teachers who think that there is a difference against them made their explanations on the themes of difference between languages and misconceptions. The teachers who talked about the differences between languages mentioned the sub-themes of difference in meaning between languages, erroneous translation into mother tongue and word association. The teachers who thought that there was a difference in their favor made their explanations on the theme of full concept learning. The teacher, who made a statement on the theme of full concept learning, emphasized that the student did not have a misconception since the student encountered the concept for the first time.

It is seen that all of the participating teachers mentioned that there is a difference between the conceptual understanding of bilingual students. 14.2% of the participating teachers stated that this difference was in favor of bilingual students, while 85.8% stated that this difference was against bilingual students. It is seen that the emphasis on conceptual understanding difference is the highest rate (50%) between languages. While the rate of those who talked about conceptual understanding differences and misconceptions is 30%, the rate of those who talked about full concept learning is 20%. When the difference between the conceptual understanding of bilingual students and other students is examined in general, it can be said that there is a difference against bilingual students due to differences between languages and misconceptions.

In-Class Interaction Structures of Inquiry-Based Science Education and Bilingual Students

The interaction structure is categorized as triadic and chain order. In the triadic order, teachers ask questions, student answers them, and the teachers evaluates. In chain order, the teacher starts the conversation with a question. Students answer, the teacher reflects the answer to that student or other students with new questions. There is no evaluation and the dialogues are long. Teachers' opinions were asked about which order is used more in the classroom interaction structures of bilingual students of science lessons taught with the research-based teaching method, and the answers given are presented in Table 3, thematically.

Table 3. *Exemplary Statements and Sample Opinions Regarding Themes, Sub-Themes, Sub-Themes About Which Order of In-Class Interaction Structures the Participant Teachers Use in Inquiry-Based Science Education*

Theme	Sub-theme	Example Statements on Sub-Themes	*f*	%	Sample Expressions from Teachers' Opinions
Chain Order	Learning Through Discovery	Curiosity, Doubt	1	10	*"I think the chain order is used more. Because in the chain order, the child is constantly trying to be thought through with questions, since he or she will investigate a problem based on the phenomenon of curiosity."* T1
		The student gets the information.	3	30	
		Guidance with questions	2	20	"*We use the chain layout more. Because students are mostly trying to find answers and solutions themselves."* T2
	Process Oriented	Process is important, not evaluation.	1	10	*"We use chain order more. Because we involve the whole class in the process and we do not present the information directly, we ensure that the students find it…"* T3
		Everyone is included in the process.	1	10	*"I think the chain order is used more. Talking about a question in a conversational atmosphere will increase the student's retention time. In inquiry-based science teaching, chain order is used more because the process is more important than evaluation."* T7
	Constructivist Approach	Student-centered	1	10	*"The chain order is used more. The triadic order is more suitable for traditional education. But our approach to inquiry-based science teaching is innovative and student-centered."* T5
		Innovator	1	10	

All of the participating teachers emphasized that chain order, one of the classroom interaction structures, was used in inquiry-based science teaching. Participating teachers made their explanations on the sub-themes of teaching by discovery, process-oriented and constructivist approach. Teachers who talked about learning by discovery stated that they arouse the feelings of curiosity and doubt in the students, they enable the students to reach the information themselves, and they guide the students with questions. The teachers, who emphasized the process-oriented sub-theme, stated that they included everyone in the process and that the process, not the evaluation, was important. Teachers emphasizing the constructivist approach, on the other hand, stated that the chain order is student-centered and innovative.

It is seen that all of the participating teachers prefer chain order among classroom interaction structures in inquiry-based science teaching. It is seen that the emphasis on chain order is the sub-theme of teaching by discovery with the highest rate (60%). It is seen that the rate of those who talked about being process-oriented and those who emphasized the constructivist approach sub-theme are equal to 20%. Interaction structures are divided into triadic order and chain order. It is seen that chain order is preferred among these interaction structures in inquiry-based science teaching.

Inquiry-Based Science Education and Bilingual Student Participation and Interests

In order to determine the effects of science lessons taught with the inquiry-based teaching method on the participation and interest of bilingual students, the opinions of the teachers were asked and the answers given are presented in Table 4, thematically.

Table 4. *Exemplary Statements and Sample Opinions of Participant Teachers on Themes, Sub-Themes and Sub-Themes Regarding the Effects of Science Lessons Taught with Inquiry-Based Teaching Method on the Participation and Interests of Bilingual Students*

Theme	Sub-theme	Example Statements on Sub-Themes	*f*	%	Sample Expressions from Teachers' Opinions
Increase in class	Constructivist Approach	Student-Centered	3	18,75	*"In the lessons where we use the lecture method, the children are in a passive position, they themselves get bored*

participation and interest		Configuring Information	2	12,5	*and they are constantly distracted. But when we move through programs that center the student, such as inquiry-based, children's interest in the lesson increases and their participation increases."* T4
		Active participation of passive students	2	12,5	*"The child researches and analyzes a subject he/she is curious about and comes to a conclusion about it. He/she creates his/her own knowledge. Therefore, student participation will be more."* T1 *"Their participation and interest in the course is definitely increasing. Even normally distracted students can focus their attention on more subjects with inquiry-based science teaching."* T6
	Motivation	Curiosity	3	18,75	*"As there are interesting topics, their participation and interest in the course increases."* T3
		Motivation	2	12,5	*"The active role of the student in solving a problem increases their motivation. A motivated student also increases his/her interest in the lesson."*
		Proximity to Life	1	6,25	T7 *"...student has more control over these subjects since science lessons are things that we constantly encounter in life and that we constantly see. Therefore, their participation and interest in the course increases."* T5
	Interaction	Social Relations	2	12,5	*"But when we progress through programs that center the student, such as research-based, children's interest in the lesson increases, their participation increases and their social relations increase."*T4
		Everyone to share their opinion	1	6,25	*"...Because we take the opinions of all students here and we care about them, so the student participates in the lesson more actively."* T5

When Table 4 is examined, it is seen that the participation and interest of bilingual students in inquiry-based science teaching has increased. It is seen that the participant teachers made their explanations on the sub-themes of constructivist approach, motivation and interaction. Teachers who mentioned the constructivist approach theme expressed the positive effects of student-centeredness, knowledge structuring, and passive students' active participation. Teachers who talked about the theme of motivation talked about the positive effects of curiosity, motivation and closeness to life on the active participation of students in the lesson. Teachers who talked about the theme of interaction, on the other hand, emphasized that social relations and sharing everyone's opinion positively affected students' participation and interest in the lesson.

All of the participating teachers stated that inquiry-based science teaching positively affected students' participation and interest in the lesson. The sub-theme (43.75%) with the highest emphasis on participation and interest in the course is the constructivist approach. It is seen that the rate of effect of motivation on student participation and interest is 37.5%. It is seen that the effect of the interaction on the participation and interest in the course is 18.75%. When the effect of inquiry-based science teaching on the participation and interests of bilingual students is examined in general, it can be said that it is positive and increases the interest of the students in their participation in the lesson.

Inquiry-Based Science Teaching and Bilingual Students' Group Working and Collaboration Skills

In order to determine the effect of science lessons taught with the inquiry-based teaching method on the bilingual students' group working and cooperation skills, the opinions of the teachers were taken and the answers given were tabulated and presented in Table 5.

Table 5. *Exemplary Statements and Sample Opinions of Participant Teachers on The Effects of Inquiry-Based Science Education on Bilingual Students' Group Working and Collaboration Skills on Themes, Sub-Themes, Sub-Themes*

Theme	Sub-theme	Example Statements on Sub-Themes	*f*	%	Sample Expressions from Teachers' Opinions
Working with the Group and Collaboration Increases	Interdependence	Cooperation	4	17,39	*"In inquiry-based science teaching, students are already researching a topic that needs to be researched as a group. They transfer their skills collaboratively."* T1
		Solidarity	2	8,69	"*Working together allows students to work more harmoniously. Here they support each other."* T6
		Sharing	2	8,69	"*Affects positively. Because we produce as a group and share as a group."* T5
	Accountability	Working with a Group	4	17,39	*"Because the students are doing research here as a group, not just individual research…"*T4
		Responsibility	2	8,69	*"They are active in group work and collaboration. A responsibility is placed on the child."* T3
	Social Skills	Communication	3	13,04	*"... In this sense, working with groups also increases the interaction and communication betweenstudents."*T1
		Socializing	2	8,69	*"It provides a significant increase. Working together allows students to work more harmoniously."* T6
		Working together	2	8,69	*"Each group talks about their duties and responsibilities within themselves, and this creates a strong bond and cooperation between them."* T5
		A Strong Bond	1	4,34	
No Group Working Skills	Individual Goals	Individual Study	1	4,34	*"For the first time, I usually try not to train with the group. Because it wanders off. So it is better when they work individually."* T2

When Table 5 is examined, it is seen that inquiry-based science teaching has a positive effect on bilingual students' group work and cooperation skills in general. Teachers who talked about their positive effects focused on the sub-themes of interdependence, accountability and social skills. Teachers who talked about interdependence mentioned the positive effects of cooperation, helping and sharing. The teachers, who emphasized the sub-theme of accountability, emphasized group work and responsibility. Teachers talking about social skills, on the other hand, talked about communication, cohesion, working together and strong bonds between students. The teacher, who stated that he/she did not have the skills to work with a group, stated that he/she trained his/her students individually.

The majority of the participating teachers stated that inquiry-based science teaching positively affected bilingual students' group work and cooperation skills. The sub-themes with the highest emphasis on group work and cooperation (34,78%) are the sub-themes of interdependence and social skills. It is seen that the rate of the effect of the sub-theme of accountability on the ability to work with the group and cooperation is 26.08 %. It is seen that the rate of those who state that they do not work with a group but rather do individual work is 4.34 %. When the effects of inquiry-based science teaching on bilingual students' group working and cooperation skills are examined in general, it is seen that it increases their group working and cooperation skills.

Inquiry-Based Science Education and Bilingual Students' Attitudes to Science Lesson

In order to determine the effects of science lessons taught with the inquiry-based teaching method on the lesson attitudes of bilingual students, the answers given to the teachers when their opinions were asked are presented in Table 6 by being themed.

Table 6. *Exemplary Statements and Sample Opinions on Themes, Sub-Themes, Sub-Themes of Participant Teachers' Views on the Effects of Inquiry-Based Science Education on the Attitudes of Bilingual Students towards Science Lesson*

Theme	Sub-theme	Example Statements on Sub-Themes	*f*	%	Sample Expressions from Teachers' Opinions
Positive Attitude Increase	Affective Effects	Motivation	2	18,2	*"Inquiry-based science teaching makes students love science more. Because we put students in confusion, we make them doubt what they know, which motivates them."* T3 *"As this method ensures active participation of students in the lesson, it increases their motivation. It makes them more willing to participate in the lesson. This increases students' science attitudes."* T7
		Self-confidence	1	9	
		Motivation	2	18,2	
	Student Participation	Active Participation	2	18,2	*"...my bilingual students had a lot of fun despite knowing very little Turkish. My Syrian students were incredibly happy to participate in those activities and to observe them. As such, it made them love science class."* T5
		Learning by Doing and Experiencing	2	18,2	
	Teacher Influence	Teacher Influence	2	18,2	*"The science lesson starts in the 3rd grade and continues in the 4th grade. 3rd grade students are generally unfamiliar with science lessons. Since there is uncertainty, it causes negative emotions and attitudes in the student. This may cause bias. Especially in bilingual students, this may be more common in students who have communication problems. In other words, their attitudes towards science lesson may be low at the beginning of the process. If we cannot turn this student's attitude into a positive one, it continues like this…"* T4 *"...It's actually a little bit about how the teacher conveys, whether it's research or experiments. If the teacher expresses it well and especially emphasizes the concepts for bilingual students, the effect is positive."* T1

Emphasizing that inquiry-based science teaching positively affects the attitudes of bilingual students, the teachers made their explanations on the themes of affective effects of the method, effects on student participation, and teacher effects in the method. Teachers who talked about affective effects mentioned positive effects on motivation, self-confidence and motivation. Teachers who stated the effects on student participation talked about the effectiveness of active participation and learning by doing. Those who talked about the teacher effect in the method emphasized the importance of teacher guidance in the process.

It is seen that all of the participating teachers mentioned that the method positively affects the attitudes of bilingual students towards the science lesson. It is seen that the emphasis on affective effects towards attitude was made with the highest rate (45.4%). The rate of those who talked about the effect on student participation and contribution to attitude is 36.4%. The rate of those who talked about the teacher effect is 18.2%. When the effects of inquiry-based science education on the attitudes of bilingual students towards the science lesson are examined in general, it can be said that it causes an increase in positive attitudes thanks to the positive effects in the affective field, and the support provided to the active participation of the students in the lesson creates a positive attitude.

Inquiry-Based Science Teaching and Bilingual Students' Problem Solving Skills

In order to determine the problem-solving skills of bilingual students in science lessons taught with the inquiry-based teaching method, teachers' opinions were taken and the answers given are presented in Table 7 by being themed.

Table 7. *Exemplary Statements and Sample Opinions of the Participant Teachers on the Effects of Science Lessons Taught with Inquiry-Based Teaching Method on the Problem Solving Skills of Bilingual Students*

Theme	Sub-theme	Example Statements on Sub-Themes	*f*	%	Sample Expressions from Teachers' Opinions
Increase in Problem Solving Skills	Implementation Process	Access to Information	2	15,38	*"...We leave student alone with the problem. The student himself/herself decides how to solve this problem and what steps to take."* T5
		Doing research	1	7,69	*"...The child is trying to find something to solve these problems, doing researches."* T4
		Generating Idea for Solution	1	7,69	*"Since they can recognize the connection when it is inquiry-based, they can generate ideas to solve the problem there. As a result, their problem-solving skills increase."* T6
		Relationship Building	1	7,69	
	Implementation Objective	Being Problem-Focused	3	23,07	*"Because inquiry-based science teaching already includes problem solving and is interlocked with each other…"* T3
					"There is always a problem in inquiry-based science teaching. We present a problem to the student." T4
		Being Student-Centered	1	7,69	*"As inquiry-based science teaching already includes problem solving, and because they are interlocked with each other, their problem solving skills develop because students are in the center."* T3
Difficulty in Solving Problems	Lack of Skills	Teacher Support	3	23,07	*"If we think about problem solving, students have difficulties in solving problems when there are concepts they do not know because they are bilingual in this sense."* T1
		Tendency to Avoid the Problem	1	7,69	*"Problem solving skills do not develop much. They are not prone to problem solving. They often ask for support for a solution."* T2
					"Because the biggest problem of our new generation, especially our new generation, is that families do not expose their children to too many problems, every problem is solved by the family themselves, and the student comes to primary school in this way. When they start primary school, many students do not know what to do in the face of the problem they are experiencing. For example, not being able to establish friendships or not knowing how to behave in a classroom environment. As such, the student tends to avoid more problems." T5

When Table 7 is examined, it is seen that the problem solving skills of bilingual students generally increase in inquiry-based science teaching. It is seen that the participant teachers made their explanations on the application process, application target and lack of skills. Teachers who talked about the application process theme talked about the positive results of accessing information, doing research, generating ideas for solutions and establishing relationships. Emphasizing the sub-theme of the application goal, the teachers stated that the problem-oriented and student-centered nature of the application positively affects the problem-solving skills of the students. Emphasizing the theme of lack of skills, the teachers mentioned the students' need for teacher support and their tendency to escape from the problem.

It is seen that the majority of the participating teachers stated that inquiry-based science teaching improves the problem-solving skills of bilingual students. The sub-theme (38.45%) with the highest emphasis on problem solving skills is the application process. It is seen that the effect of the application target on the problem solving skill is 30.76%. It is seen that the effect of the theme of difficulty in problem solving is again 30.76%. When the effect of inquiry-based science teaching on the problem-solving skills of bilingual students is examined, it can be said that it has a positive effect in general. In other words, it is seen that students increase

their problem solving skills.

Inquiry-Based Science Education and Its Effect on Bilingual Students' Permanent Learning

In order to determine the effect of science lessons taught with the inquiry-based teaching method on the permanent learning of bilingual students, teachers' opinions were taken and the answers given are presented in Table 8 by being themed.

Table 8. *Exemplary Statements and Sample Opinions of the Participant Teachers on the Effects of Science Lessons Taught with Inquiry-Based Teaching Method on the Permanent Learning of Bilingual Students on Themes, Sub-Themes*

Theme	Sub-theme	Example Statements on Sub-Themes	*f*	%	Sample Expressions from Teachers' Opinions
Provides Permanent Learning	Active Participation	Learning by Doing and Experiencing	5	20	*"In inquiry-based science teaching, children already learn by doing. They do a lot of thin gs themselves."* T4
		Class Participation	5	20	*"... we think that when we explain a subject well, students understand it very well. But the important thing is that the students are active in this process, not us."* T5
		Student-Centered	3	12	*"It provides permanent learning because it provides more permanent learning because the student tries to solve the problems encountered in daily life, and because the student is in the center and deals with himself/herself."* T3
	Cognitive Constructivism	Access to Information on Their Own	3	12	*"It provides very permanent learning as they wonder and find it and research and find it themselves."* T2
		Learning by Experience	1	4	*"But in inquiry-based science teaching, the information is permanent as the student learns the information through their own experiences."* T4
		Far From Memorization	1	4	*"In the lessons we teach with the lecture method, old learnings are often forgotten because the child memorizes and then forgets."* T4
	Scientific Process Skills	Doing Research	2	8	*"...provides permanent learning as they search and find themselves."* T2
		Making Inferences	2	8	*"They do experiments, they observe, they draw conclusions, sometimes they do groupwork."* T4
		Experiment and Observation	2	8	*"In inquiry-based science teaching, students do not easily forget what they have learned because they are in the middle of the process and ask questions because they work in cooperation and communication."* T5
		Communication	1	4	

When Table 8 is examined, it is seen that it affects the permanent learning of bilingual students positively in inquiry-based science teaching. It is seen that the participant teachers made their explanations on the sub-themes of active participation, cognitive constructivism and scientific process skills. Teachers who talked about the theme of active participation emphasized the importance of learning by doing, participating in the lesson and being student-centered. Talking about the cognitive constructivism sub-theme, the teachers mentioned the importance of students' accessing the information themselves, learning from their own experiences, and the importance of inquiry-based science teaching being away from rote learning. Teachers who emphasized scientific process skills, on the other hand, emphasized that students' research, inference, experimentation, observation and communication provided permanent learning.

It is seen that all of the participating teachers stated that inquiry-based science teaching positively affects the permanent learning of bilingual students. The sub-theme (52%) with the highest emphasis on permanent learning is active participation. It is seen that the effect of cognitive constructivism sub-theme on permanent

learning is 20%. It is seen that the effect of scientific process skills on permanent learning is 28%. When the effect of inquiry-based science teaching on the permanent learning of bilingual students is examined in general, it can be said that it is positive and this method increases the permanent learning of the students.

DISCUSSION, CONCLUSION, RECOMMENDATIONS

The aim of this study is to determine how inquiry-based science teaching affects the learning processes of bilingual students. In this section, the results obtained from the research findings, the relations of the results with other studies and suggestions for future studies are included. In this study, which was conducted with primary school teachers within the scope of phenomenology design, one of the qualitative research methods, it was observed that inquiry-based science teaching improved the learning processes of bilingual students in general, supported their learning, and increased some skills.

According to the results of the study, it was determined that inquiry-based science teaching positively affected the conceptual understanding of bilingual students and minimized their misconceptions. When the relevant literature was examined, some studies supporting the results of the research were found. İnal (2013) concluded in his/her study that inquiry-based teaching reduces students' conceptual misconceptions and their conceptual understanding is positively affected. Kula (2009) stated in his/her study that inquiry-based teaching positively affects concept learning and at the same time reduces misconceptions. Parim (2009), in his/her study, concluded that inquiry-based teaching had positive effects in eliminating misconceptions in the experimental group. A study conducted with students who were taught in a language other than their mother tongue revealed that inquiry-based science teaching was effective in learning science for these students, even if they were at a disadvantage in communicating (Fradd et al., 2001).

According to the results of the study, it was concluded that inquiry-based science teaching positively affected the science lesson attitudes of bilingual students. It has been concluded that the positive effects of this approach, such as students' motivation, self-confidence, motivation, active participation, learning by doing, have a positive effect on students' attitudes. Similar results were found in the literature. Akpullukçu (2011), Duban (2008) and Tatar (2006) examined the effects of inquiry-based teaching method on students' attitudes towards science lessons in their study. The findings obtained in these studies demonstrate that inquiry-based science teaching affects students' attitudes positively.

According to the results of the study, it was concluded that inquiry-based science teaching increased the problem-solving skills of bilingual students in general, while some students had difficulties in solving problems and could not solve it without help. In a study that followed the inquiry-based teaching process of bilingual students, it was observed that bilingual students were more problem-solving oriented when they received encouraging support (Hampton & Rodriguez, 2001). When the literature was examined, similar results were found regarding problem solving skills. Altunsoy (2008), in his/her study, concluded that the students in the experimental group had higher post-test scores of scientific process skills. Again, Tatar (2006) concluded in his/her study that inquiry-based science teaching positively affects students' scientific process skills. Yıldırım and Berberoğlu (2012) concluded in their study that inquiry-based science teaching has no effect on the development of students' scientific process skills.

According to the results of the study, it was concluded that the participation and interest of bilingual students in inquiry-based science teaching increased. The fact that it is suitable for the constructivist approach, provides motivation and interacts with the students has been revealed as a result of the opinions of the participating teachers. When the literature is examined, studies that overlap with the results of the study have been found. McPhedran (2006), in his study in which inquiry-based learning tried to determine students' interest, concluded that students' interest in science lessons increased. Similar to our research, it has been determined that bilingual primary school students, who receive inquiry based science education in a language different from their mother tongue, participate more actively in the lesson, comprehend the content information more easily, and therefore, their interest increased (Hampton & Rodriguez, 2001).

According to the results of the study, it was concluded that inquiry-based science teaching positively affects the permanent learning of bilingual students. It has been concluded that the use of active participation, cognitive constructivism and scientific process skills support permanent learning. When the relevant literature is examined, there are similar studies with the study result, as well as studies that do not overlap. Aydede (2006) investigated the effects of active learning approach on the level of retention and found a significant difference between the experimental and control groups. Fife (2003) tested the effect of teaching with activities on permanent learning and could not observe a significant difference between the experimental group and the control group. He/she claimed that the reason for this was that he/she kept the duration of the study short. It has also been emphasized by various studies that the inquiry based education of bilingual students has positive effects on their skills and active participation (Thomas & Collier, 1995; Nieto, 2000).

In conclusion, it has been determined that inquiry-based science teaching improves classroom interaction structures towards student-centeredness, supports the conceptual understanding and permanent learning of bilingual students, contributes to their participation and interest in the lesson, increases their science attitudes positively, and develops problem-solving, group work and cooperation skills. For these reasons, it is suggested that science lessons be based on inquiry in classrooms with bilingual students. Considering the situations emphasized by the participating teachers, it is revealed that bilingual students need teacher support. Therefore, providing bilingual students with a guided inquiry-based science education may be beneficial to them.

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