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Research Article

The contribution of the "scientific literacy workshop" on high school students' research attitudes

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Abstract

This study aims to examine the contribution of the Scientific Literacy Workshop on high school students' research attitudes. To that end, Scientific Literacy Workshop Project was planned and implemented over 10 weeks. This study was designed within the framework of the project. The mixed research method was employed, and the exploratory sequential design was utilized. The study group consisted of 42 high school students studying in a province center in the Central Black Sea Region of Turkiye in the 2021-2022 academic year. The data were collected through a semi-structured Interview Form and Scale of attitude towards Scientific Research. In the analysis of the quantitative data, pared samples t-test and ANOVA were used, and content analysis was used in the analysis of the qualitative data. Results revealed that the Scientific Literacy Workshop positively contributed to participant students' research attitudes. Students emphasized that scientific research was not as complicated as they thought, and it could be carried out by anyone who has enough interest and knowledge. Based on the results, we recommended that projects which would encourage students to research like the Scientific Literacy Workshop should be conducted at all grade levels.

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Introduction

The source of science is knowledge. Heimsoeth (1986) claimed that a discipline is unimaginable that is not based on any knowledge. Knowledge, with the common definition, is the period of change that occurs in the cognitive structure of a person as a result of observations and experiences (Bateson, 1972). Knowledge has three basic components intelligence, experience, and intuition. Knowledge is not readily available in nature, there are objects and events in nature. Only humans can create, produce, and turn knowledge into action (Jones, 2004). Today, in the information age, societies that produce and export knowledge have been described as developed societies and have stepped forward. Therefore, the ability to access information and product knowledge has become very important for societies and individuals. There are five basic ways of accessing knowledge: Individual experience, authentic, mystical, rational, and scientific method. Knowledge-based on individual experience is the information that individuals obtain as a result of interaction with the environment through their senses. In the authentic method, individuals try to gain knowledge by forming a consensus with other individuals as well as their own experiences. In the mystical method, expert opinion is sought to access reliable information. In the rational method, it is tried to reach reliable information with the help of reasoning or logic. On the other hand, the knowledge obtained through the scientific method has certain sources, is produced according to a certain systematic, and the accuracy, validity, and reliability can be confirmed repeatedly or in different ways when necessary.

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According to Millar (1994), the scientific method is the most reliable way of solving factual problems and producing knowledge with common and certain processes. Because scientific knowledge has the characteristics such as being factual, systematic, rational, cumulative, valid, and relative, and can only be produced through the scientific method. Thus, countries take necessary measures for students at all grade levels to understand and internalize the scientific method. Within this scope, Turkish National Education tries to gain knowledge and skills about scientific methods for students at all levels of formal education with the Scientific Research Methods course. In this way, it is tried to ensure that students use the scientific method to access information, produce knowledge, and solve problems encountered.

However, the positivist approach and the post-positivist approach conflict in terms of their perspectives on scientific knowledge. According to the positivist approach, the only valid way of knowledge construction is assumed to be the scientific method. The scientific method seeks regularity in nature by detecting the relationship between some event groups. That is, the laws of nature are based on experimentation and observation, in which the attributes of beings or their reproducible relations are put forward with mathematical expressions, and there are no mythological or fictional explanations. According to Guénon (2005), scientific theories are just credible truths, not immutable ones. Because scientific theories always have the potential to develop and change. The modern understanding of science has tried to make it worthless by denying everything that transcends the sciences or at least declaring them unknown. However, it should be noted that although this understanding considers the knowledge we obtain with our senses the most reliable one we can obtain, many philosophers doubted the certainty of this knowledge in principle (Cleland, 2001; Khun, 1970; Woodcock, 2014). Today, many thinkers reject a sharp distinction between scientific concepts and other belief systems, because scientists are affected by human characteristics, beliefs, and social structure. Instead of the hypothesis that science is a cumulative process and rises continuously and linearly on what has been known until now, it has been put forward that scientific knowledge rises in leaps based on paradigms (Au, 2018; Nola & Sankey, 2000; Woodcock, 2014). Because, the scientific method is only one of the ways that make it possible for people to reach accurate information, and people have various ways of knowing, and reaching knowledge.

Therefore, in the current study, the scientific method is not seen as the only way of reaching knowledge but is considered a valid method for reaching and producing knowledge. In this context, this study focused research concept which is one of the important stages of the scientific method, and attitude towards research that is seen as a significant psychological factor affecting research behavior.

Scientific Method

Every discipline aims to make generalizations that will create judgments about the explanation of observed events, and the relationships of events. These explanations and generalizations are reached through rational arrangements named the scientific method. The scientific method is a reasoning process in solving problems and performing research or a study (Çaparlar & Dönmez, 2016). First conceptualized by Descartes in the 16th century, the scientific method is essentially a synthesis of Bacon's inductive method and Aristo's deductive method (Bauer, 1994). The scientific method creates a system of supervision and evaluation that will minimize dilemmas in providing information. Thus, biases are reduced and validity reaches the highest level. In this respect the scientific method is considered to be the most reliable way of problem-solving, producing knowledge, and accessing information through common and specific processes (Karagözoğlu, 2006).

Scientific laws are cause-effect relationships, while theories explain how things happen. Scientific laws express regularities in nature and tell us what happens in the universe, but they do not offer any explanations. They are used to say that a phenomenon that exists only exists. We construct and test hypotheses to explain these regularities. If these hypotheses are not falsified, they become valid and provide a model for explaining scientific laws. These models are called scientific theories. Scientific theories are networks thrown to capture (explain) reality in general (Popper, 2010). Theories are abstract generalization systems because they explain the relationships and generalizations observed factually by making use of some non-observational concepts. Theories never take their final form, because there is a dynamic development process for every theory as a result of new data and hypotheses. In this respect, scientific development is an

endless and dynamic process, consisting of removing the theories that are inadequate in the light of new experiments, and replacing them with those that seem more valid (Bauer, 1994).

Experimental sciences often use induction, a method that leads from facts to laws. The inductive method tries to make inferences about the future based on the regularities in the past. In other words, they use past observations to predict the future. Therefore, we need to consider that we cannot be sure of the future based on previous observations alone and that there may always be exceptions to the patterns or regularities we observe. This is called the induction problem. This also ensures that science is always open to change. On the other hand, the deductive method adopts falsification concepts and approaches. Accordingly, a rational or observational generalization (hypothesis/experiment) is tried to be falsified with logical conclusions based on observations or related inferences. In this approach, it is tried to reach the right information by finding and explaining the wrong information (Popper, 2010).

As understood, the scientific method is the most valid way of accessing information and solving problems. In this context, students need to have full knowledge of scientific process skills to develop a basic scientific understanding (Aktamış & Ergin, 2007). We can not expect all students to be a scientist, but every individual should observe, ask questions, analyze data, understand a problem case, and solve the problems, to survive. Gaining scientific process skills is not special to scientists or scholars. Because these skills are as important in the scientific and academic fields, and in the success of daily activities and business life (DebBurman, 2002). Therefore, knowledge and skills of the scientific method are important that should be gained by all students in the formal education process. However, many researchers emphasized that it is not sufficient for individuals to have knowledge and skills about scientific processes, at the same time, they should have also psychological characteristics such as a positive attitude, motivation, and self-efficacy, to set the scientific process (Hook, 2020; MacNamara, Button & Collins, 2010; Miyazaki & Taylor, 2008; Rutjens, Heine, Sutton & van Harreveld, 2018). Because attitude towards research is an important variable that affects the research behavior, as well as research competency, research anxiety, and research experience.

Research Attitude

The attitude, which was seen as an internal factor that predicts human behaviors (Zan & Martino, 2007), also plays a significant role in the formation of research behavior. Research-oriented attitudes generally includes feelings about research. These feelings include negative thoughts and negative emotions such as anxiety, fear of failure, inadequacy, and lack of interest (Bolin, Hag Lee, GlenMaye & Yoon, 2012; Taşgın, 2018). Many researchers claim that attitude is a more important factor in research behavior than cognitive factors such as knowledge, skills, experience, and academic preparation (Butt & Shams, 2020; Mutz & Daniel, 2013; Swindoll, 2012). Accordingly, we can claim that attitude towards research is an important concept for individuals to act on their knowledge and skills about the scientific process. According to Papanastasiou (2005), determining research-oriented attitudes is important for the development of a positive attitude among students, and this case helps to ease their learning. Because, in today's world, research is one of the important behavior that plays a key role in individuals' academic and professional success.

Unfortunately, the previous literature tells us that students' research-oriented attitudes are either not at the desired level (Amoo & Gbadamosi, 2021; Butt & Shams, 2013; Henry, Ghani, Hamid, & Bakar, 2020; Papanastasiou, 2005; Shaukat, Siddiquah, Abiodullah, & Akbar, 2014). Addams and Holcomb (1986), emphasized that students find the scientific process difficult and boring,- and, therefore develop a negative attitude. According to some researchers, although students have theoretical knowledge and skills about the scientific process, they have developed a negative attitude, because they have had not a chance to turn this theoretical knowledge into practice (Belgrave & Jules, 2015; Butt & Shams, 2020; Byman, Krokfors, Toom, Maaranen, Jyrhämä, Kynäslahti, & Kansanen, 2009). In addition, there are findings in the previous literature stating that students have difficulties understanding scientific jargon and that they develop negative attitudes because they see scientific knowledge that they could not easily understand as useless (Shkedi, 1998). Even if students are aware of the importance of research, they are anxious about the research process, they are afraid of conducting research, and they feel weak. The reasons for students' avoidance behavior and negative thoughts about research arise from the justifications stated above.

Importance of Study

We believe that if students develop good research skills and attitudes which are essential for learning and generating their reflections and ideas, they can be successful both academically and in daily life. Therefore, we attach great importance to the development of students' research attitudes, as well as their knowledge and skills about the scientific process. Various studies have found attitudes toward scientific research as a result of previous literature reviews. Many of these studies examined directly students' attitudes toward scientific research (Korkmaz, Şahin, & Yeşil, 2011; Küçükoğlu, Taşgın, & Çelik, 2013; Saracaloğlu, Varol, & Ercan, 2005; Yenilmez & Ata, 2012). Some studies examined the relationship between attitudes toward scientific research and various variables. For example, Aşiroğlu (2016) examined the relationship between pre-service teachers' research attitudes and their success in a scientific research course. Baş (2017) examined the relationship between teachers' following status of educational research and their research attitudes. In some studies, the relationship between research attitudes and level of anxiety (Bökeoğlu & Yılmaz, 2005; Duygu & Şahin, 2019), epistemological belief (Kürşad, 2015), and research competencies (Saracaloğlu, 2008) was examined. As can be understood from the previous literature review, there are many findings about determining the research attitudes and examining its relationship with various variables. However, none of the previous studies are concerned with improving students' research attitudes. We can consider that no study focuses to improve research attitudes as a deficiency of the related literature. We attach great importance to developing research attitudes which are seen as an effective variable in the formation of research behavior. The current study did not only contented to determine students' research attitudes but also focused to develop them. This feature makes the current study unique. In this context, a project titled "Scientific Literacy Workshop" which is expected to contribute to the development of students' research attitudes has been planned. This project aims to develop the interest, motivation, and attitudes of high school students toward scientific papers, and to encourage them for carrying out scientific research. The current study was designed within the scope of this project.

Aim of the Study

Within this scope, the current study aimed to examine the effect of the "Scientific Literacy Workshop Project" on high school students' attitudes toward research. With this main purpose, the research questions that guided this study are as follows:

- What is the contribution of the "Scientific Literacy Workshop" on high school students' research attitudes?
- Do high school students' research attitudes differ according to the demographic characteristics?
- How are high school students' views about scientific process?

Method

In the current study, the mixed method which combines research results with quantitative and qualitative data collection techniques was used. The mixed method enables to presentation, analysis, and combining of results within a framework using various methods. According to Ivankova, Creswell, and Stick (2006) using mixed methods is better for understanding research problems than using qualitative and quantitative approaches alone. In this study, a mixed method was preferred to examine the research questions in depth.

Research Model

In this study, "exploratory sequential design", one of the mixed research methods was allowed. The main feature of this design is to explain the data collected and analyzed with the quantitative method, with the data collected and analyzed with the qualitative method. Therefore, in this design, quantitative data is collected and analyzed first, and then qualitative data is used to support and explain quantitative data (Creswell & Plano Clark, 2011). In the quantitative dimension of the study, a controlled non-group pretest-posttest quasi-experimental design was allowed. According to Büyüköztürk (2004), the experimental pattern is the only way to determine the effects of a variable and is the most reliable method in testing cause-and-effect relationships. In this study, the experimental pattern was used to examine the effect of the independent variable (Scientific Literacy Workshop) of the research on the dependent variable (Research attitude). In the qualitative dimension, students' views about the scientific process were collected through semi-structured interview forms at the end of the workshop, to support and explain the quantitative data. In this context, in

the qualitative dimension, the basic qualitative research design was employed. This research method focuses on how people make sense of themselves and their experiences rather than cause-and-effect relationships. In this design, an inductive strategy is adopted, descriptive results are obtained, the data are presented with direct quotations, and discussed by comparing with the related literature (Merriam, 2002). We employed the basic qualitative research design because this study focused on revealing the student's research-behaviors, thoughts, and feelings about scientific research, and the change in these perceptions at the end of the workshop.

Participants

The study was conducted with a total of 42 high school students studying at public high schools in a province center in the Central Black Sea region of Turkey, in the 2021-2022 academic year. A purposive sampling technique was employed in the determination of the study group. This technique allows for in-depth research by selecting information-rich situations depending on the purpose of the studies and is preferred when it is desired to work in one or more special cases that meet certain criteria or have certain characteristics (Tongco, 2007). In this study, we employed convenience sampling among the purposive sampling techniques, because there were special cases that the study group had to meet, such as participating in the Scientific Literacy Workshop and being volunteered. Table 1 presents the participants' demographic features.

Table 1. Biographical data of participants

Variable	Sub-Group	Frequency	Percentage	Total
Gender	Girls	23	54.76	42
	Boys	19	45.24	
School	Academic High School	27	64.28	42
	Vocational High School	15	35.72	
Grades	9th Grade	9	21.42	42
	10th Grade	10	23.80	
	11th Grade	13	30.98	
	12th Grade	10	23.80	

As seen in Table 1, participant students were 23 girls, and 19 were boys. While 27 students study at academic high schools, 15 students study at vocational high schools. In Turkey, high schools that accept students with an entrance examination are named academic high schools, and high schools that accept students without an examination are named vocational high schools.

Data Collection Tools

In the data collection procedure, a “Demographic Information Form”, “Interview Form” and “Scale of attitude towards Scientific Research” were employed.

Demographic Information Form and Interview Form

To determine the demographic characteristics of the participants, and to reveal their perceptions about scientific research, a form consisting of two sections was created by the researcher. The first section of the form includes questions to determine the demographic characteristics of the participants such as gender, school, and grade level. The second section consists of open-ended and semi-structured questions that aimed to reveal participants' views about scientific research in depth. In qualitative research design, data are collected with interviews, observation, or document analysis methods. In this study, online interviews were adopted, and a semi-structured interview form was developed by the researcher. The preparation procedure of the form began with the relevant literature reviewed (Akay, 2013; Baykara, 2019; Çınar & Köksal, 2013; Miller, Slawinski Blessing, & Schwartz, 2006; Sarı, 2006; Senler, 2015; Woitkowski, Rochell, & Bauer, 2021). Based on the relevant literature review, the 9-item draft interview form was developed, and submitted to the opinions of two scholars (who had a PhD. in Curriculum and Instruction) who are experts in qualitative studies, to achieve content validity. As a result of the opinions of the experts, the number of questions in the form was reduced to 6. In addition, to test the comprehensibility of the interview form, it was applied to three students in the 10th grade. In this way, the content and face validity of the interview form was tried to be ensured. In the interview

form, students' perspectives on scientific research and research behaviors were questioned, and the contribution of the Scientific Literacy Workshop to their academic and intellectual development was tried to be examined.

The scale of Attitude towards Scientific Research

The scale of Attitude towards Scientific Research (SASR) was developed by Korkmaz, Şahin, and Yeşil (2011), contains a total of 30 items, and consists of four sub-dimensions: Unwillingness to Help Researchers (1-8 items), Negative Attitude towards Research (9-17 items), Positive Attitude towards Research (18-23 items), Positive Attitude Towards Researchers (24-30 items). The scale is in a 5 points Likert type, and scored between "(1) Strongly disagree" and "(5) "Completely agree". Korkmaz, Şahin, and Yeşil (2011) calculated the Cronbach Alpha reliability coefficients for the whole scale as .89. For sub-dimensions Cronbach Alpha reliability coefficients were calculated for Unwillingness to Help Researchers as .85, Negative Attitude towards Research as .81, Positive Attitude towards Research as .80, and Positive Attitude Towards Researchers as .76. In the scoring of the scale, the negative sub-factors Unwillingness to Help Researchers and Negative Attitudes towards Research were coded in reverse. As a result of this coding, the alpha value was calculated as .86 in all measurements, indicating a high score reliability.

The Scientific Literacy Workshop

We planned a project titled "Scientific Literacy Workshop", which is expected to contribute to the development of students' research attitudes. This project aims to develop the interest, motivation, and attitudes of high school students toward the scientific process, to encourage them to conduct research activities through the scientific process. Before starting the project, an information meeting and a case study were held with the study group including how to read an article, what to pay attention to and about the evaluation process. Within the scope of the project, 10 papers from different fields were selected by the project team, the selected papers were shared with the students, and the authors and students were brought together in online meetings to discuss the articles. The online meetings lasted 10 weeks, and every meeting included an article discussion with the author. In the online meetings, the students met with the authors whose papers they read, exchanged information, and asked the questions they had prepared beforehand about the paper and its process. Thus, by closely examining scientific jargon, students had the opportunity to follow the articles which are among the most valuable scientific publications from the primary source, and meet with academics and authors. By this means, it has been tried to ensure that students learn the important stages of a scientific paper such as planning, literature review, data collection, analysis, and reporting directly from their authors and observe the scientific process on site. These article review meetings continued for 10 weeks. At the end of the process, students were asked to prepare a portfolio file that included identifying a problem situation, developing suggestions for solving this problem, determining a method, and writing down possible results and suggestions. Portfolio files prepared by the participants were evaluated by the project team, and successful students were rewarded. We assumed that by observing the scientific process from primary sources, students' prejudices, anxieties, and fears about the scientific process will be broken, and their attitudes toward research will also improve.

Before the Scientific Literacy Workshop began, the Scale of Attitude towards Scientific Research was administered to the students as a pre-test. The Scientific Literacy Workshop project was started one week after the pre-test application. The project team selected 10 articles that are suitable for the academic level and interests of the students and shared these articles with the students once each week. Students were asked to read the article, take notes, and prepare the questions they would ask. Afterwards, article authors and participant students were brought together online to evaluate and discuss each article. Each online meeting is planned to last two hours in two sessions. In these online meetings, students had the opportunity to meet the authors, listen to the article directly from the author, ask questions, follow the scientific processes on-site, and make evaluations about scientific processes. These article review meetings continued for 10 weeks. At the end of the process, students were asked to prepare a portfolio file that included identifying a problem case, developing suggestions for solving this problem, determining a method, and writing down possible results and suggestions. The portfolio files prepared by the participants were evaluated by the project team, and the successful students were rewarded. One week after the end of the project, the Scale of Attitude towards Scientific Research was applied to the students as a post-test. Thus, the analysis process of quantitative data was started.

Analysis

One of the assumptions for performing parametric tests in the analysis is the normal distribution of the data (Buyukozturk, 2004). Therefore, in the current study, before starting the data analysis process, all data obtained have been tested by the Shapiro-Wilk test whether showing normal distribution. The other main assumption for normal distribution is to look at the kurtosis and skewness values of the data. The data obtained from the Scale of Attitude towards Scientific Research (SASR) were close to normal distribution since the kurtosis and skewness values were between -1 and +1, and according to the Shapiro-Wilk test results ($p>.05$), (Buyukozturk, 2004). Descriptive statistics such as frequency, percentage, arithmetic mean, and standard deviation were used to describe participants' demographic characteristics (gender, school, and grade level). In addition, procedural statistics such as pared samples t-test, independent samples t-test for gender and school type variables, and one-way variance analysis (ANOVA) for grade level variables were performed. All results were interpreted at $p<.05$ significance level.

Qualitative data were collected through focus group discussions in 2 groups with a total of 12 randomly selected students, after the application of the post-test. Bowling, (2002) defines focus group discussions as obtaining in-depth information and producing thoughts, using the effect of group dynamics in an unstructured or semi-structured interview, and discussion between a small group and a leader. According to this definition, focus group discussions are mostly used to reveal surface information. The important thing is not to reach the information that will lead to generalizations, but to describe the views and perspectives of the participants. In this context, the interviews were held online in two sessions, each session lasted approximately 1.5 hours and all interviews were recorded. The recorded data were later transcribed and transferred to an excel file. In the analysis of the data, the content analysis method was performed. To describe the findings as clearly and visualize as possible, the display format shown in Figure 1 (Maviş Sevim & Akın, 2021) was used for the theme, sub-themes, and codes. Using Figure 1, firstly the raw data were carefully read in content analysis, and the views of the participants were coded. Then, coded opinions were collected under sub-themes with similar characteristics. Finally, considering the research questions, sub-themes were combined under themes. When making direct quotations, participant students' names did not use, instead codes used that were created for each participant [Student(S), Girl (G), Boy (B), S1G-S12B].

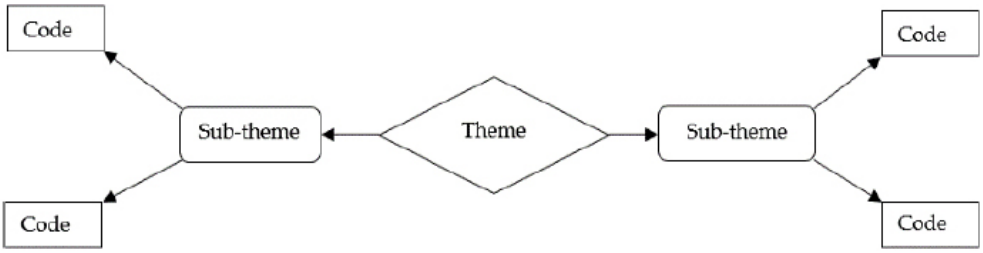

Figure 1. Presenting System of Qualitative Data

Validity and Reliability Study

According to Merriam (2009), the concepts of validity and reliability in quantitative research are replaced by the concepts of credibility, confirmability, transferability, and consistency in qualitative research. In this study, some measures have been tried to be taken to provide the specified elements. To ensure the credibility of the study, all interviews were recorded with a voice recorder with the permission of the participants, the recorded data were turned into written documents, and direct quotations were often included in the findings. Thus, detailed description and depth-oriented data collection were tried to be achieved. To ensure confirmability, findings and results obtained as a result of the analysis were shared with two of the participant students, students were asked whether the results reflected the facts of their expressions, and their confirmation was obtained. To ensure the transferability, of the information of the study group, all processes related to data collection and analysis were explained in detail. To ensure consistency of the study, content, and face validity were taken for the semi-structured interview form. The collected data were shared with another researcher and common themes and sub-themes were created. Miles and Huberman's (1994) "Consistency Percent = Consistency / Consistency + Inconsistency" formula was used to determine the agreement percent of these

two analysis. According to this calculation, the analysis of the researcher and the other expert were found to be substantially consistent (.83).

Results

The results are presented in two sections quantitative results and qualitative results. Firstly, the quantitative results covering the first two research questions are given, and then the qualitative results are presented.

Quantitative Results

The findings regarding to the first and second research questions of the study are summarized and presented in this section. The first research question was examining the effect of the "Scientific Literacy Workshop Project" on high school students' research attitudes. For this purpose, the mean scores of the students from the pretest and posttest applications of the Scale of Attitude towards Scientific Research were examined with the paired samples t-test, and the results are presented in Table 2.

Table 2. Paired samples t-test results for attitude towards research

	Groups	N	$\bar{X}$	Sd	Shx	T-test			r
						t	df	p	
Total Mean Score	Pre-test	42	2.68	.33	.051	-18.98*	41	.000	.78
	Post-test	42	3.30	.26	.038				
Not Helping Researchers	Pre-test	42	2.98	.19	.025	-21.82	41	.876	
	Post-test	42	3.07	.12	.012				
Negative Attitude Towards Research	Pre-test	42	2.21	.51	.001	-16,68*	41	.000	.75
	Post-test	42	3,18	.27	.014				
Positive Attitude Towards Research	Pre-test	42	2.69	.24	.027	-22.17*	41	.000	.71
	Post-test	42	3.65	.16	.040				
Positive Attitude Towards Researchers	Pre-test	42	2.41	.23	.053	-19.23*	41	.000	.77
	Post-test	42	3.98	.30	.066				

*p<.05

Table 2 presents paired samples t-test results regarding the pretest-posttest mean score of students from the Scale of Attitude towards Scientific Research. As seen students' pretest mean score was $\bar{X}$=2.68 (Sd=.33), and the posttest mean score was $\bar{X}$=3.30 (Sd=.26). The results of the paired samples t-test performed to test the change of students' pretest-posttest mean scores showed that, there was a statistically significant difference [t(41)=-18.98, p<.05] in favor of the posttest, in a high effect size (r=.78). As a result of the pre-test and post-test application of the scale, "Not Helping the Researchers" dimension did not show a significant difference, while the "Negative Attitude Towards Research", "Positive Attitude Towards Research" and "Positive Attitude Towards Researchers" showed significant differences (p<.05).

The second research question was examining if students' post-test mean scores on the Scale of Attitude towards Scientific Research differ according to demographic characteristics. To test whether the post-test mean scores of the students differ according to the gender and school variable, independent samples t-test was performed, and the results are presented in Table 3.

Table 3. Independent samples t-test results of the gender variable

	Groups	N	$\bar{X}$	Sd	t	Df	p
SASR Mean Score	Girls	23	3.35	.22	1.337	40	.189
	Boys	19	3.24	.27			
SASR Mean Score	Academic HS	27	3.57	.32	.988	40	.0389*
	Vocational HS	15	3.02	.18			

*p<.05

While girls' SASR mean score was $\bar{X}$=3.35 (Sd=.22), boys' mean score was $\bar{X}$=3.24 (Sd=.27). Independent Samples T-test showed that girls' and boys' post-test mean scores did not statistically differ according to the gender variable [t(40)=1.337, p>.05]. While Academic High School students' SASR mean score was $\bar{X}$=3.57 (Sd=.32), Vocational High

School students' mean score was X̄=3.02 (Sd=.18). Independent Samples T-test showed that Academic High School students' mean score was statistically higher than Vocational High School students' mean score [t(40)=.988, p<.05]. To test whether the post-test mean scores of the students differ according to the school variable, independent samples t-test was performed, and the results are presented in Table 4.

Table 4. ANOVA test results of the grade level variable

		Sum of Squares	Df	Mean Square	F	p
SASR Mean Score	Between Groups	.138	3	.046	.722	.545
	Within Groups	2.420	38	.064		
	Total	2.558	41			

The ANOVA test results shown in Table 5 revealed that, the posttest mean scores of the students did not statistically differ according to the grade level variable (F=.722, p>.05).

Qualitative Results

Students' perceptions about the scientific research

Firstly, participant students were asked to describe the scientific research process with a few words, and results of the content analysis regarding this question are summarized in Figure 2.

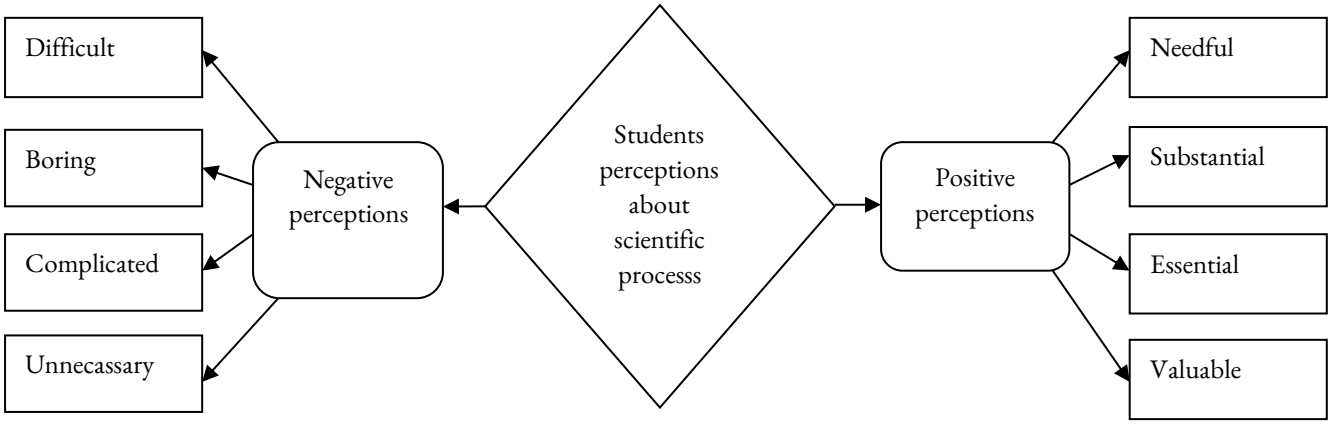

Figure 2. Students' perceptions about the scientific process

As symbolized in Figure 2, students described the scientific research process under two sub-themes as positive and negative perceptions. More than half of the students (f=7) expressed positive perceptions while describing the scientific research process. According to these students, scientific research is a necessary process for technological development and knowledge generation. In addition, students described scientific research as needed for their self and academic development. For example: *"Scientific research is needful for the civilization advent of human being, and it is very important in producing new information... (S4,G)" and "If we want to develop ourselves as personally and academically, we must give much attention to the scientific research... (S11,B)".* Some of the students perceived scientific research as substantial and valuable by emphasizing the value of the knowledge obtained as a result of the scientific process. In addition, scientific research is perceived as essential, because it is seen as the most common way of accessing information and solving problems. Following statements can be given as examples of these perceptions: *"Scientific research is substantial because the most accurate and valid information can be reached with this method... (S2,B) and "Scientific research is essential because it teaches us ways of solving problems we encounter both our daily life and lessons... (S3,G).*

In addition to these positive perceptions, some of the students (f=5) also expressed negative perceptions about the scientific research by emphasizing both deficiencies of themselves and the disadvantages scientific method. As known, the scientific process is a long and exhausting process that requires great labor and time. Some of the participant students emphasized this aspect of scientific research and described it as difficult and boring. For example: *"There are many difficulties in conducting scientific research. Although we have theoretical knowledge about the process, conducting research scares me... (S1,B) and "For me, scientific research is the matter of scientists and scholars as it requires a lot of technical knowledge and skills. It's boring for me to deal with so much technical procedure... (S9,G)".* Some of the students stated

that the language of scientific papers was too heavy and incomprehensible, and therefore they perceived the scientific process as complicated. Therefore, the papers that students have difficulty in understanding and internalizing are seen as unnecessary. Following statements can be given as examples of these perceptions: *"I don't understand why the language used in scientific papers is so complex. It's as if these papers were written so that no one would understand... (S5,B)" and "Information that I do not understand clearly or that I have difficulty in understanding is unnecessary for me. Information should be clear, concise and understandable... (S7,G)".*

Students' perceptions about the importance of the scientific research

Then, participant students were asked about the importance of scientific research, and results of the content analysis regarding this question are summarized in Figure 3.

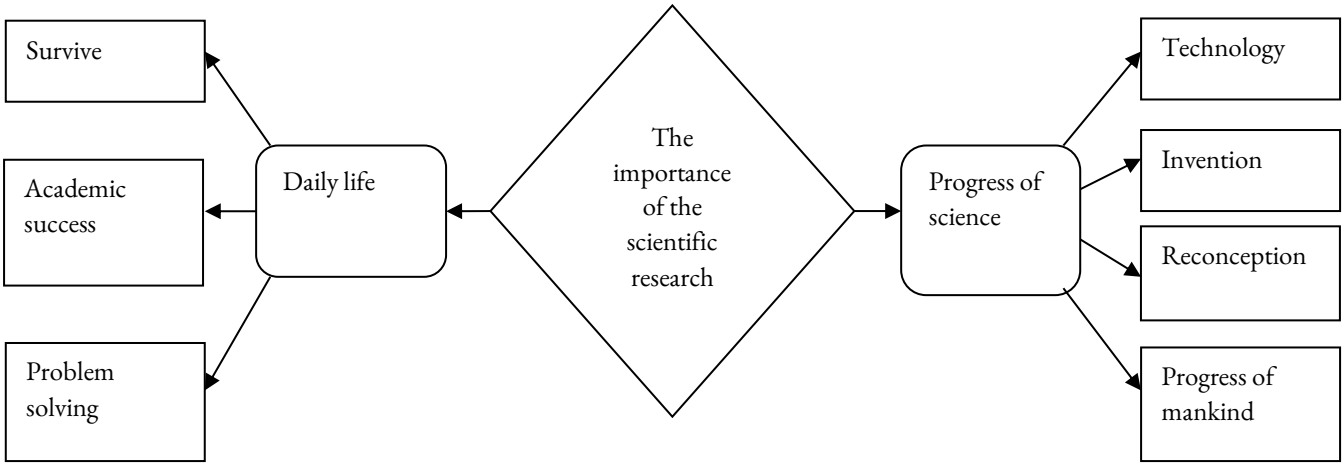

Figure 3. Students' Views about the Importance of the Scientific Research

A majority of the participant students stated that scientific research are more related to the progress of science (f=8). According to these students, scientific research results are effective in technological development, the development of inventions, the emergence of reconception, and the progress of mankind. For example: *"I can say that technology has developed as a result of scientific research and research-development activities... (S9,G), "Scientific research played a pioneering role in the emergence of new inventions... (S7,G)", "Scientific research results have helped to break stereotypes, and create an innovative way of thinking... (S4,G)" and "Mankind owes the current level of civilization to the scientific research... (S10,B)".*

One-quarter of the students (f=4) emphasized the benefits of scientific research to daily life while explaining its' importance. Some of the students claimed that the scientific process is not only effective in the progress of science but also that it is a dynamic process necessary for survival in nature and society. For some students, scientific research is seen as a necessary tool to be successful both in school and academic life. However, a few students argue that scientific process knowledge and skills are effective in solving the problems encountered in every aspect of life. The following statements can be given as examples of these views: *"Mankind needs scientific research results to survive both in nature and in society... (S1,G), "Conducting scientific research can make us distinguished in school life and that may enable us to be academically successful... (S5,B)" and "Not only scientists use the scientific method, but every human uses it to solve the problems they encounter, even if they are not aware of it... (S11,B)".*

In addition to these positive perceptions, some of the students (f=5) also expressed negative perceptions about the scientific research by emphasizing both deficiencies of themselves and the disadvantages scientific method. As known, the scientific process is a long and exhausting process that requires great labor and time. Some of the participant students emphasized this aspect of scientific research and described it as difficult and boring. For example: *"There are many difficulties in conducting scientific research. Although we have theoretical knowledge about the process, conducting research scares me... (S1,B) and "For me, scientific research is the matter of scientists and scholars as it requires a lot of technical knowledge and skills. It's boring for me to deal with so much technical procedure... (S9,G).* Some of the students stated that the language of scientific papers was too heavy and incomprehensible, and therefore they perceived the scientific process as complicated. Therefore, the papers that students have difficulty in understanding and internalizing are seen as

unnecessary. Following statements can be given as examples to these perceptions: *"I don't understand why the language used in scientific papers is so complex. It's as if these papers were written so that no one would understand... (S5,B)" and "Information that I do not understand clearly or that I have difficulty in understanding is unnecessary for me. Information should be clear, concise and understandable... (S7,G)".*

Students' views about their own scientific method knowledge and skills

Participant students were asked to evaluate themselves about the scientific method knowledge and skills, and results of the content analysis regarding this question are summarized in Figure 4.

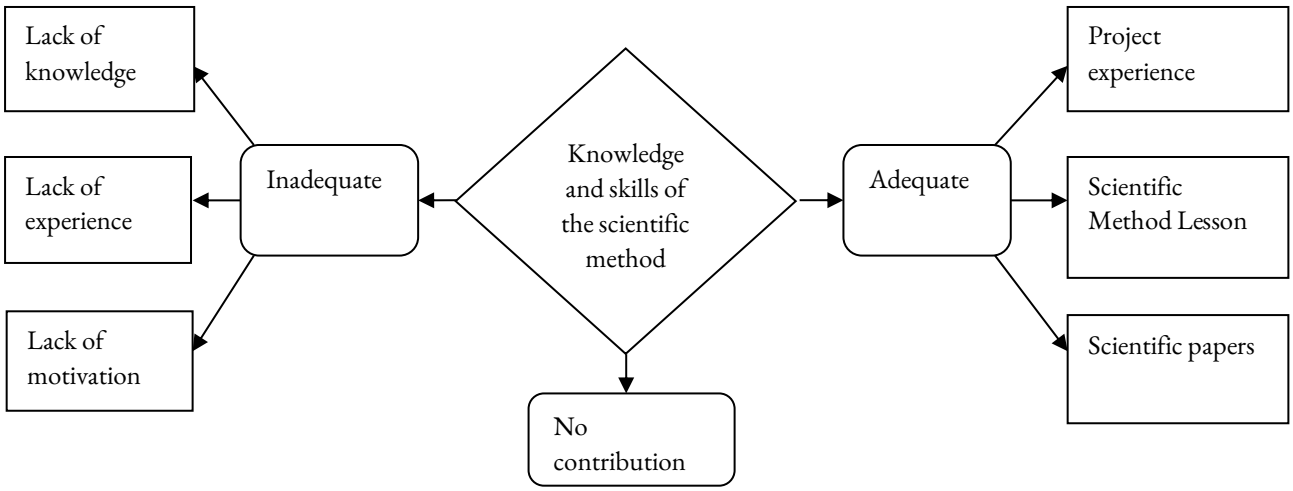

Figure 4. Students' views on their adequateness about the scientific method

Half of the participant students (f=6) evaluated themselves as inadequate in the scientific method. These students linked the inadequacy of the scientific method with a lack of knowledge, experience, and motivation. Some of the students stated they do not have enough knowledge about the scientific method, due to the course content being an insufficient and unqualified educators, although they take lessons about the scientific method. Some of the students stated that they see themselves as inadequate in the scientific method due to they had no chance to experience scientific research. Some of the students emphasized lack of motivation as the most important reason for their inadequacy in the scientific method. The following statements can be given as examples of these views: *"We have been taking scientific method courses since middle school. However, I could not learn much because the content of the courses was empty, and the trainers were insufficient in this regard... (S7,G), "I did not have a chance to practice my knowledge about the scientific method, so I forgot it... (S4,G)" and "Most of our time at school is spent preparing for the university entrance examination. I consider myself inadequate because our teachers do not lead and encourage us to conduct scientific research... (S5,B)".*

About 33% of participant students (f=4) evaluated themselves as adequate about the scientific method. These students stated that they had project experience before, they learned necessary information in the scientific method course, and they follow scientific papers regularly. Some of the remarkable statements of these views are as follows: *"I have been assigned TUBITAK projects several times before. Therefore, I consider myself sufficient in the scientific method... (S10,B)", "I think scientific method courses was very productive for me. I learned too much in these lessons, so I see myself adequate about the scientific method... (S9,G)" and "I regularly read scientific papers that interest me. Therefore, I think that I have sufficient knowledge about the process... (S3,G)".*

Two students did not report an opinion about their competencies, stating that they had never been assigned to a scientific project before, they did not have the opportunity to test their knowledge, and the scientific processes did not interest them.

Students' views about the scientific literacy workshop

Lastly, participant students were asked about how was the Scientific Literacy Workshop, and how was it effected their approach to the scientific method. Results of the content analysis regarding to this question are summarized in Figure 5.

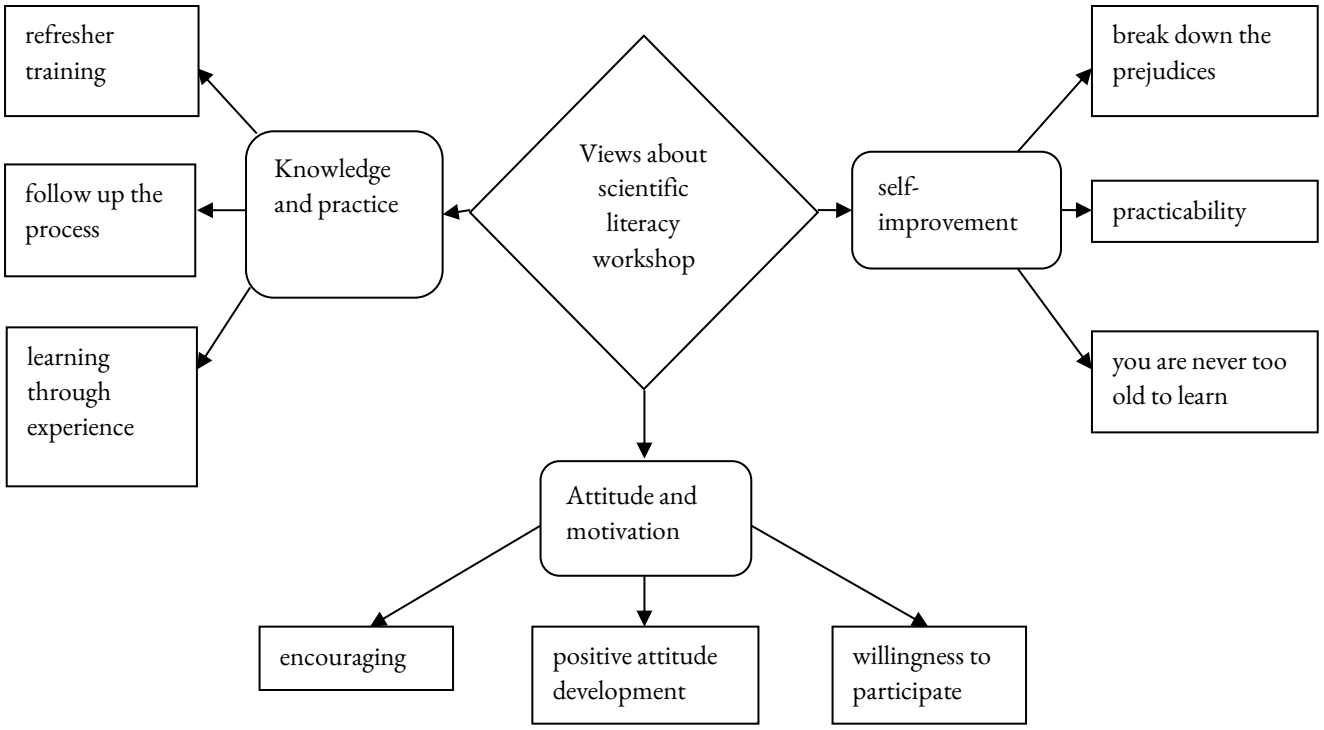

Figure 5. Students' views about the scientific literacy workshop

As seen in Figure 5, the Scientific Literacy Workshop helped to develop students' scientific knowledge and practice, self-improvement, attitude, and motivation. According to the majority of the students this Project helped them to refresh their knowledge about the scientific process. For example: *"I remembered the knowledge and how the scientific process works, thanks to the Scientific Literacy Workshop... (S9,G)" and "Thanks to the project, I had the chance to remember and understand how the scientific process works, as well as reviewing articles... (S5,B)".* Students emphasized that the project enabled them to observe the whole process of a scientific paper from planning to publishing first hand. This observation helped students to assimilate and comprehend the scientific process. Some of the remarkable statements of these views are as follows: *"We observed directly from the author about the process from planning to publishing of an article. Thus, it was a useful activity for taking into practice to my knowledge about scientific processes... (S3,G)" and "I clearly understood which sections should be in a scientific paper and what these sections should contain... (S2,B)".* In addition, students emphasized the Project helped to develop their scientific literacy, by learning through experience. For example: *"During the project, I had the chance to put the scientific process knowledge I learned theory into practice. In this way, I think I internalized the scientific process better... (S7,G)".*

Students stated that the project also contributed to their self-improvement by helping them to break down prejudices, understand that the process is practicable, and realize that they are never too old to learn. Some of the remarkable statements of these views are as follows: *"I used to think that the scientific method is a difficult and complex process. During this project, I realized that the scientific process was not as difficult and complex as I had thought, it was just a prejudice... (S6,B)", "In this project, I had the opportunity to closely observe a scientific process, and be involved in it. In this way, I realized that the scientific process is a practicable procedure that can be conducted by anyone... (S4,G).*

Students also stated that the Project encouraged them to follow and conduct scientific research, helped them to develop positive attitudes, and helped them to be a willingness to participate in scientific research. Some of the remarkable statements of these views are as follows: *"This project was important in terms of encouraging me towards scientific processes. Because being involved in the process and actively following it personally encouraged me... (S11,G), "During the project, my perceptions about scientific research positively changed. I realized that the scientific process is not threatening and difficult, on the contrary, it is a process that can be performed by every individual... (S7,B) and "Before that, I was hesitant to participate in scientific studies. Thanks to this project, I can now volunteer to participate in scientific research... (S1,G)".*

Conclusion and Discussion

Current findings revealed that students' research attitudes observably improved at the end of the Scientific Literacy Workshop. According to this result, we can claim that the Scientific Literacy Workshop positively contributed to participant students' research attitudes. This might be through the opportunities provided by the Project for the students. One of these advantages which the Project presents was helping students to put their scientific process knowledge and skills into practice. During the Project, students had the chance to observe the whole process of a scientific paper from planning to publishing. In this way, students were able to experience how the scientific method they learned theoretically works in practice. The students had the chance to experience the scientific process at first hand, realized that the process was not as difficult and incomprehensible as they thought. Therefore, this awareness stage may have changed students' perspectives about scientific processes and helped them to develop positive attitudes. This claim is supported by students' views too. Initially, students described the scientific process as boring, difficult, complicated, and unnecessary, and emphasized that scientific research is the business of scientists and scholars. However, it was observed that students' perceptions of scientific research positively changed during the Project. Students stated that scientific research was not as complicated as they thought, and it could be carried out by anyone who has enough interest and knowledge. In addition within the Project scope, students had the chance to refresh their scientific method knowledge and skills and stated that they learned better through experience.

Another opportunity provided by the Scientific Literacy Workshop to the participant students was bringing them together with scholars and authors. By this means, the students had the chance to meet the authors whose papers they follow, discuss the articles, and observe the scientific process first hand. This case may have encouraged students about the scientific method and scientific research and may have positively affected their attitudes too. Previously, students had a prejudiced approach towards scholars and authors, because they did not have the opportunity to meet any of them. They also thought that scientists were isolated from society and that scientific jargon was incomprehensible. The students, who had the opportunity to meet scholars and authors from different fields within the scope of the Project, realized that the situation was not as they thought. During the Project, students came together with authors and scholars in online meetings, discussed the articles, and refreshed their scientific process knowledge and skills. Students stated that they learned scientific terms through these meetings, and realized scientific jargon was not as incomprehensible as they thought. Thus, it is thought that eliminating students' prejudices against scholars and scientific jargon positively affected their attitudes toward research. The negative impact of prejudices on human behaviors and attitudes toward a phenomenon is already known (Harell, Soroka, & Iyengar, 2016; Hurwitz, 2008).

In the previous literature, many findings revealed attitudes toward the research of students at various educational levels. The reported results in these studies are often very diverse. In some studies, it was revealed that students' attitudes toward research were at a moderate or high level (Kakupa & Xue, 2019; Karadaş & Özdemir, 2015; Park, McGhee, & Sherwin, 2010; Polat, 2014; Shaukat, Siddiquah, Abiodullah, & Akbar, 2014; Siamian, Mahmoudi, Habibi, Latifi, & Zare-Gavgani, 2016). Contrary to this result, some findings indicated that students' attitudes toward research were at a low level (Addams & Holcomb, 1986; Amoo & Gbadamosi, 2021; Butt & Shams, 2013; Henry, Ghani, Hamid, & Bakar, 2020; Papanastasiou, 2005; Shaukat, Siddiquah, Abiodullah, & Akbar, 2014). It is quite clear that most of the previous studies focused on students' attitudes towards research tried to reveal the present condition, and far from the concern of developing it. This study focused not only on the revealing present condition of students' attitudes towards research but also on developing it. Therefore the results of the current study are considered important in contributing to the related literature.

This study also explored the effects of demographic variables on the students' research attitudes. It was found that male and female students perceived research attitudes were not significantly different. Research is a substantial component of every profession and student. Today almost every profession demands good skills in research. These professions are not usually gender oriented. Therefore, both female and male students have to be components of research skills. A similar attitude towards research in the males and the females in the current study may be due to the reason that all the students can realize the practicality and importance of scientific research. This claim was also supported by students' opinions. Both female and male students stated that they realized the scientific process is practicable to

everyone during the Project process, and scientific research can support them both personally and academically. This result is in contrast to the results of previous studies which suggested that female students have less interest and involvement in research activities than males. For example, Shaukat, Siddiquah, Abiodullah, and Akbar (2014) stated that male students had more positive attitudes toward research than females. According to Costello (1991), males held more positive attitudes toward research than females because research is a male-dominated domain. Butt and Shams (2013), explained the males' positive attitudes with the fact that the males assume that the research is useful for their professional careers. According to Lindsay, Breen, and Jenkins (2010), the reason for the positive attitudes of males toward the research may be that they are more inclined toward mathematics, statistics, and economics than females. In the previous literature, there are also findings overlapping current results (İlhan, Çelik, & Aslan, 2016; Kakupa & Xue, 2019; Siamian, Mahmoudi, Habibi, Latifi, & Zare-Gavgani, 2016).

Another finding of this study is that students' research attitudes did not statistically different according to the grade level variable. According to this finding, students' research attitudes were similar regardless of grade level. All high school students in Turkey receive scientific method courses at any grade level. Therefore, we can assume that high school students at all levels have scientific method knowledge and skills. It is thought that the attitudes of students at different grade levels with similar scientific method knowledge and skills, may be similar too. This result was supported by Kakupa and Xue (2019)'s findings indicated that there was no significant difference in research attitudes of students from different age groups. Results also showed students' research attitudes were statistically different according to the type of school they attended. Perceived attitudes of students studying at academic high schools were higher than students studying at vocational high schools. We can say that in Turkey, students studying at academic high schools are relatively more successful than students studying at vocational high schools (Berberoğlu & Kalender, 2005). Students who are academically more successful may have more interest and involvement in scientific research. It can be considered as an expected result that the attitudes of the students who have more interest and involvement in scientific research are also higher.

We believe that if students develop good research skills and attitudes, which are essential for learning and generating their reflections and ideas, they can be successful both academically and personally. Therefore, we attached great importance to the development of students' research attitudes, as well as their knowledge and skills about the scientific process. As a result, we can assume that the current study which was carried out with the concern of developing students' research attitudes, achieved its purpose. Feedback from students also supports this assumption. Students stated that they were encouraged to be involved in the scientific process thanks to the Project and that they would now participate in scientific research voluntarily. Therefore, it is thought that the Scientific Literacy Workshop would be a pioneer project for educators, and the results of this study would be a good example for further studies that focus on developing students' research attitudes.

Recommendations

Recommendations for Teachers

As can be seen, it is not sufficient to provide students with scientific method knowledge and skills. Students should be encouraged about scientific processes, and they should be offered the opportunity to turn their theoretical knowledge into practice. With this intention, we recommended that projects such as the Scientific Literacy Workshop should be implemented by teachers for students at all grade levels.

Scientific research is important for students' academic and self-improvement as well as professional careers. Therefore, teachers should improve themselves with effective strategies and pedagogies for developing positive attitudes toward research among their students.

Recommendations for Further Studies

Measuring students' research attitudes is essential to investigate the interest and involvement of students in research. It is suggested that further studies should not only be contented with measuring students' research attitudes, but also take measures to improve it.

The limitation of this study was that the sample size was not adequate; the study group consisted of only 42 high school students who participated in the Scientific Literacy Workshop. Thus students' research attitudes at other teaching levels remain unknown, which limits the generalization of the current findings. In further studies, it may be beneficial to conduct similar studies with larger participants and at different teaching levels in terms of increasing the generalizability of the results.

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