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Original Article

Examination of the Relationship between Statistical Literacy Levels and Statistical Literacy Self-Efficacy of High School Students

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Abstract

The purpose of this study was to examine the existence of a relationship between statistical literacy levels and statistical literacy self-efficacy of high school students. A total of 163 high school students studying at two different high schools in the 10th, 11th and 12th grades constituted the study sample. The "Statistical Literacy Self-Efficacy Instrument" and selected questions from the "Levels of Conceptual Understanding in Statistics (LOCUS)" project, adapted into Turkish, were utilized for data collection. The data were analyzed using both qualitative and quantitative methods according to a correlational research design. It was determined from the results that the statistical literacy of high school students was at a "Low" level and their statistical literacy self-efficacy was at an "Intermediate" level. Importantly, the statistical literacy self-efficacy of students was found to be a significant predictor of statistical literacy. It was determined that the strongest predictor of statistical literacy were factors regarding efficacy related to basic statistical concepts and confidence related to the statistical process that follows, while the weakest predictor was a factor regarding the belief related to statistical reasoning. Thus, it was important that this research emphasized the affective aspect of statistical literacy in particular and portrayed that this aspect was of great importance for students' statistical literacy. As a result, as part of the statistical teaching and learning process, activities aimed at developing the statistical literacy self-efficacy of students parallel to the target of students' statistical literacy is proposed.

Keywords

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Self-efficacy
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Introduction

As a natural result of the unabated proliferation of data on a day-to-day basis, it is now a priority to educate individuals to overcome the data mess that surrounds them. The way to deal with intensive data and to use data effectively is to improve individuals' statistical skills. Actually, statistical literacy appears to be the most important of these skills because every person equipped with statistical literacy can make accurate decisions regarding their future by controlling the data that plays an active role in their lives. Guidelines from the Assessment and Instruction in Statistics Education (GAISE) reports, which have an important place in statistical education, emphasize this distinctive function of statistical literacy (Aliaga et al., 2005; Bargagliotti et al., 2020; Carver et al., 2016; Franklin et al., 2007). For example, in the introduction of the GAISE II (Bargagliotti et al., 2020) report prepared for K-12, it is mentioned that the way to lead a healthier, happier and more productive life in a data-besieged world is to have a profile equipped with statistical literacy. Therefore, the ultimate goal for all should be statistical literacy. It is also highlighted in the report that in statistical education during the school years, making statistical literacy a routine skill that individuals can apply is of utmost importance. In this context, the aim is that every individual graduating from high school can evaluate data results and make a judgment regarding its validity. Additionally, the GAISE (Carver et al., 2016) report prepared for the undergraduate level, highlights the need to address statistical literacy in statistics courses in a more comprehensive and in-deep manner (Schield, 2017). Therefore, statistical literacy is ranked among the most important learning objectives of mathematics education (Özmen & Baki, 2019; Rumsey, 2002; Sharma, 2017), and especially due to the start of the digital transformation of today's world, it is brought to the forefront that one needs the ability to understand and interpret statistical information in various formats (Bargagliotti et al., 2020; Frost, 2013). For example, Callingham and Watson (2017) state that statistical literacy concerns a variety of groups, from undergraduate students to adults, from teachers to younger students, and also emphasizes that this is a social need. Furthermore, some believe that having these skills in our age is equivalent to fulfilling our duty as citizens (Sproesser, Kuntze, & Engel, 2014; Weiland, 2017). Thus, the importance given to statistical literacy leads to questions about what indicators can be used to show competence and what characteristics can be observed. Although researchers have defined statistical literacy, which has a fairly wide scope and a variety of aspects, there is no common framework yet accepted by all (Sharma, 2017). Based on the descriptions of different researchers in the literature, Rumsey (2002) summarizes the indicators of statistical literacy as:

- Interpretation, critical evaluation and multifaceted discussion of statistical information from various channels in the media (Gal, 2002)
- Understanding and using statistical language (words, symbols and terms) (Garfield, 1999)
- Creating meaning and reasoning about statistical concepts (Snell, 1999)
- Interpreting statistical results according to their context (Watson, 1997).

If these indicators are considered, individuals are expected not only to have knowledge of statistics but also to use this knowledge in different contexts as well as making data-based interrogatives. As a result, it is necessary to create an atmosphere of statistical literacy in statistics courses as much as possible (Hassad, 2007; Özmen, 2015).

In recent years, the subject of statistics has become increasingly common in mathematics curricula in a variety of countries such as New Zealand and Singapore, and as a result, the importance of educating students in terms of statistical literacy has been emphasized (Batur, Özmen, Topan, Akoğlu, & Güven, 2021). While in Turkey, the country in which this current study took place, these highlights were especially prominent in the national mathematics curricula prepared for middle school students in 2013 and 2018 (Ministry of National Education [MoNE], 2013a, 2018a). Although statistical literacy is not shown as a direct objective in these curricula, students are taught according to learning outcomes based on the statistical process which includes stages to formulate questions, collect data, analyze data and interpret results as well as information regarding statistical concepts. In contrast to the importance of these curricula in emphasizing the experience of the statistical process, it is noticeable that they are not functional at the point of ensuring that students see all the stages of this process entirely. In both curricula, learning outcomes that reflect the important skills of statistical literacy, such as interpreting concepts in the context of a question and making inferences by evaluating results, tend to lag behind (Özmen & Baki, 2019). Examining the mathematics curricula for high school, it is noted that there has been a significant reduction in statistical learning outcomes in the current curriculum compared to that of 2013 curriculum (MoNE, 2013b, 2018b). For example, in the current curriculum in particular, the skills that reveal statistical literacy, such as reasoning using statistical knowledge and ideas, and performing a critical approach, are demonstrated less, and noticeable gaps in using these skills with the topics of inferential statistics such as correlation, regression, hypothesis testing which allow an advanced interpretation of statistics, is also noted (Batur et al., 2021). Thus, statistical literacy in this curriculum is directed to students via their familiarity with the basic concepts of statistics as well as their simple interpretation (MoNE, 2018b). Although it is extremely important that statistical literacy, which is shown as the focus of statistics teaching, be integrated into the courses taught, it is also important to know to what extent students are equipped in terms of their proficiency following this process. Therefore, many large-scale research projects conducted in statistical education have drawn attention to situations that reveal students' level of knowledge and preparation.

The aim of the LOCUS project is to develop valid and reliable questions to illustrate the statistical understanding of students at the middle school to high school grade levels (Jacobbe, Case, Whitaker, & Foti, 2014). The project is focused on the principles of the GAISE (Franklin et al., 2007) report, which highlights statistical literacy, and views statistical literacy through a comprehensive perspective. This report provides a general framework for educators on how to teach statistics so that students are statistical literate. In the latest updated report, it can be recognized that the principles presented in the GAISE (Franklin et al., 2007) report have been considered around the world, and as a result, have shaped statistics teaching (Bargagliotti et al., 2020). Therefore, it should be emphasized that questions created in the light of the GAISE (Franklin et al., 2007) report principles, are important for supporting the statistical literacy of students (Batur, Elmas-Baydar, & Güven, 2019). With the help of LOCUS questions, an understanding of the statistical concepts of students can be detailed as well as their statistical understanding of more qualified thinking can be expanded upon. In this respect, questions are an important resource for determining and developing statistical literacy. At the same time, the LOCUS project demonstrates an approach that highlights the conceptual understanding of statistics, and reflections of this approach are observed in the developed questions. Given that conceptual understanding is the focus of statistical literacy (Franklin et al., 2007; Kuntze, Engel, Martignon, & Gundlach, 2010), individuals with statistical literacy are expected to integrate the mathematical structures underlying statistical situations rather than carry out a number of mathematical operations (Koparan, 2012). In other words, instead of reaching results by just calculations, being statistically literate requires demonstrating an action beyond computing by making sense of the mathematical patterns created by the data. This essential emphasis is especially evident in the LOCUS project. The project also draws attention to the differences between mathematical and statistical reasoning. Although statistics is included in mathematics, it is accepted that this discipline differs from mathematics by its nature (Groth, 2007). From here, it is understood that real statistical literacy will only occur as a result of knowing the points distinguishing statistics from mathematics. In this regard, it has been stated that the questions addressed within the LOCUS project also serve such a purpose (Jacobbe et al., 2014). At the same time, the project aims to enable students to know most concepts regarding statistics and use them to clarify situations in their daily life. Thus, it is stated that statistical literacy will be then approached in a more comprehensive manner. As a result, the questions of the LOCUS project differ significantly from many of the instruments developed to assess statistical literacy and form the basis for many studies in the area of statistics (Batur, Baki, & Güven, 2019; Bolch & Jacobbe, 2018; Engledowl & Tarr, 2020; Whitaker & Jacobbe, 2017). In this regard, it was decided in this current study to use LOCUS questions to examine the statistical literacy of students in-depth.

Self-efficacy is an individual's belief in their own ability to organize and implement a chain of action necessary to manage a particular situation (Bandura, 1997). In other words, self-efficacy is not a function of an individual's abilities, but rather an indicator of his or her perception of what he or she can do with his or her abilities (Gürcan, 2005). Just because an individual has the abilities necessary to respond to events in his or her life does not mean that he or she will use these abilities as needed in different situations. Achievement requires not only having the ability, but also a strong perception of having the controlling power that drives these abilities (Bandura, 1997). This perception significantly determines how individuals think and behave (Bandura, 1997; Pajares, 1992). Such that, the individuals with a high level of self-efficacy express their determination by never giving up in the face of difficult tasks, while the individuals with a low level of self-efficacy believe that what they will do is much more difficult than it really is, and as a result, more easily give in and be less persistent on accomplishing their tasks (Arseven, 2016; Kurt, 2012). Importantly, such a way of thinking will reduce personal satisfaction as well as affect the ability of individuals to perceive achievement.

The experiences of achievement and failure encountered in a particular process can cause changes in individuals present self-efficacy. As a matter of fact, self-efficacy increases when someone is successful in a task, whereas repeated failures can create a feeling of inefficacy (Betz & Hackett, 1986). At this point, if a person can develop strong and resilient self-efficacy, then they can easily overcome the negative effects of failures (Kesgin, 2006). Thus, self-efficacy acts as an extremely important motivator for the self-realization of the individual. For this reason, self-efficacy is often considered an important internal dynamic that affects the work of an individual and triggers his or her achievement (Erol & Avcı-Temizer, 2016). Especially in the educational understanding of today, where the concepts of learning and learner have become the focus, self-efficacy has become more important in terms of learner characteristics that affect learning (Arseven, 2016). The more a student believes that he or she has the ability to do a particular task, the more he or she becomes willing to learn and demonstrate the required behavior. Therefore, self-efficacy can be viewed as a strong factor that leads students towards achievement (Schunk & Pajares, 2009; Zimmerman, 2000). For this reason, it is important to consider self-efficacy in areas such as mathematics and statistics, where the achievement factor is especially important, yet the achievement anxiety of students can be quite high. This means ensuring that students are self-confident about mathematical questions (MoNE, 2018a). As a matter of fact, in the TIMMS and PISA exams, which include questions that measure and evaluate mathematical literacy and are conducted in participating countries around the world, it is believed that one of the reasons for poor results in Turkey is due to a lack of students' mathematics self-efficacy (Doğan & Barış, 2010; Önder & Gelbal, 2016). On the other hand, self-efficacy, which is considered so important for mathematics, may be developed differently in different types of subjects.

In statistics education, special emphasis is placed on the statistics self-efficacy of individuals (Mercimek & Pektaş, 2013). It is stated in the GAISE report that steps should be taken to ensure that students have a positive statistics self-efficacy (Olani, Hoekstra, Harskamp, & van der Werf, 2011). Educators are also asked to show great sensitivity to this issue and focus on the development of statistics self-efficacy in students (Sevimli, 2010). As a matter of fact, statistics self-efficacy is the belief of individuals in their ability to organize and execute action plans necessary to perform particular tasks related to statistics (Dopa-Pathirage, 2015). This self-belief of students helps them successfully acquire knowledge within the statistics course (Perepiczka, Chandler, & Becerra, 2011; Salim, Gopal, & Ayub, 2018). A good understanding and interpretation of the basic concepts and terms contained in statistical information, in other words, a strong use of statistics, in a way, requires literacy skills. In activating these skills, statistical literacy self-efficacy comes to the forefront. Because in today's world, when we are faced with different volumes of data, statistical literacy requires the ability to correctly understand, interpret and criticize this data. Whether this situation arises from self-efficacy, especially in relation to statistical literacy, which drives these abilities, it is an important topic of research. Batur, Yiğit, and Baki (2019) draw attention to the evaluation of statistical literacy self-efficacy of students by expanding on studies regarding statistics. This presents the need to look at statistical literacy through a perspective that is not only cognitive but also affective.

Statistical literacy self-efficacy can be defined as the self-directed perception of individuals to critically approach statistical situations and communicate effectively. Given that statistical literacy self-efficacy has a multidimensional structure, the factors about confidence related to the statistical process, belief related to statistical reasoning, and efficacy related to basic statistical concepts that are deemed important in terms of this competence must also be examined (Batur, Yigit, & Baki, 2019). Thus, the viewpoint on the best evaluation of statistical literacy self-efficacy can be expanded. In this sense, confidence related to the statistical process can be defined as the self-confidence of individuals at consecutive stages in the form of formulating an appropriate question that explains statistical situations, collecting data, reducing data and interpreting results. Besides, belief related to statistical reasoning can be expressed as the belief of individuals in the critical approach to data groups, interpreting, criticizing statistical results and deciding on the generalizability of results. The efficacy related to basic statistical concepts can be defined as the perception of individuals regarding the competence to know the meaning of concepts and symbols belonging to statistics, to be able to convey their ideas belonging to these concepts in written and oral form and to be able to use statistical language effectively. All these definitions point to the importance of examining statistical literacy in terms of self-efficacy.

During the last decade of statistical education, studies directed towards statistical literacy (Garfield & Ben-Zvi, 2008) often focus on portraying the present statistical information of individuals. Although the importance of the affective aspect is emphasized in some of the developed statistical literacy models (Gal, 2002; Watson, 2006), there are large gaps at the point in which this emphasis is reflected in practice. Moreover, the studies using these models mostly focus on cognitive components and neglect affective components. It has been revealed that the affective aspect is also important for the formation of statistical literacy through a limited number of studies conducted in the context of self-efficacy (Carmichael, Callingham, Hay, & Watson, 2010; Carmichael & Hay, 2009; Lin & Huang, 2013). The common emphasis of these studies is that self-efficacy has an important place in terms of statistical literacy. For this reason, it is also important to consider statistical literacy self-efficacy in studies that examine the statistical literacy of individuals. Especially given the emphasis on increasing statistical literacy levels of students prior to university (Watson, 2006), it is important to investigate the statistical literacy and statistical literacy self-efficacy of high school students. As a matter of fact, high school is the level where compulsory education ends, and some individuals enter directly into a profession. Therefore, it is very important that high school students, who will be adults in the future, experience statistical literacy in all its aspects. Despite this, studies on statistical literacy in Turkey, have mostly been at the middle school level and only focus on cognitive aspects (Çatman-Aksoy, 2018; Koparan, 2012; Topan, 2019; Yolcu, 2012). This highlights the need of directing the focus of research on statistical literacy to the high school level (Dursun, 2019; Murod, Priatna, & Martadiputra, 2019) as well as to include the affective aspect in these studies.

Self-efficacy studies conducted in statistics education usually focus on statistics self-efficacy (Aydın & Sevimli, 2019; Aydın, Sevimli, & Abed, 2019) and the extent to which self-efficacy of students predicts statistical success (Abd-El-Fattah, 2005; Finney & Schraw, 2003; Lane, Hall, & Lane, 2004;

Sevimli, 2010; Zare, Rastegar, & Hosseini, 2011). Compared to these studies in which the relationship between statistics self-efficacy and success is established, it seems that there are no studies investigating the relationship between statistical literacy and statistical literacy self-efficacy. Carmichael et al. (2010), in their study, show that prior mathematical achievements of students predict their interest about statistical literacy mediated by statistical literacy self-efficacy. Although this study is important in that statistical literacy self-efficacy portrays the mediating role, it is limited in that this role again addresses the affective aspect of statistical literacy. To eliminate this limitation, it is very important to conduct studies that provide a bridge between the affective aspect and the cognitive aspect of statistical literacy. From here, the importance of examining the relationship between statistical literacy self-efficacy and statistical literacy emerges. In the studies conducted, the aim is to fully reflect the competencies related to both aspects. At this point, the quality of the instruments used, and the analyses performed come to the forefront. For example, integrating the cognitive aspect with the quantitative data from a multiple-choice test alone may not be sufficient for interpreting statistical literacy, which requires a high level of skill. From here, the importance of using LOCUS questions that reduce the repetition of absolute information and increase the power of interpretation is being understood. The data obtained with the help of these questions can be analyzed in-depth by adopting qualitative approaches. Additionally, it is extremely important to employ factors with the strong theoretical ground in reflecting the affective aspect of statistical literacy. This makes the research conducted with the data obtained from the statistical literacy self-efficacy instrument of importance. Thus, we consider that the current study will shed light on future research due to the instrument utilized as well as the approaches that were adopted for revealing the affective and cognitive aspects of statistical literacy.

In particular, it was worth researching the complex relationships between the factors of confidence related to the statistical process, belief related to statistical reasoning and efficacy related to basic statistical concepts, and statistical literacy, which are important for statistical literacy self-efficacy. Thus, statistical literacy self-efficacy can be examined more deeply in different aspects. As a matter of fact, while the components that make up the theoretical structure of statistical literacy are noted in the literature, the role of self-efficacy of these components (factors) in the formation of statistical literacy is neglected. For example, determining which factor explains the level of statistical literacy is expected to guide education and training practices aimed at improving the statistical literacy of students. Thus, this study will make significant contributions to statistical education.

Purpose of the Study

In this study, the purpose was to examine the relationship between statistical literacy self-efficacy and the statistical literacy levels of high school students. According to the main purpose of this study, the questions to be addressed were as follows:

1. What is the distribution of the statistical literacy levels of high school students?
2. What is the distribution of statistical literacy self-efficacy of high school students?
3. How do scores for statistical literacy self-efficacy of high school students differ in terms of factors regarding confidence related to the statistical process, belief related to statistical reasoning, and efficacy related to basic statistical concepts?
4. Is statistical literacy self-efficacy a significant predictor of statistical literacy of high school students?

Method

This research, which had the purpose of examining the relationship between statistical literacy self-efficacy and statistical literacy levels of students, was based on a correlational research design. In this type of research, statistical techniques such as correlation and regression were used to analyze the relationship between measured variables. Based on one variable, the other variable can be predicted (Fraenkel & Wallen, 2006). In the measurement of the variables involved in this study, a design in which qualitative and quantitative analyses were used together was followed. In this sense, a qualitative approach was used in the process of examining statistical literacy of students. In the quantitative part of the study, analyzes were conducted to determine statistical literacy levels, statistical literacy self-efficacy, and the predictive strength of statistical literacy self-efficacy on statistical literacy of students.

Study Group

The study group of this research consisted of 163 high school students studying at two different public high schools located in the eastern Black Sea region of Turkey. One of the high schools in this study had a higher-than-average level of achievement on the central exam administered by the national government for assessing students during their transition to secondary education, while the other school had a lower-than-average level of achievement on the same exam. Thus, these schools were selected for this study for the purpose of providing diversity in terms of the high school students' achievement levels. Furthermore, the selection of students studying at these high schools was based on the completion of the topics related to the statistics learning area in the current national mathematics curriculum for high school (MoNE, 2018b). According to this criterion, students were selected from the 10th, 11th and 12th grades by using simple random sampling (where the probability of each student being selected is equal) (Kerlinger & Lee, 1999). Thus, the purpose was to provide differentiation in terms of grade level. The demographic information of the participants is included in Table 1.

Table 1. Demographic Information of the Study Group

Grade level	Gender				Total	
	Female		Male			
	f	%	f	%	f	%
10th grade	33	52	29	48	62	38
11th grade	22	48	24	52	46	28
12th grade	32	58	23	42	55	34
Total	87	53	76	47	163	100

Data Collection Instruments

In this study, the data collection instruments utilized were the "Statistical Literacy Self-Efficacy Instrument" to determine the statistical literacy self-efficacy of students, and the LOCUS questions to determine their statistical literacy. Information about each of these data collection instruments is presented in the following.

The Statistical Literacy Self-Efficacy (SLS) Instrument

This instrument, developed by Batur, Yiğit, and Baki (2019) was used to determine statistical literacy self-efficacy of high school students. The SLS is a 5-point Likert-type scale (including the degrees of strongly disagree (1), disagree (2), moderately agree (3), agree (4), strongly agree (5)) and it has 25 positive items and 13 negative items. The construct validation of the instrument was provided through exploratory factor analysis. As a result of the analysis, it was determined that 38 items of the instrument were distributed under three factors and the total variance explained by factors was 41.521%. When naming the factors, components of the statistical literacy model developed by Özmen (2015) were considered. Thus, there were three distinct factors: "confidence related to the statistical process (CSP)", which had 13 items, "belief related to statistical reasoning (BSR)", which had 12 items, and "efficacy related to basic statistical concepts (EBSC)", which had 13 items. Findings regarding the reliability of the instrument were obtained from the Cronbach's Alpha internal consistency coefficient and the independent samples t-test based on the difference between the mean score of 27% of the lower and upper groups. The Cronbach Alpha coefficient for the overall instrument was calculated as 0,934. Additionally, the t-test showed that the difference between the mean scores of the lower and upper groups was significant ($p < 0,05$). In this current study, confirmatory factor analysis was performed to test the fit of the 3-factor structure of the present instrument as a result of the exploratory factor analysis. Confirmatory factor analysis is a statistical method that reveals the fit of items in an instrument whose factor structure is determined by the factor to which it depends (Tabachnick & Fidell, 2007). In this method, the fitting of the model was evaluated based on the values shown by many fit index. As a result, the Chi-square value, which is considered the initial fit index, was looked at first and it was determined that this value was significant ($\chi^2 = 1203,299$, df = 662, p = 0,00). Then, other values of the instrument fit index were checked by considering particular criteria values ($0 \leq \chi^2/df \leq 2$ (Kline, 2011), IFI, GFI, CFI and TLI ≥ 0,90 and RMSEA ≤ 0,05 (Byrne, 2001). Thus, it was concluded that the values of the fit index of the instrument ($\chi^2/df = 1,81$; GFI = 0,92; CFI = 0,92; IFI = 0,91; TLI = 0,91; RMSEA = 0,045) provided the underlying criteria values and confirmed the factor structure of the model. The items of the statistical literacy self-efficacy instrument are given in Appendix 1.

LOCUS Questions

In this research, the statistical literacy of students was measured using questions selected from the LOCUS project (Jacobbe et al., 2014). First, by obtaining the necessary permissions these questions were accessed from the website (see https://locus.statisticseducation.org/) where LOCUS sample questions are shared. While the questions were being selected, it was noted if they were in line with the learning outcomes associated with the statistics learning area contained in the current national mathematics curriculum for high school in Turkey (MoNE, 2018b). As a result, four questions and a total of 12 open-ended questions along with the sub-components of these questions were utilized in this research. To adapt the selected questions from English to Turkish for use in this study, two experts in the area of English who are native Turkish speakers, were asked to translate the questions. Thus, the Turkish draft form of the questions was created. Then, the draft form was checked by three mathematics educators and a statistics area expert with knowledge in the area of statistics. Along with the opinions of experts, a common assessment was made, which resulted in the questions being reorganized. Next, the opinions of two Turkish educators were applied to eliminate any question deficiencies in terms of language and expression. The resulting Turkish questionnaire was also back translated into English by two education experts. The Turkish and English translated forms were compared by the researchers with the original questions to determine whether the questions retained the same meaning. Once the researchers determined that the final questions retained their meaning the form was prepared. Then, a pilot study was conducted with 20 high school students to evaluate the comprehensibility of LOCUS questions provided in the questionnaire form. As a result of the pilot study, one of the questions that students had difficulty understanding was removed, and some other questions were changed. Thus, four questions and a total of 11 questions together with their sub-components were finalized for use in the main study. The Turkish version of the LOCUS questions used in this current study is presented in Appendix 2. Furthermore, another pilot study was conducted with 68 high school students to show the extent the indicators of the categorical scoring rubric on the website were consistent with the responses of students according to the assumptions of the mathematics curriculum in Turkey. As a result of this second pilot study, the indicators of the categorical scoring rubric were revised based on the students' responses. Sample student responses are included to provide a clearer understanding of each indicator (see Appendix 2 - Table 8).

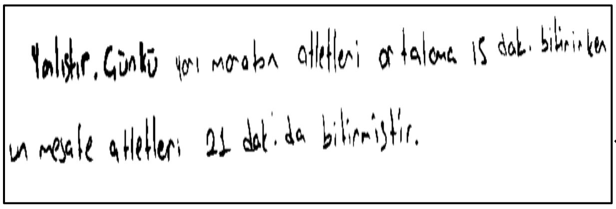
Ethics and Procedures

Data within the scope of this research was collected personally by the researchers in accordance with permissions obtained from the Directorate of National Education of the province with which the schools where the research was carried out were affiliated. Additionally, it was approved by the Trabzon University Social and Human Sciences Ethics Committee where the research was conducted within the framework of ethical rules. High school students who participated in the research were informed about the research, and their responses were used only for scientific purposes. Also, the participants personal information was not shared with any person or institution. The instruments prepared for the participating high school students were voluntarily completed within a 90-minute period. Furthermore, during the study process, students were first asked to respond to the SLS Instrument and then to the LOCUS questions. As a result, the data from the two instruments were collected consecutively.

Data Analysis

In this study, the statistical literacy levels of students were determined as a result of the analysis of their responses to LOCUS questions. The responses of students were analyzed based on the categorical scoring rubric developed within the scope of this research. Indicators of each question in the categorical scoring rubric were rated as "Inadequate (0 points)", "Intermediate (1 points)" and "Advanced (2 points)". According to the categorical scoring rubric, the category of Inadequate (0 points) included responses with poor statistical content, more personal ideas at the forefront, and were not directly associated with the context. While for the Intermediate (1 points) category, students seem to be aware of statistical concepts. Importantly, their awareness was limited to the basic use of statistical skills and mostly included simple definitions and superficial explanations. In the Advanced (2 points) category, it was recognized that students supported their explanations with statistical evidence, effectively used statistical concepts, and as a result, demonstrated a critical approach to situations. In Table 2, it is illustrated how the students responds to the LOCUS questions were analyzed according to the prepared categorical scoring rubric.

Table 2. Sample Question Analysis According to the Categorical Scoring Rubric

Student Response*	 Yalıştır. Çünkü yarı maraton atletleri ortalama 15 dak. bitirirken uzun mesafe atletleri 21 dak.'da bitirmiştir.	"It's wrong. Because runners of the half-marathon finish in an average of 15 minutes, while runners of the long-distance finish in 21 minutes"
Explanation	The student evaluated the average according to greater-less at the tour time. Student was unable to explain the effect of outliers on the average (Intermediate / 1 points)	

*see Appendix 2 - Table 8 for the SL2-b Question

When the table is examined, it can be seen that the response of student contains simple definitions. For this reason, this response was coded to be in the intermediate category, where statistical information is limited to explanations at a basic level.

As in the above sample, responses of students to LOCUS questions were analyzed in this approach and their total scores were obtained. These scores were analyzed using descriptive statistics (frequency, percentage, average and standard deviation). The results were evaluated according to the cut-off point ranges which were created. These point ranges were structured based on the formula *gap width = array width / number of desired groups* (Güngördü, 2000, as cited in Öztürk, 2003). Thus, when considering that the response to each question changes between 0 - 2; levels of statistical literacy were established as Low (0 – 0,66), Intermediate (0,67 – 1,33), and Good (1,34 – 2,00). The score of students in each question and the overall average score taken from the LOCUS questions were evaluated and their level was determined.

The total scores of the students were calculated from their responses to the statistical literacy self-efficacy instrument. When calculating these scores, attention was paid to the reverse encoding of negative items contained in the instrument. Thus, the scores obtained were analyzed using descriptive statistics (average, standard deviation, percentage, etc.). Then, the results of the analysis were evaluated according to the cut-off scores created for the statistical literacy self-efficacy instrument. Therefore, considering that the response to each question changes between 1 - 5, the levels to be used for statistical literacy self-efficacy of students were established as Low (1,00 – 2,33), Intermediate (2,34 – 3,67) and Good (3,68 – 5,00). The average for the items contained in the instrument and the overall instrument were interpreted based on these levels. In this way the statistical literacy self-efficacy levels of the students were determined. Raw scores from each factor were converted into linear scores using the Rasch model while determining how the scores of the statistical literacy self-efficacy of students differed in terms of factors regarding CSP, BSR and EBSC. In the end, the purpose was to compare factors on a single scale.

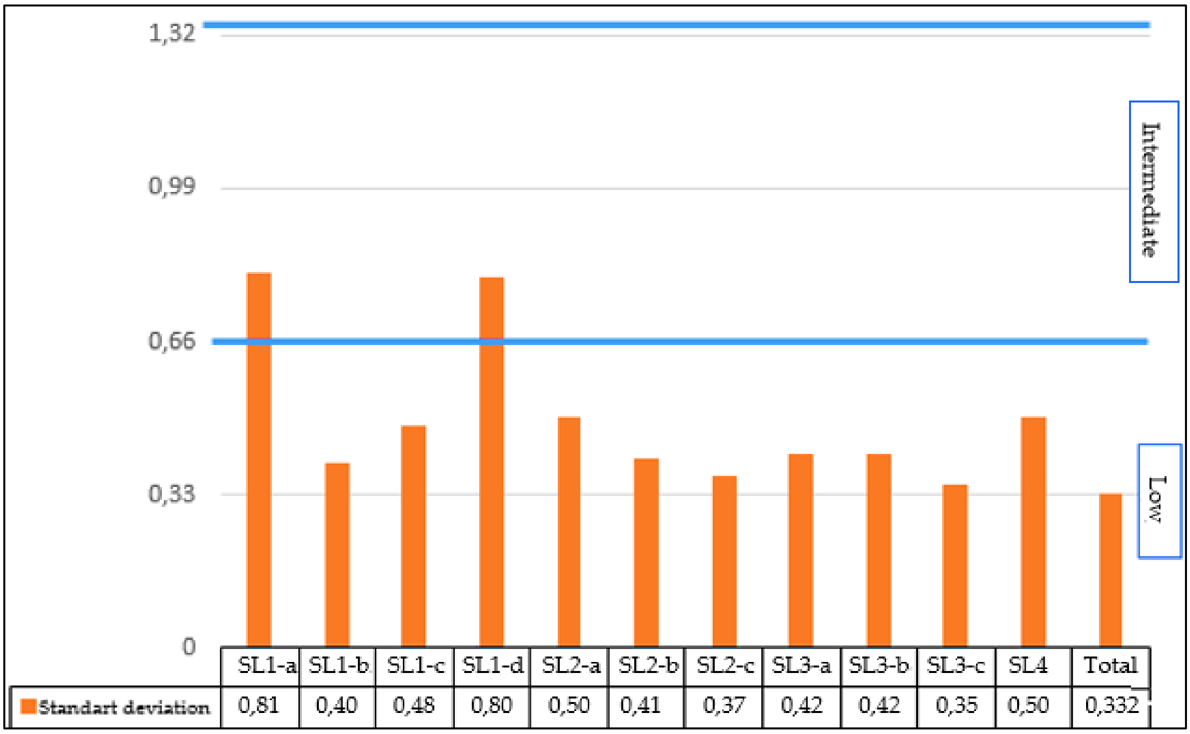
Stepwise multiple regression analysis was used to determine whether statistical literacy self-efficacy were a significant predictor of the statistical literacy of students. Firstly, the normality of the data was examined from the prerequisites required for this analysis. In this study, the normality hypothesis was controlled by creating a histogram and a normal distribution curve. Thus, it was observed that the data was derived from the normal distribution. Additionally, the scatter plot was reviewed to verify whether the relationship between statistical literacy self-efficacy and statistical literacy was linear. The scatter plot showed that there was a linear relationship between both variables. Next, the hypothesis required for this analysis, including the relationship between variables was less than 0,90, the change in explained variance (R^2) was significant, albeit small ($p < 0{,}05$), variance inflation factor (VIF) was less than 10 and the tolerance value (TV) was greater than 0,10 (Çokluk, Şekercioğlu, & Büyüköztürk, 2014), was checked. As a result, it was observed that the correlation coefficients between variables changed between 0,497 – 0,793, the change in explained variance was significant R^2 ($p = 0{,}01$), the values of VIF changed between 1,456 – 2,962 and the values of TV changed between 0,338 – 0,687 for this research. Thus, this analysis was carried out on the grounds that the hypothesis of stepwise multiple regression were met.

Results

In this section, in parallel with the purpose of this research study, findings were provided to examine the relationship between statistical literacy levels and statistical literacy self-efficacy of high school students. For this, in line with the questions focused on within the scope of this research, the findings section was organized into three separate headings. First, results were presented regarding the statistical literacy levels of students. Then, the statistical literacy self-efficacy levels of students were determined by considering their responses to the items on the instrument, and the scores for each sub-factor of the instrument were compared. Finally, findings regarding the predictive strength of statistical literacy self-efficacy to statistical literacy of students were included.

Findings on Statistical Literacy Levels

In Graph 1, the distribution of the average scores obtained by students from LOCUS questions in terms of statistical literacy levels is provided along with the standard deviation values for each average score.



Graph 1. Distribution of Scores obtained from LOCUS Questions in terms of Statistical Literacy Levels

When Graph 1 is examined, it was found that students were at a "Low" level for the vast majority of questions (SL1-a, SL1-b, SL2-a, SL2-b, SL2-c, SL3-b, SL3-c, SL4). In this group, the average score ($\bar{x}$ = 0,141) of the students was quite low, especially in the SL1-b (selecting of sample), SL2-c (interpreting of the graph) and SL3-c (selecting of the appropriate measure of central tendency) coded questions. Besides, it was found that students can reach the "Intermediate" level in the SL1-c (selecting of the appropriate table and graph), SL1-d (reading of the table and graph) and SL3-a (drawing of the graph) coded questions. Among these questions, the highest average score ($\bar{x}$ = 0,99) appears to have been obtained from the SL1-d coded question. As a result, it can be stated that students can go up to the "Intermediate" level in LOCUS questions while not reaching the "Good" level for any question. When the standard deviation of the scores was evaluated, it was determined that the lowest standard deviation belonged to the SL3-c coded question and the highest standard deviation to the SL1-a (formulating a question) coded question. This indicated that the question the students had the most consensus in from the LOCUS questions was SL3-c, while they had the least consensus on SL1-a. Besides, the overall average ($\bar{x}$ = 0,483) calculated to determine the statistical literacy of students was also quite low. According to this average, the statistical literacy of students was found to be "Low". Additionally, looking at the overall standard deviation of responses to LOCUS questions, it was noted that it was 0,332. The fact that this value was low indicated that there was a consistency between the responses that the students provided for the questions.

Results (in percentage and frequency) showing the distribution of scores of students from LOCUS questions in terms of the categories are provided in Table 3.

Table 3. Distribution of Scores from LOCUS Questions in terms of the Categories

Question	Inadequate		Intermediate		Advanced	
Code	f	%	f	%	f	%
SL1-a	101	62	28	17	34	21
SL1-b	143	88	17	10	3	2
SL1-c	21	13	125	77	17	10
SL1-d	52	32	60	37	51	31
SL2-a	70	43	93	57	0	0
SL2-b	128	79	35	21	0	0
SL2-c	141	86	21	13	1	1
SL3-a	21	13	133	82	9	5
SL3-b	127	78	36	22	0	0
SL3-c	140	86	23	14	0	0
SL4	98	60	64	39	1	1
Total	1042	58	635	35	116	7

For each question: maximum:2 minimum:0

When Table 3 is examined, it was observed that in general 58% of student responses to LOCUS questions were in the inadequate category. While it was found that 35% of student responses to the questions were in the intermediate category, whereas only 7% of the responses were in the advanced category. This demonstrated that more than half of students had responses to LOCUS questions which were in the inadequate category.

It was found that the responses of a vast majority of students to LOCUS questions had poor statistical content. For example, the SL1-b question mentioned how to select a sample of 100 students to determine a sports branch that will be added to a physical education class. 88% of student responses to this question were in the inadequate category. Thus, in this category, they usually tended to select a biased sample. For example, the response by the S135 coded student was as follows:

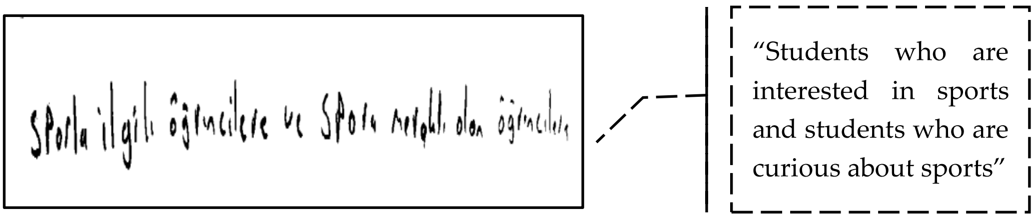


Figure 1. Response of Selecting a Sample in the Inadequate Category

As shown in Figure 1, the student stated that 100 students should be selected from among those interested in sports. As such, the student could not explain randomness, considering the limitations (interest of each student in sports is not at the same degree, and this affects the preference of a person, etc.) in the direction of the representation of the population. Thus, the response of the student was considered as inadequate. It seems that only 17% of students responded to this question at the intermediate category. These responses were found to have the content of *"I take particular students from all age groups / class levels"*, *"I take equal students from girls and boys"* mostly without considering the limitations and only related to the representation of the population. Also, these students did not note randomness when selecting a sample. Such that, in this question, only 2% of students focused on more than one dimension related to the concepts of randomness and representativeness and were considered to respond in the advanced category.

Additionally, it was determined that students had difficulty with questions that required interpreting and making inference of graphs (SL2-a, SL2-b, SL2-c, SL3-b, SL3-c and SL4). It was found that students who responded to the vast majority of these questions were placed in the inadequate category. For example, for the SL2 question, information about the times runners ran in long-distance and half-marathon were presented with histograms. In c, which is the sub-component of this question (SL2-c coded question), students were asked to compare the tour times of one of the runners from both races. While 86% of students responded to this question in the inadequate category, 13% were able to answer it according to the intermediate category. While students who responded to this question in the advanced category formed for only 1%. Thus, it was found that a vast majority of the students generally supported the situation presented within their responses, which were evaluated in the inadequate category, and as a result, offered reasons in their own way. For example, a sample response by the student S21 is provided in the following.

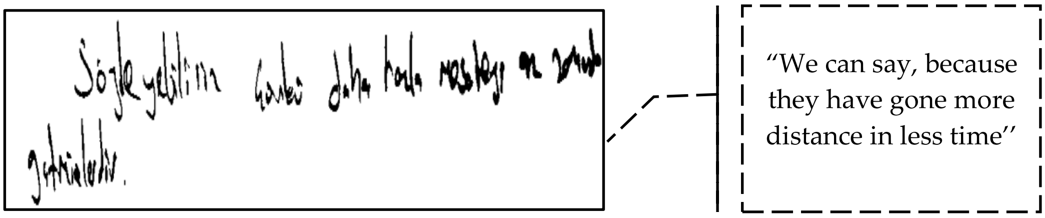


Figure 2. Response of Interpreting of the Graph in the Inadequate Category

As shown in Figure 2, the student focused on a lower amount of time of half-marathon runners by looking at the histogram. Thus, the student developed the idea that all runners who ran this race would also have a lower time. However, the student did not consider that the lower time of the half-marathon runners in general may be due to individual runners. For this reason, this response was evaluated to be in the inadequate category. Also, students who responded to this question according to the intermediate category, generally stated, that, *"It can't be said. The number of tour may change for each runner".* Although these students considered runners individually, they could not statistically explain that such a situation could not be inferred from the graph. Thus, it was observed that there was only one student who presented this explanation. The student coded Ö134 stated that, *"When looking at the graph, long-distance runners' tour times changed more. However, this does not mean that a runner running here will have more tour time than a runner in the half-marathon. Because a runner can be an outlier in the distribution. Only a general comment comes from the graphs".* As a result, this response which had a statistical evidence was evaluated in the advanced category.

It was also observed that there were questions in which students used their statistical skills at a basic level. For example, in question SL1-c, students were asked to create a table and graph summarizing probable responses from 100 students. While 13% of students responded to this question according to the inadequate category, responses in the intermediate category were 77% and 17% in the advanced. Thus, it was determined that students who responded in the inadequate category generally preferred to use a line graph. As a matter of fact, it appeared these students did not understand that there was a situation within the question that required comparing the data. Besides, in responses within the intermediate category, students generally carried the data to the coordinate system as well as showed it in ordered pairs. The response by student S148 regarding these findings is provided in the following.

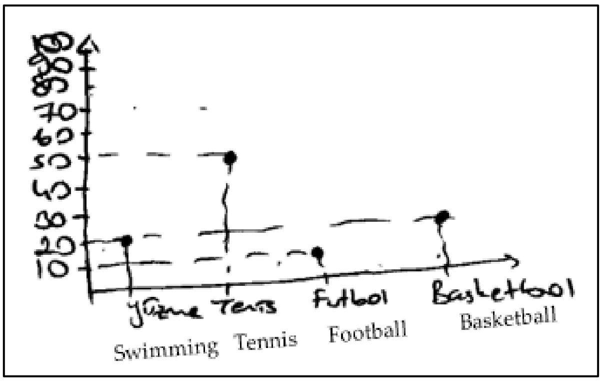
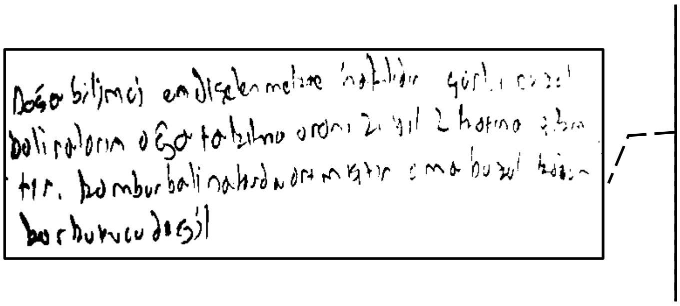


Figure 3. Response of Selecting the Appropriate Table and Graph in the Intermediate Category

As shown in Figure 3, the student was able to recognize the limit of 100 people in the equation and distributed the data appropriately in accordance with the various sports. In the drawing created by the student, it was seen that they categorically represented the sports branches. Thus, the appropriate comparisons were made between the different sports. Although the graph created by the student resembles a scatter plot, it does not exactly match the drawing or the purpose of this graph. Because such graphs contain ordered pairs obtained by marking the corresponding value of another variable for the value of a quantitative variable. Namely, it was thought that the change in the independent variable shown on the x-axis was important for the dependent variable on the y-axis. As a result, interpretations of the direction and strength of the relationship between the variables could be made. While there were no ordered pairs in the student's drawing (see Figure 3), there was also no relationship. Therefore, the response of the student to this question, at least due to the fact that the student had considered the idea of comparing categorical variables, was evaluated to be in the intermediate category. As a matter of fact, only 17% of students were able to respond to this question in the advanced category by drawing bar and pie graphs.

There were also questions regarding which students critically evaluated situations by using their statistical knowledge and making the appropriate inferences. For example, in the SL4 coded question, there was only one student whose response was considered to be in the advanced category. In this question, the numbers of whales which get entangled in fishing nets in two consecutive years was presented through a double bar graph. Students were asked to comment on the change in the number of entanglements of glacier whales and humpback whales. There were 60% of students who responded to this question in the inadequate category, and generally the responses reflected their personal ideas such as *"there has been a decrease in the number of glacier whales because the glaciers have melted rapidly"* and *"one species of fish can have such a result because it eats another"*. Also, the responses in the intermediate category were from 39% of students *"Glacier whales increased from five in the first year to 11 in the second year. There is also an increase in the humpback whales. I couldn't be sure"*. This student tended to only read the information presented in the graph and not reach a definite conclusion. Furthermore, only one student commented on the change in the number of whales by using proportional reasoning. For example, the response by student S101 is provided in the following.



"The environmentalist is right to be concerned, because the rate of entanglements of glacier whales in fishing nets has increased 2 times in 2 years. Humpback whales have also increased, but not as worrying as glacier whales"

Figure 4. Response of Proportional Reasoning in the Advanced Category

As shown in Figure 4, the student responded to the rate of change in the number of glacier whales as being greater. In the response, the student was able to establish a proportional relationship between the data by stating that glacier whales increased by 2 times and humpback whales increased less. As a result, this response was evaluated to be in the advanced category.

Findings on Statistical literacy Self-efficacy

To determine the distribution of statistical literacy self-efficacy of high school students, descriptive statistics were calculated for the overall instrument first presented. The results of this analysis are provided in Table 4.

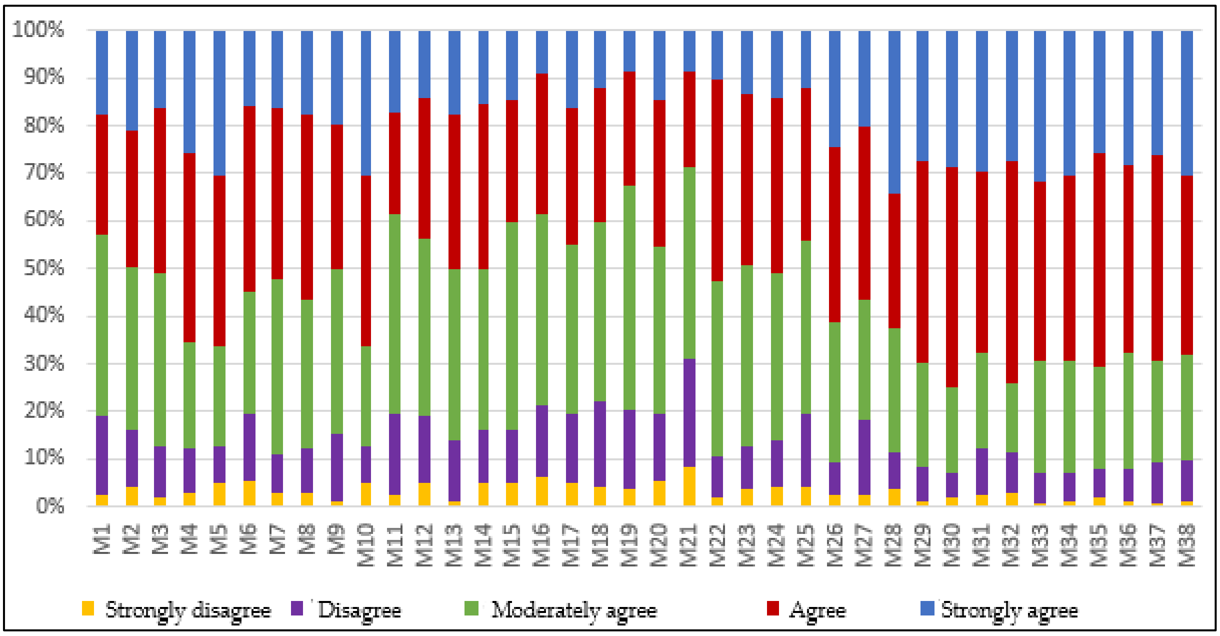
Table 4. Descriptive Statistics for the SLS Instrument

	N	Average	Standard Deviation	Minimum	Maximum
SLS	163	2,93	0,40	2,22	3,61

Minimum: 1, Maksimum: 5

The overall average (x̄ = 2,93) of opinions expressed by students in each of the items from the SLS Instrument is shown in Table 4. When this average was evaluated in terms of statistical literacy self-efficacy levels, it was determined that the statistical literacy self-efficacy of students was in the "Intermediate" level. Additionally, when the overall standard deviation of the instrument (sd = 0,40) was evaluated, it was interpreted that as a result of the low observed standard deviation, the students were consistent in their opinions regarding the instrument items.

Based on the opinions expressed by the students for each item of the SLS Instrument, interpretations were made regarding the statistical literacy self-efficacy levels. In this sense, the graph created can be seen in the following (see Graph 2).

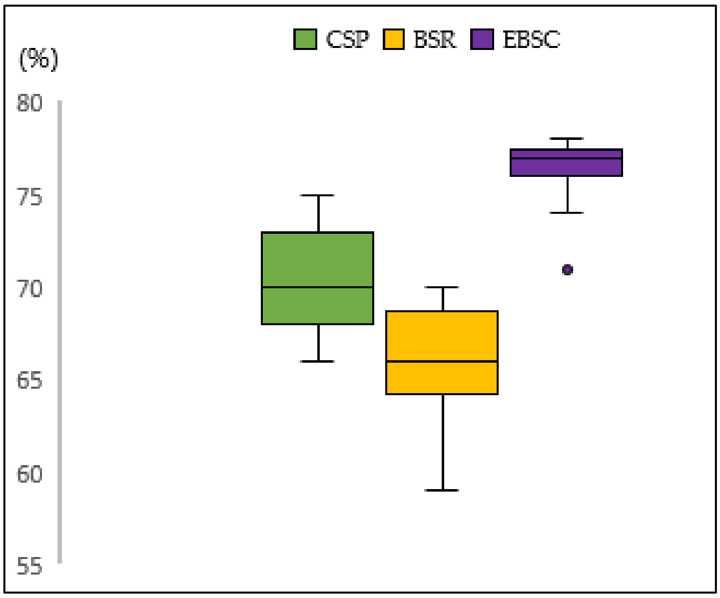


Graph 2. Distribution of Opinions of High School Students for Each Item of the SLS Instrument (%)

When Graph 2 is examined in terms of the opinions of students regarding the degrees of the SLS Instrument, it appeared that the students primarily focused on the opinion of "agree". Such that, while 34% of students had this opinion, 30% reported opinions that corresponded to "moderately agree". Whereas students expressed opinions with a "strongly disagree" rating by at least 3%, followed by opinion "disagree" at 11% and "strongly agree" at 22%, respectively.

When Graph 2 is examined in terms of opinions of students on the items of the SLS Instrument, it was seen that the highest number of "strongly disagree" responses were given to the I21 coded item under the BSR factor. In this item, it was also found that the scores of statistical literacy self-efficacy of students ($\bar{x}$ = 2,227) were the lowest. As a matter of fact, students were included in the I21 coded item at a "Low" level. The distribution scores of statistical literacy self-efficacy of students (in average and standard deviation) in terms of items is provided in Appendix 1 - Table 7. Thus, in I19 and I16 coded items, which were under the BSR factor and whose students received low scores ($\bar{x}$ = 2,239), the students were also shown to have a "Low" level. In other items of the SLS Instrument, the statistical literacy self-efficacy of students showed at most an "Intermediate" level and did not reach the "Good" level. Next, students received the highest score ($\bar{x}$ = 3,614) among these items from the I29, I30, I32, I33, I34, I35 and I38 coded items under the EBSC factor. Whereas it was observed that students had the most "strongly agree" opinions for the I28 coded item ($\bar{x}$ = 3,011) under the EBSC factor. Such that this item was again followed by the I33 coded item under this factor. It was also observed that the I33 coded item, along with the I37 coded item ($\bar{x}$ = 2,772) were items in which the students reported the least number of "strongly disagree" opinions. Besides, it seemed that students had a "strongly agree" opinion the least in terms of the I19, I21 and I16 coded items.

In Graph 3, it is shown which scores regarding the statistical literacy self-efficacy of high school students differed in terms of factors for the CSP, BSR and EBSC.



Graph 3. Comparison of Scores of Statistical Literacy Self-efficacy of High School Students in terms of Factors for CSP, BSR and EBSC (%)

When Graph 3 is examined, it was seen that the scores for self-efficacy of high school students in the EBSC factor were higher than in other factors. Although the EBSC factor was followed by the CSP factor, the factor in which students had the lowest self-efficacy was the BSR. As a matter of fact, scores under the EBSC factor were predominantly distributed in the range of 74% to 78% when excluding the point perceived as an outlier. For example, this was 66% - 75% for CSP and 59% - 69% for BSR. It was also recognized that the median, which was used to summarize scores under the EBSC factor, was 76%. This included 70% for CSP and 66% for BSR.

Findings on Statistical Literacy Self-Efficacy Predicts Statistical Literacy

To investigate whether statistical literacy self-efficacy (SLS) predicted the statistical literacy (SL) of high school students, analyses were carried out to determine the existence of the relationship between dependent and predictor variables. Thus, the correlation coefficients between the variables were checked by looking at whether there was multicollinearity between CSP, BSR and EBSC as predictor variables. Importantly, it would be accepted that the absence of correlation coefficients below 0.90 create multicollinearity and this is a problem for multiple linear regression analysis (Çokluk et al., 2014). Thus, the analysis results obtained in this regard are presented in Table 5.

Table 5. Correlation Analysis Results Showing the Relationship between SL and the CSP, BSR and EBSC Factors

Variables	**SL**	**CSP**	**BSR**	**EBSC**
SL	1			
CSP	0,517*	1		
BSR	0,577*	0,551*	1	
EBSC	0,575*	0,497*	0,793*	1

N = 163 *p = 0,000

According to the findings in Table 5, between the statistical literacy and sub-factors of statistical literacy self-efficacy, it was seen that there was a positive significant relationship (for CSP r = 0,517, p = 0,000, for BSR r = 0,577, p = 0,000 and for EBSC r = 0,575, p = 0,000). Whereas when the relationship between the sub-factors of statistical literacy self-efficacy with each other were considered, it was determined that there were positive significant relationships between factors (for CSP - BSR r = 0,551, p = 0,000, for CSP - EBSC r = 0,497, p = 0,000, for EBSC - BSR r = 0,793, p = 0,000). Considering that the correlation coefficients between each sub-factor changed between 0,497 - 0,793, it turns out that the relationship detected between the variables did not create multicollinearity. Thus, stepwise multiple regression analysis was performed, as it was observed that all hypotheses were met. For this analysis, the BSR factor, which had the highest correlation with statistical literacy, was selected and processed. Then, the EBSC and CSP factors were gradually included in the analysis. The findings of this analysis are presented in Table 6.

Table 6. Results of Stepwise Multiple Regression Analysis on the Prediction of Statistical Literacy

Model	**Predictor Variables**	**B**	**Standard error**	**β**	**t**	**F**	**R (r)**	**R²**	**ΔR²**
1	(Constant)	50,058	9,045		5,535*	80,366	0,577	0,333	0,333
	BSR	1,876	0,209	0,577	8,965*				
2	(Constant)	42,169	9,180		4,593*	47,037	0,608	0,370	0,037
	BSR	1,057	0,335	0,325	3,155**				
	EBSC	0,982	0,319	0,317	3,079**				
3	(Constant)	20,580	10,711		1,921**	37,967	0,646	0,417	0,047
	BSR	0,696	0,339	0,214	2,055**				
	EBSC	0,852	0,310	0,275	2,750**				
	CSP	0,852	0,238	0,262	3,586*				

Dependent variable: SL; *p < 0,01 **p < 0,05

When the ANOVA test results are examined in Table 6, the explained variance or the regression model for the relationship in question was found to be statistically significant ($F_{(1, 162)} = 80,366$; $F_{(2, 162)} = 47,037$; $F_{(3,162)} = 37,967$; $p < 0,01$). This indicated that the predictor variables (CSP, BSR and EBSC factors) successfully predicted statistical literacy according to the established regression model. The contribution of each of these variables, which significantly contributed to the interpretation of statistical literacy, according to the explained total variance, was determined. Thus, the total variance explained at the end of the three stages (model) was reached.

In the first stage, the BSR factor was entered into the regression model. This factor was found to only explain for 33,3% of the total variance in statistical literacy (R = 0,577; $R^2 = 0,333$). It was also found that the standardized regression coefficient for predicting statistical literacy of the BSR factor was statistically significant (β = 0,577; t = 8,965; p < 0,01).

In the second stage, the EBSC factor was added to the regression model after the BSR factor. With the addition of the EBSC factor to the model, the explained total variance increased from 33% to 37% ($R = 0{,}608$; $R^2 = 0{,}370$). Thus, the EBSC factor was found to contribute 3,7% of the total variance. When the other variables in the model were constant, the standardized regression coefficients of the predictor variables at this stage were statistically significant, respectively BSR ($\beta = 0{,}325$; $t = 3{,}155$; $p < 0{,}05$), EBSC ($\beta = 0{,}317$; $t = 3{,}079$; $p < 0{,}05$) had relative importance.

In the third and final stage, the CSP factor was added to the regression model after the BSR and EBSC factors. With the addition of the CSP factor in the regression model, the explained total variance increased from 37% to 41,7% ($R = 0{,}646$; $R^2 = 0{,}417$). Thus, the CSP factor contributed 4,7% of the total variance. Considering the three predictor variables in this regard, it was determined that statistical literacy self-efficacy explained for 41,7% of statistical literacy. When other variables in the model were constant, in this phase, the standardized regression coefficients of the predictor variables were statistically significant, their order of relative importance in predicting statistical literacy in descending was: EBSC ($\beta = 0{,}275$; $t = 2{,}750$; $p < 0{,}05$), CSP ($\beta = 0{,}262$; $t = 3{,}586$; $p < 0{,}01$) and BSR ($\beta = 0{,}214$; $t = 2{,}055$; $p < 0{,}05$). This indicated that the strongest predictor of statistical literacy of the students was the EBSC and the CSP factors that followed it, and the weakest factor was the BSR.

Discussion, Conclusion and Suggestions

The skills necessary to understand, evaluate and draw conclusions about that numerical information that deeply affects our daily lives are directly related to statistical literacy (Gal, 2002). Such that, individuals need these skills at every stage throughout their lives, not just in the short term (for example, the learning process, professional life, etc.). In other words, statistical literacy is an indispensable part of our lives. Therefore, it is believed that considering every factor that shapes the statistical literacy of students will ultimately shed light on the quality of statistics instruction (Franklin et al., 2007). Perhaps the most important of these is statistical literacy self-efficacy (Batur, Yiğit, & Baki, 2019). Because self-efficacy is considered the best predictor of achievement among psychosocial factors (Robbins et al., 2004). Therefore, to better understand and interpret statistical literacy, which is a broad concept, it is very important to determine statistical literacy self-efficacy. In this current study, the relationship between statistical literacy self-efficacy and the statistical literacy of students was investigated. In this section, results on statistical literacy levels and statistical literacy self-efficacy of students are presented in parallel with the questions discussed within the research. Furthermore, the results regarding the predictive strength of statistical literacy self-efficacy to statistical literacy are discussed.

Discussion on Statistical Literacy Levels

When statistical literacy levels of high school students were examined, it was found that students were at a "Low" level and failed to reach the "Intermediate" level. A study by Watson and Callingham (2004) shows that students at the high school level can demonstrate skills such as critical approach, reasoning by using basic knowledge of statistics and are able to reach the highest levels of statistical literacy. This contradicts the present research results, suggesting that the mathematics curriculum for high school in Turkey may be insufficient for providing students with the necessary statistical literacy skills. As a result, it is often emphasized that teaching conditions should be improved to maximize the statistical literacy levels of students (Chick & Pierce, 2011). However, even studies at the middle school level, where the learning outcomes related to statistics in Turkey are the most intense, even if they are limited, only draw a maximum intermediate profile for the statistical literacy of students (Çatman-Aksoy, 2018; Çatman-Aksoy & Işıksal-Bostan, 2021; Koparan, 2012; Topan, 2019; Yolcu, 2012). Such a situation indicates that both our curriculum and our teachers, who are the practitioners of this curriculum, are insufficient at building the groundwork for conceptual understanding among students. However, for the knowledge learned to be utilized in later levels of learning; it can only be achieved through conceptual understanding (Smith, Bill, & Raith, 2018). In particular, it is essential to create a conceptual understanding to provide students with the requisite skills such as statistical thinking, reasoning and literacy (Lindsey, 2017). However, it is noted that statistical courses in general cannot serve this purpose (Rumsey, 2002; Sharma, 2017; Watson, 2006). We can also see the reflection of this situation in the PISA and TIMMS exam results, which are organized with the participation of many countries around the world. In questions targeting the statistics learning area, the literacy of our students is quite low compared to other countries (PISA, 2018; TIMMS, 2016). It is also believed that the poor outcomes in Turkey on such exams are due to the statistics instruction, which in the end does not directly target statistical literacy (Batur et al., 2021). Thus, learning outcomes which are limited to only the 9th grade high school level, provide a narrow understanding of the statistical literacy of high school students. Thus, to develop competence, which is as multifaceted and dynamic as statistical literacy, students must be continually familiarized with statistical concepts and continually reinforced in terms of this competence. In such a case, this can only be achieved through a well-planned approach towards teaching according to learning outcomes which are more related to numbers and content.

In the current study, SL1-b (selecting of sample), SL2-c (interpreting of the graph) and SL3-c (selecting the appropriate measure of central tendency) coded questions were especially effective at the "Low" level of statistical literacy for high school students. The underlying reason for this was thought to be because these subjects integrated more advanced skills such as statistical reasoning and thinking. Despite this, statistics teaching in schools is aimed at providing students more basic statistical skills (Leavy & Hourigan, 2015; Sharma, 2017). From here, it was understood that the importance of teaching practices for statistics in Turkey should provide students with the ability to think at a more advanced level. For this, countries throughout the world that deal with statistical literacy from different perspectives (such as New Zealand and Singapore etc.) can provide valuable information that can be significantly beneficial (Batur et al., 2021). On the other hand, in this current study it was determined that students can reach the "Intermediate" level and that the question with the highest average was question SL1-d (reading of the table and graph). It is believed that this is due to the fact that the question required direct reading of the data within the table and graph. Because in questions SL2-a, SL2-b, SL2-c, SL3-b, SL3-c and SL4, in which the students were asked to comment by making a relationship between the graphs, they did not reach the same level of achievement. This indicated that the students' knowledge of the tables and graphs remained at a basic level and could not reach the dimensions which require interpretation and inference. Additionally, a parallel situation is observed in many studies within the literature and the cause of their basic level of knowledge is typically linked to a lack of statistical literacy (Batur, Baki, & Güven, 2019; Bolch & Jacobbe, 2018; Patahuddin & Lowrie, 2018; Sharma, 2006). While, in this study it was found that students who developed "Intermediate" level answers to SL1-c (selecting of the appropriate table and graph) and SL3-a (drawing of the graph) gave better responses than they did for interpreting the graphs. However, in their study, Kaynar and Halat (2012) find that students are less successful at drawing graphs than interpreting the graphs. However, while basic concept knowledge is sufficient for drawing a graph, it is necessary to evaluate and make a judgment regarding this information to interpret a graph. For this reason, it can be said that such a result creates a contradiction with the current research. Thus, it was observed that students often made simple mistakes in selecting the appropriate table and/or graph, which was caused by their inability to fully create a bar graph. To prevent this situation, it was recognized that it is important for teachers to focus on having classroom discussions as well as encouraging students to confront new and unique contexts.

In the present research, it was found that the high school students provided incorrect responses to LOCUS questions which were more in the inadequate category, that is, unassociated with the context, in effect reflecting their personal ideas. As a result, it was believed that the reason for this situation was that students continued to have conceptual deficiencies which persisted from their middle school education as well as did not have much experience with different types of contexts for addressing these deficiencies. As a matter of fact, many researchers agree that students evaluate statistical questions by only using contextual information and by reflecting their personal knowledge and experiences (Ben-Zvi & Garfield, 2004; Koparan, Güven, & Karataş, 2014; Pfannkuch & Wild, 2004). In this sense, it is important for students to develop solutions by adding their statistical knowledge to the questions they encounter. Otherwise, waiting for students to be statistically equipped will be nothing but a dream.

Discussion on Statistical Literacy Self-Efficacy

When the statistical literacy self-efficacy of high school students were examined, it was found that the students were generally at the "Intermediate" level. Such a result was attributed to the inability to activate and support the conceptual understanding of the student in classes where statistics instruction was performed. Such that, most researchers emphasize the importance of active learning in increasing interest in statistics for students, which leads to more efficient learning (Steinhorst & Keeler, 1995; Strayer et al., 2019). As a matter of fact, traces of this situation have been found in studies within statistics instruction which make applications based on the student (Hall & Vance 2010; Huang & Mayer, 2019; Koparan, 2012). The common conclusion of these studies is that applications developed within the framework of active learning have a strengthening effect on the affective aspect of students in relation to statistics. From here, it is understood that improvements should be made to improve the statistical literacy self-efficacy of students regarding the content of statistics. On the other hand, statistical literacy means much more than just a subject in mathematics curriculum (Carmichael et al., 2010), and the fact that the criteria for having this skill are contained in a complex process is considered another factor that affects this result. Thus, many studies conducted in mathematics and statistics education in particular reveal high self-efficacy of students in these areas (Aydın & Sevimli, 2019; Yürekli, 2008). However, this contradicts the current research findings. From this, it was revealed that the self-efficacy of individuals in both mathematics and statistics and their self-efficacy in statistical literacy differed significantly. Therefore, it was important to examine the statistical literacy self-efficacy of students more fully. It is a fact that this need is felt especially at the high school level, particularly in our day and age when every individual graduating from high school has the goal of becoming statistically literate (Bargagliotti et al., 2020). In this sense, more studies are needed to examine the statistical literacy self-efficacy of students at this level.

When the statistical literacy self-efficacy of high school students were examined on the basis of these items, it was found that the I21 coded item under the BSR factor had the lowest average (see Appendix 1 - Table 7). Along with this item, it was also found that students had self-efficacy at a "Low" level in the I19 and I16 coded items, which are again included in this factor and in other items of the instrument at an "Intermediate" level. Thus, it was understood that this situation was directly related to the difficulty experienced by our students in possessing the competencies required through their reasoning skills. As a matter of fact, most researchers describe reasoning as an important indicator for statistical literacy (Gal, 2002; Özmen, 2015; Watson, 2006); however, the reasoning of many of our students is also weak (Koparan, 2012). Therefore, it is thought that by increasing the number of learning outcomes that students can demonstrate through statistical reasoning and performing the accompanying instruction, the self-efficacy of statistical reasoning will be improved. Besides, it was determined that the items with the highest average in the opinions of students were I29, I30, I32, I33, I34, I35, I36 and I38 under the EBSC factor (see Appendix 1 - Table 7). The self-efficacy of students was most at the "Intermediate" level in these items and had not reached the level of "Good". It was believed that such a result was caused by an inability to transfer knowledge of basic concepts to students for statistical situations. However, Gal (2002) shows that for statistical literacy, knowing the basic concepts in understanding, interpreting and critical approach to statistical messages and making relationships between concepts is a priority. In this regard, it is believed that self-efficacy can be increased by confronting different contexts in which students can use basic concepts.

When scores of statistical literacy self-efficacy were compared in terms of sub-factors of the instrument, it was observed that self-efficacy of students in factors regarding EBSC and CSP that follows, were better in comparison the BSR. It was believed that such a result comes from the fact that less weight was given to statistical reasoning in our statistics teaching, especially in the curriculum, and therefore the statistical literacy self-efficacy of students was affected by this. As a matter of fact, Özmen and Baki (2019) find that the components of the statistical process and understanding of the basic concepts in mathematics curriculum for middle school are more at the forefront than the components of reasoning and context. Although there are learning outcomes based on statistical process and understanding of basic concepts, they have pointed out that the content of these learning outcomes is insufficient for effective statistical literacy. Thus, it can be stated that this finding is also reflected in the statistical literacy self-efficacy of high school students educated with such a program and is consistent with the results of the current study. As a matter of fact, it is pointed out that prior knowledge of students in the area of statistics is important for increasing their self-efficacy (Zimmerman & Goins, 2015). In this case, it can be stated that it is important for students to graduate from middle school with a high level of prior knowledge to increase their self-efficacy of the components of statistical literacy during their high school years. Thus, the priority of each level should be to provide students with the necessary knowledge and skills to increase their self-efficacy of statistical literacy as their education proceeds.

Discussion on Statistical Literacy Self-Efficacy Predicts Statistical Literacy

It was determined that statistical literacy self-efficacy predicts the statistical literacy of students. However, Bandalos, Yates, and Thorndike-Christ (1995) show that the general self-efficacy of students does not predict statistics achievement. It is believed that considering the general self-efficacy of students, which cannot be directly related to the area of statistics, may have led to such a result. As a matter of fact, the creation of each sub-factor of the instrument used in this current study was based on the components of Özmen's (2015) statistical literacy model which is considered to be of great importance for the prediction of statistical literacy. From here, it is understood that the affective factor which predicts information regarding a particular area or subject should also be selected according to each area and/or subject. As a matter of fact, it is emphasized that self-efficacy in the area of statistics are more effective for achievements of individuals in statistics (Gundlach, Kuntze, Engel, & Martignon, 2010). As a result of the many studies shaped around this idea, statistics self-efficacy is a significant predictor of the statistical achievement of students (Abd-El-Fattah, 2005; Finney & Schraw, 2003; Lane et al., 2004; Sevimli, 2010; Zare et al., 2011). Additionally, a study by Zimmerman and Goins (2015), examines the concept more specifically, and they conclude that the chi-square test of independence self-efficacy of undergraduate students predicts their knowledge of this concept. Furthermore, starting from statistics in general and going more specifically towards the concepts of statistics, it appears that there were no studies which examine the relationship between statistical literacy self-efficacy and statistical literacy. Therefore, it is suggested that future studies be conducted that investigate the relationship between statistical literacy self-efficacy and statistical literacy from different perspectives.

Importantly, each sub-factor of statistical literacy self-efficacy was seen as a predictor of statistical literacy. It was believed that the sub-factors were not completely separate from each other, and on the contrary, the presence of complementary properties of the others was effective in this case. For example, at the stage of interpreting results in the statistical process, students were expected to use reasoning, especially understanding the basic concept. Additionally, students need to use their understanding of basic concepts when they use reasoning about statistical situations. Whereas when the predictive strength of the sub-factors to statistical literacy was examined, it was found that the strongest positive predictor of statistical literacy was EBSC and CSP, which followed this factor by a small margin. The factor that was the weakest predictor of statistical literacy was BSR. As a matter of fact, it is often emphasized that our mathematics curriculum still cannot go beyond providing students with the basic concept skills related to the statistics learning area (Özmen & Baki, 2019). Based on this emphasis, it was believed that self-efficacy related to the EBSC factor largely explained for their statistical literacy. However, the importance of focusing on the reasoning of students is often emphasized in classes where statistics instruction is performed (Sharma, 2017). This calls for a curriculum aimed at developing understanding of statistical reasoning among students and then a need for qualified statistics instruction which reflects this program within the classroom.

As a result, in this current study, it was determined that the statistical literacy of high school students was at a "Low" level, and their statistical literacy self-efficacy was at an "Intermediate" level. Additionally, it was found that students were a significant predictor of statistical literacy along with each sub-factor of statistical literacy self-efficacy. Furthermore, the EBSC factor was found to be the strongest predictor of the statistical literacy of students. As one of the key learning outcomes in the area of statistics, statistical literacy has a wide range which requires high-level skills. Although it is emphasized that the research was important in reflecting statistical literacy, both in the cognitive and affective aspects, there were some limitations. These limitations are presented in the following:

1. The LOCUS question pool, which is used to measure statistical literacy, contains a large number of open-ended questions. In this study, some of the LOCUS questions were selected and utilized. Given the scope of statistical literacy, measuring this competence with a small number of questions was a limitation.

2. Self-report instruments have some limitations, for example, responses to items according to what is socially acceptable, responding to the question without reading it, items are not clear which leads to different interpretations, the structure of items (reflecting the preconceptions of the researcher, etc.) affect responses, items lead to possible subjectivity and responding to items only according to the degrees found in the instrument (Demetriou, Uzun-Özer, & Essau, 2015). Since the statistical literacy self-efficacy instrument was also a self-report instrument, the current research had such general limitations.

3. When determining statistical literacy self-efficacy and the statistical literacy level of high school students, their past experiences were not considered, and the study was limited to the present situation.

Finally, in the data society, where understanding statistical information and conducting high-level interrogatives based on this information are more important, the examination of the statistical literacy self-efficacy of students is of great importance. The most original aspect of this current study was that it drew attention to the importance of statistical literacy self-efficacy as well as portrayed its strength in predicting statistical literacy. Thus, in order for statistics teaching to be qualified, it is suggested that plans be made for improving the statistical literacy self-efficacy of students along with their overall statistical literacy.

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Appendix 1. The Statistical Literacy Self-Efficacy (SLS) Instrument

Table 7. Statistics on Scores from Items of The Statistical Literacy Self-Efficacy (SLS) Instrument

Factor	Code	Items	x̄	sd
Confidence related to the Statistical Process	I1	I fail to choose an appropriate data collection method for the research purpose	3,113	0,683
	I2	I find it difficult to formulate an appropriate question about the statistical situation	3,160	0,675
	I3	I often find it difficult to relate statistical concepts to daily events	2,833	0,649
	I4	I cannot develop a critical viewpoint on statistical situations	2,703	0,694
	I5	I find it difficult to compare the expected situation with the observed situation for a statistical event	2,871	0,665
	I6	I have difficulty choosing the appropriate sample to examine a statistical situation	2,962	0,607
	I7	It is difficult for me to make comparisons between data sets	2,901	0,691
	I8	I cannot generate an original conclusion by thinking statistically in a situation	3,149	0,698
	I9	I find it difficult to decide the significance of a statistical conclusion	2,630	0,715
	I10	I cannot explain why and how data is generated in the statistical process	2,759	0,644
	I11	I find it difficult to support my ideas with statistical evidence	3,290	0,622
	I12	I find it difficult to see statistical concepts in a given text	3,115	0,674
	I13	I find it difficult to interpret graphs of any data group	3,219	0,676
Belief related to Statistical Reasoning	I14	I can hypothesize about any statistical situation	3,159	0,758
	I15	I can make predictions about the conclusion based on a statistical situation	2,347	0,920
	I16	I can make exact predictions about the statistical situation	2,239	0,846
	I17	I can interpret the conclusions of statistical findings	2,350	0,872
	I18	I can determine the question for a statistical situation	2,357	0,858
	I19	I can discuss statistical conclusions with my friends	2,239	0,926
	I20	I can explain the effect of the weights of data on the mean in a particular data set	2,341	0,791
	I21	I can explain how statistical conclusions are obtained	2,227	0,788
	I22	I can analyze statistical information	2,342	0,841
	I23	I can communicate any statistical situation	2,366	0,829
	I24	I can detect terms that contradict the statistics in a given text	2,343	0,831
	I25	I can evaluate the ideas generated for a statistical conclusion	2,344	0,886
Efficacy related to Basic Statistical Concepts	I26	I can use statistical formulas effectively in solving questions	3,358	1,54
	I27	I can make appropriate conversions between graphs of data groups	3,282	1,40
	I28	I know what it means if the standard deviation of a data group is high or low	3,011	1,57
	I29	I can predict what the median of a data group will be approximately	3,614	1,59
	I30	I can interpret how the arithmetic mean or the media is affected by outliers	3,614	1,60
	I31	I know what most statistical concepts mean	3,008	1,62
	I32	I can express my ideas on statistical concepts verbally and in writing	3,614	1,52
	I33	I know what to do to compare two data groups whose arithmetic means are equal	3,614	1,61
	I34	I can tell the mode of the data group by looking at the graph of a data group	3,614	1,55
	I35	I do not have any misconceptions about statistical concepts	3,614	1,60
	I36	I can compare groups by using the modes of two data groups	3,614	1,60
	I37	I can decide which measure of spread or tendency would be appropriate to use in a statistical question	2,772	1,54
	I38	I can make statistical inferences about a particular situation	3,614	1,37

Appendix 2. Turkish Version of LOCUS Questions

Table 8. LOCUS Questions, Categorical Scoring and Sample Student Response

	Question	Categorical Scoring *	Sample Response
SL1	The student council members at a large high school have been asked to recommend one of the various sports branches to be added to physical education class next year. They decide to survey 100 students and ask them to choose their favorite activity among the sports of football, tennis, basketball or swimming.		
SL1-a	What question should be asked on the survey? Write the question as it would appear on the survey	(2): The questions that clearly articulated and will require a response based on people's interests.	Which sports among football, tennis, basketball, and swimming would you prefer to be added to physical education class next year?
		(1): It also may contain related data; but incomplete or unclear questions.	Which sports activity from the options do you want to see in physical education class?
		(0): No response, questions unrelated to context, responses containing guidelines rather than a question.	Choose your most favorite among the sports branches.
SL1-b	How would you choose the sample of 100 students? Explain	(2): The random sample selection from the population related to context is highlighted clearly and responses on how to do it.	Not every student at the school may be interested in physical education. With this in mind, I select random students from each grade and form a group of 100 and ask them.
		(1): Feeling the need for random sampling (lottery, etc.) or clearly emphasizing it; but responses that do not consider criteria of sample selection (representativeness, etc.).	I select 100 people randomly and ask them.
		(0): No response, biased sample selection.	I ask 100 people who are interested in and like sports.
SL1-c	Create a table or graph summarizing possible responses from the survey. The table or graph should be reasonable for this situation	(2): Creating the appropriate table or graph (such as a bar or pie graph) fully reflecting the data.	
		(1): Did not fully create the appropriate table or graph to summarize the data or deficiencies in scaling, naming, number of people.	
		(0): No response, selecting a graph (such as a line graph) that does not appropriately summarize the data / creating an incorrect table.	
SL1-d	What sports should the student council recommend be added to physical education class next year? Justify your choice based on your answer to part (c)	(2): Responses explaining the branch to be selected based on the table and graph with its reason.	Football must be added because of it received the highest percentage of votes compared to other sports in the graph.
		(1): Deciding on the sport to be chosen based on the table and graph, without explaining the reason or responses that summarize the graph but do not draw conclusions.	
		(0): No response, giving personal responses independent of (c) sub-component or misinterpreting the created table or graph.	

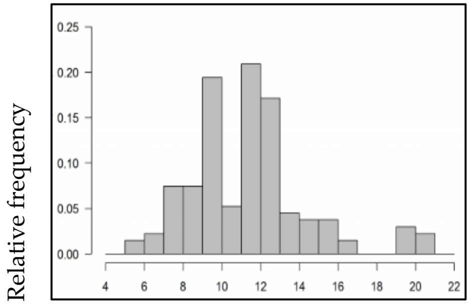
Question

SL2

Istanbul hosted two races held on the international platform last year. Individual runners chose to run either a long-distance (5 kilometers) or a half-marathon (45 kilometers). 134 runners ran in the long-distance, and 224 in the half-marathon. The tour time, which is the average amount of time it takes a runner to run a kilometer, was calculated for each runner by dividing the time it took the runner to finish the race by the length of the race.

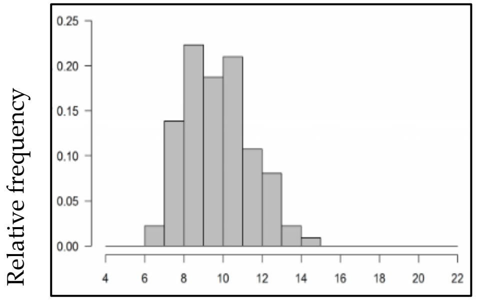
The histograms below show the distributions of tour times (in minutes per kilometers) for the runners in the two races.

Graph 1. Tour times for Long-Distance Runner



Tour times (minutes per kilometers)

Graph 2. Tour times for Half-Marathon Runner



Tour times (minutes per kilometers)

SL2-a

	Categorical Scoring *	Sample Response
By looking at the graphs above, Ceren predicted that the tour times of runners in the long-distance race would be more consistent than the tour times of runners in the half-marathon. Do these data support Ceren's statement in graphs? Explain why or why not	(2): Making relationships between the variability (spread) and consistency and using measures of spread when comparing distributions.	Ceren's prediction is incorrect. Because the range of long-distance runners changed between 5-21, while the half-marathon range changed between 6-15. This reveals that long-distance runners have more range than half-marathon runners, thus showing more variability.
	(1): Comparing distributions at the basic level, not providing a statistical response.	Ceren's prediction is incorrect. Because the times of half-marathon runners are closer to each other. So, the times are more harmonious and ordered.
	(0): No response, personal responses that do /do not support Ceren's prediction.	Yes. I think Ceren made a correct prediction. Because the long-distance is more consistent. No. He or she should run more regularly because it is long-distance. In addition, the number of runners running in the half-marathon is higher.

SL2-b	Merve predicted that, on average, the tour time for runners of the half-marathon would be greater than the mile time for runners of the long-distance race. Do these data support Merve's statement? Explain why or why not	(2): Drawing attention to the center when comparing the average of distributions and explaining the effect of deviations from the center on the average.	Merve's prediction is wrong. Because the two outliers in the long-distance runners' tour times will increase the average, thus shifting the center of the distribution up.
		(1): Comparing distributions at the basic level.	Merve has said it wrong. Because the tour time of the half-marathon is shorter. Therefore, its average will also be lower.
		(0): No response, personal responses that do / do not support Merve's prediction.	Yes. I think Merve made a correct prediction. Because the long-distance is more consistent. No, I do not agree. Because this situation depends entirely on the speed of the runners.
SL2-c	Recall that individual runners chose to run only one of the two races. Based on these data, is it reasonable to conclude that the tour time of a runner would be less when that runner runs a half-marathon than when he or she runs a long-distance? Explain why or why not	(2): Demonstrating that abstract idea about the response to the question (establishing the general-specific relationship, thinking entire situations), and responses that establishing a relationship between the average tour time and each data.	No comment can be made on this subject. Because by looking at the graphs, one can only make a comment about all runners. It is wrong to consider this in terms of both graphs and reduce it to a runner. For example, while one of the runners can be the runner who runs the shortest time in the long-distance, the other can be running the longest time in the half marathon.
		(1): Stating that cannot comment, but a responses that does not have statistical content about the reason.	No comment can be made. Because this situation depends entirely on the individual speed of the runners.
		(0): No response, personal responses that do /do not support the question.	It can be said. Because half-marathon runners have less time than long-distance runners. It cannot be said. Because the half-marathon is longer, runners will run slower, but they will run more quickly because the long-distance is shorter.

	Question
SL3	Fifth-grade students conducted a nutritional study regarding *Scout Cookies*. They asked the question, "Do types of Scout cookies that contain a chocolate ingredient typically have more calories than those that do not contain a chocolate ingredient?" To gather data, the students found the nutritional data for the various types of *Scout Cookies*. The data are shown in the tables below.

Table 1. Scout Cookies that Do Not Contain a Chocolate Ingredient

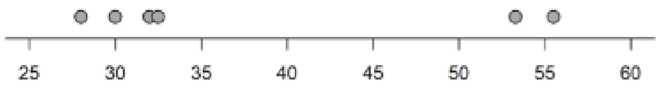
Type of Scout Cookie	Number of calories per cookie
Oat extract	55,5
Peanut butter	53,3
Coconut	28
Bread crumbs	30
Almond	32,5
Dry fig	32

Table 2. Scout Cookies that Contain a Chocolate Ingredient

Type of Scout Cookie	Number of calories per cookie
Caramel	70
Cream	40
Raspberry	65
Double sauce	70
Bitter	70
White chocolate	75
Milky	40

Beren constructed the dotplot below for the number of calories per cookie in cookies that do not contain a chocolate ingredient.

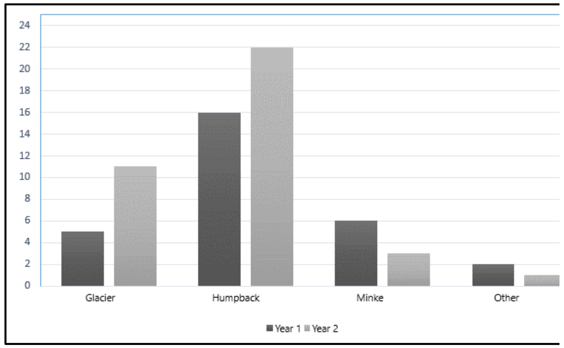
Graph: Scout Cookies that Do Not Contain a Chocolate Ingredient



Number of Calories

		Categorical Scoring *	Sample Response
SL3-a	Construct a dotplot of calories for cookies that contain a chocolate ingredient.	(2): Graph drawing without deficiency in terms of naming, scaling and data placement. (1): Graph with deficiencies in its drawing. (0): No response, response unrelated to context.	

SL3-b	Compare/contrast the shapes of the two distributions. Identify –if any- unusual features.	(2): Responses involving the comparison of two distributions in terms of shape and outliers.	While the calorie number of cookies that do not contain chocolate is usually on the left side of the axis (lower); It is concentrated on the right side (higher) in those containing chocolate. This indicates that cookies containing chocolate have more calories. Besides, there are two outliers in both distributions that differ considerably from the other data.
		(1): Responses that draw attention to the variability in the data when comparing two distributions or simple and superficial descriptions of the distributions.	Looking at the graphs, it is seen that there is a change in the number of calories. The number of cookies containing chocolate is higher and there is an accumulation in higher values in this graph compared to other graphs.
		(0): No response, personal responses.	Since chocolate is a high calorie ingredient so, cookies that contain this ingredient will have more calories.
SL3-c	Are the means or medians more appropriate to compare the centers for these two distributions? Explain	(2): Responses that clearly state the effect of outliers in the data set on the mean and median.	There are outliers in both distributions. The outliers can cause incorrect interpretations of the data set as they affect the mean. For this reason, it is necessary to look at the median.
		(1): Noticing of outliers but cannot be explained statistically or responses that stated the median should be looked at, but do not provide the reason fully.	It is seen that in both distributions, there are different data from other data. These data will affect the mean. But it would be more accurate to choose to mean as it is the strongest measurement of representing the data set.
		(0): No response, presenting the mean as a response, personal responses.	In such cases, it is better to look at the mean. Because the clearest response is the mean.

	Question	Categorical Scoring*	Sample Response
SL4	The bar graph below gives the reported number of whales entangled in nets off the coasts of North America for two consecutive years  Number of whales Type of whale An environmentalist expressed more concern about the change in the number of entanglements of glacier whales than that of humpback whales from Year 1 to Year 2. Based on the data, why did the environmentalist express more concern for glacier whales?	(2): The responses that explain proportionally the change between whale types entangled in nets.	Looking at the graph, it is seen that there are 6 increases (glacier: 5-11, humpback: 16-22) from the 1st year to the 2nd year in both whale types. However, the increase rate is not the same in the two types (while it is greater than 2 in the glacier, it is less than 2 in the humpback or 120% in the glacier; it is 37.5% in the humpback). Therefore, the highest in the glacial whale explains the environmentalist's concern.
		(1): Making a general analysis of the graph, simple and superficial descriptions.	The number of whales entangled in the net increased by 6 for both glacier and humpback whales. I can't see a situation to worry about. While the number of whales entangled in net increased from 5 to 11 for Glacier and from 16 to 22 for Humpback, for Minke, it decreased from 6 to 3 and for other from 2 to 1.
		(0): No response, personal responses.	Due to melting glaciers due to global warming, glacier whales are leaving their habitats and their risk of being entangled in nets is increasing.

*The points of categories are represented as (0): Inadequate, (1): Intermediate, and (2): Advanced