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Science lesson-focused responsibility levels of primary school pupils

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** This article draws on the first author's Master's thesis parts written by the 1st author's master thesis entitled "Developing Science Lesson-Focused Student Responsibility Scale and Determining Primary School Students' Responsibility Levels", conducted under the supervision of the 2nd author.*

ABSTRACT

The study aimed to determine science lesson-focused responsibility levels of primary school students in terms of various demographic variables. This study used a quantitative research methodology and a descriptive survey model, one of the general survey models. The research was conducted in three central districts in Kayseri province, Türkiye, in the 2018-2019 academic year. The research sample included 705 pupils. The study collected data through the "Science Lesson-Focused Pupil Responsibility Scale" developed by the researchers. Scales' Cronbach Alpha internal consistency coefficient is .87 and the scale explains 50.83% of the total variance. Results of the study revealed that the children's science lesson-focused responsibility levels differed significantly in favour of female students (U=53495.5; p<0.05). Furthermore, lesson-focused responsibility levels differed significantly in favour of third-grade pupils. They differed significantly in favour of "those who like the lesson very much" according to interest level in the science lesson (U = 43331.0; p <0.05). However, they did not vary by birth order ($X^2_{(3)}$ =.236; p> 0.05), the number of siblings ($X^2_{(3)}$ = 1.140; p>.05), preschool experience (U = 24494.0; p>0.05), or the educational level of parents (U = 24494.0; p>0.05). Based on the results, boys can be assigned tasks in which they can take responsibility within the scope of daily life and science lessons, and studies that increase their level of responsibility can be carried out. In addition, the contents of the science course curriculum and textbooks can be enriched by including activities based on practices that increase learner curiosity and interest levels.

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Introduction

The development of a society and its ability to solve its economic and social problems depends on its science, technology and innovation capabilities. These abilities are vital in determining the society's development and economic growth rate (Juma et al., 2005, p.20). For this reason, these abilities should be inculcated in individuals (Rhodes & Sulston, 2010). Science education is vital in providing individuals with skills for science, technology and innovation. The science education curriculum aims to train individuals for a sustainable environment, economy and society, following scientific and technological developments and seeking and producing solutions to socio-scientific problems.

Responsibility is making choices about one's behaviour and accepting the effects and consequences of those choices (Gliker, 1970; Popkin, 1987). These choices are primarily made to meet an individual's physiological, safety and social needs. Social needs, which include belonging, being accepted and liked, social life enable the individual to interact with others and become a member of society (Maslow, 1970). Social life directs the individual to undertake various duties to protect the peace and security of their environment. This is because of a sense of responsibility.

Responsibility contributes to individuals self-awareness, acquiring a healthy sense of self by recognising their competencies and limitations, and directing their lives accordingly. Individuals with a sense of responsibility respect differences by accepting that everyone in society is valuable and has unique differences (Cüceloğlu, 2017; Glasser, 2005; Wubbolding, 2015). They feel responsible for their environment and society and are willing to undertake various duties. They like and feel attached to the earth, respect all living and non-living beings and pay attention to protecting nature. This stance makes responsible individuals more honest, conscientiousness, reliable and respected in society (Douglass, 2001; Ergül & Kurtulmuş, 2014; Gough et al., 1952; Karagöz, 2013; Messina, 2004; Spielmann et al., 2022).

In the literature, responsibility is defined into two categories individual and social. Individual responsibility is an individual's choice-making for their own life and accepting possible negative consequences (Burke et al., 2001; Glasser, 2005; Romi et al., 2009; Ryan & Bohlin, 1999). On the other hand, social responsibility is defined as the individual's actions for the benefit of society, without pursuing a relationship based on their interest, due to their sense of belonging in the social order (Berkowitz & Lutterman, 1968; Özen, 2015).

Responsibility is an essential consciousness for social peace and prosperity. Responsibility is essential for harmony in many social environments, such as family, school, and business. Unfortunately, many political, military, economic, and ecological problems are caused by individuals and institutions not fulfilling their responsibilities in the right way and at the right time (Taylı, 2013; Yeşil, 2015; Yontar, 2007).

COVID-19, a recent example of a significant pandemic that shaped world history, is a concrete example of the importance of responsibility in this context. According to information from the World Health Organization (WHO, 2020), the scientific world was confronted with a new type of coronavirus after the emergence of pneumonia cases of unknown origin in Wuhan, Hubei province, the People's Republic of China, on December 31, 2019. The virus was identified as SARS-CoV-2, causing COVID-19, on January 7, 2020, and a pandemic was later declared (WHO, 2020; Dindar Demiray & Alkan Çeviker, 2020, Ortuzar-Iragorri et al., 2024). Since COVID-19 is a type of virus, it survives in living organisms. Therefore, the virus not only affects the infected individual but also affects those in close contact with these individuals.

For this reason, in every country, necessary institutions made serious announcements about the use of masks, distancing, and hygiene to prevent the spread of the virus. In combating the pandemic, individuals must undertake the necessary responsibilities for their health and the protection of public health (Çobanoğlu, 2020). As a result, responsibility education effectively raises individuals who can cope with individual and social problems (Glasser, 2016; Gündüz, 2014; Kısa, 2009).

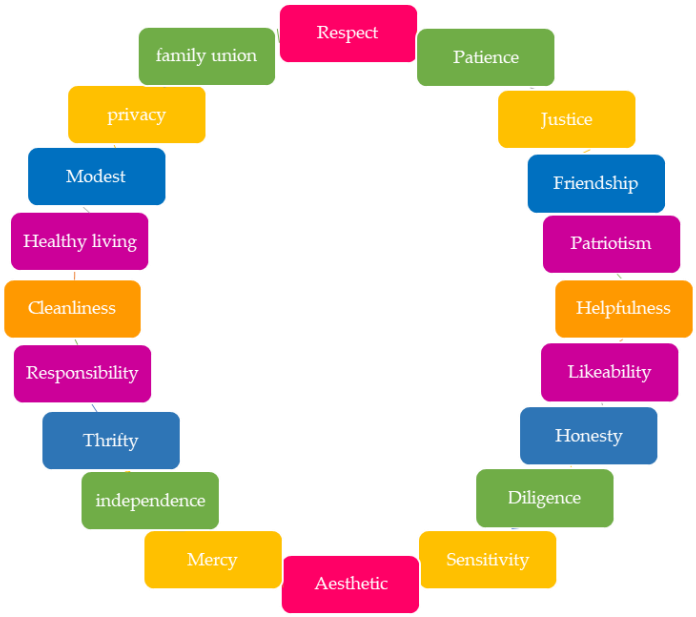
In early childhood, responsibility begins to develop from personal responsibility to social responsibility (Hayta Önal, 2005, p.1). For this reason, individuals should take responsibilities appropriate to their age, developmental level, and gender in childhood (Yavuzer, 1996, p. 107). Based on " bend a tree while it is young," individuals must gain a sense of responsibility from early childhood, transforming knowledge into action. To develop responsibility, individuals should grow up in environments where they can take responsibility. In addition, they should be allowed to make choices and take responsibility for the consequences of these choices. Otherwise, a sense of responsibility is unlikely to develop (Cüceloğlu, 2017). Many factors affect the development of responsibility. Family structure, socioeconomic status, school life and social environment are significant factors (Cüceloğlu, 2017; Glasser, 2018).

Educational institutions are organizations that hold direct responsibility and instil a sense of responsibility through their function (Demirci Güler & Açıkgöz, 2019). According to Yavuzer (2006, p. 147), "In modern education, a school is the only social institution that takes the responsibility of teaching certain knowledge patterns and skills and attitudes." Schools contribute to the personal learning of basic knowledge, skills, and values and the individual's self-realisation by meeting their academic and psychological needs. In this respect, schools contribute to the integration of the individual into society and raise them as individuals who will advance society to further (Aslan, 2011; Maslow, 1954; Rothstein, 2000).

The general objectives of the Turkish National Education System are that "All members of the Turkish nation who are of a moderate and healthy personality and mentality and character in terms of physically, mentally, morally, spiritually and emotionally the power of free and scientific thinking, a comprehensive worldview, be respectful of human rights, appreciate enterprise and individuality, who feel a responsibility towards society" (Basic Law of National Education, 1973, p.5101). For this purpose, values education is incorporated into the curricula of our country in the form of "values and competencies" across all educational programs. Furthermore, responsibility is also one of the mentioned root values targeted for acquirement in this context (Ministry of National Education, 2024). Figure 1 shows the twenty root values in the curriculum for science lessons.

Figure 1

Root values in the curriculum for the 2024 science course



Relationship Between Science Education and Responsibility

According to Francis Bacon's famous phrase, "Knowledge is power." regarding this expression, the basic principle for developed and developing countries to achieve global economic power and success is to be a society that acquires scientific knowledge and expands it (Çepni et al., 1997; Özmehmet, 2008). This fact increases the importance of educational activities in raising a qualified workforce (Buyruk, 2016). Science education is the process of individuals learning to explain, interpret and discover natural phenomena encountered in daily life by using scientific ideas and acquiring science process skills (Asoko, 2002, p. 153; Yıldız Taşdemir & Güler Yıldız, 2024). Science education plays an active role in that individuals shape the future of their country and affect the world economy. The welfare of societies depends on the sustainability of science and technological

developments. Such that countries with the highest success rate in the Trends in International Mathematics and Science Studies Research (TIMSS, 2019) and the International Student Assessment Program (PISA, 2018) are also countries with a high level of development. These countries' education systems tend to have a comprehensive and thorough science education component. The science education programmes of some countries with high scores in PISA 2018 and TIMSS 2019 are briefly evaluated below.

In the Finnish science curriculum, research- and problem-based approaches and focus on applied education were adopted by limiting the number of acquirements and aiming to raise pupils as individuals who are more sensitive to health and social issues (Özcan & Gücüm, 2020; Finnish National Agency for Education, 2020).

The basic philosophy of the Canadian science curriculum is that learners ought understand the nature and value of science and acquire scientific process skills. In this context, scientific process skills were combined with various subject titles and presented integrated with subjects. The curriculum aims to enable students to contribute to their daily lives, career development, and science with these outcomes (Bakaç, 2014; Ontario Ministry of Education, 2007).

The aim of the Hong Kong science curriculum is that students develop a positive attitude towards science, learn the language of science, and cultivate individuals who respect living and non-living beings, which are elements of the ecosystem (Cangüven et al., 2017; Hong Kong/Education Bureau, 2017).

The Estonian science curriculum aims to raise responsible individuals who understand the value of science and can generate ideas about socio-scientific issues, seek solutions to the problems they encounter by learning scientific process skills, and adopt a sustainable lifestyle. Compared with Turkey, starting to teach science in the first grade of primary schooling is a striking point. However, there are few outcomes in the curriculum. Therefore, the curriculum focuses on increasing the course quality (Republic of Estonia/Ministry of Education and Research, 2014; Karaer, 2016).

The programmes of these prosperous countries aim for school learners to realise the value of science, take responsibility for both personal and social life, and contribute to science in their future lives. The programmes are supported by practical educational activities aimed at this target. The main point of achieving this goal is to "raise science-literate individuals." The main goal of the curricula in these countries is to raise responsible and effective citizens who can achieve the countries' development goals by attaining academic success including in science.

Responsibility is one of the significant variables for academic success. Many studies accept that it is a motivating factor for student success. These studies indicate that individuals with a high sense of responsibility have advanced self-organising skills and high academic success (Aladağ, 2009; Brecke & Jensen, 2007; Helker & Wosnitza, 2016; Macready, 2009; Martel, McKelvie & Standing, 1987; Pomerantz et al., 2011; Wentzel, 1991)

There is a parallel relationship between the level of development of countries and education quality. For this reason, science education is essential for training responsible individuals who produced science and technology. (Ayas, 1995; Çepni et al., 2003; Matthews, 2017). In this context, understanding the role of responsibility in science education becomes crucial. For this reason, we examined studies about responsibility and responsibility education in the literature. We found that studies are in the psychology-psychological counseling and guidance field (Anderson, 2000; Dilmaç, 2007; Hayta Önal, 2005; Ryan & Deci, 2000) and social studies and life field (Aladağ, 2009; Gündüz, 2014; Kılcan, 2013; Sezer, 2008; Tepecik, 2008).

These studies primarily focus on student and teacher perspectives (Akbaş, 2004; Aydoğan & Gündoğdu, 2015; Burke et al., 2001; Helker & Wosnitza, 2016; Kaplan & Sulak, 2017; Kısa, 2009; Li et al., 2008; Sağlam & Kaplancı, 2018; Sapsağlam, 2017; Sezer & Çoban, 2016; Such & Walker, 2004; Şahan, 2011; Yontar, 2013). In the field of science, studies related to responsibility and value teaching are limited and include research by Çepni et al. (2003), Fuchs and Tan (2022), Kunduroğlu (2010), Tahiroğlu et al. (2010), Ayas et al. (2013), Küçükaydın (2015), Chowdhury (2016), Herdem (2016), Tekbıyık and Akdeniz (2017), and Yakar (2017).

These studies did not address the association between science lessons and responsibility. Therefore, we identified a need for research on the relationship between responsibility and science and decided to conduct this study. In this context, we aimed to contribute to the literature through this research.

This study aimed to examine the science lesson-focused responsibility levels of primary school third and fourth-grade pupils in terms of various demographic variables and to solve the following sub-problems.

1. What is the responsibility level of primary school third and fourth-grade pupils focused on science lessons?
2. Do third and fourth-grade pupils' responsibility levels focused on science lessons differ significantly based on gender, grade level, preschool experience, number of siblings, birth order, parental educational attainment, and interest in science lessons?

Methods

The study aimed to determine primary school third and fourth-grade pupils' science lesson-focused responsibility levels with reference to various demographic variables (class, gender, number of siblings, birth order, preschool experience, parental education status, and level of interest in science lesson). A descriptive research model is used in this study. The descriptive research model is a research model in which the researcher aims to determine the current state without changing the past or present situation, event, individual or object (Karasar, 2016). This model is used in studies that describe the current situation one by one and in detail in terms of variables or components encountered in nature (Karasar, 2016).

Population and Sample

The population of this research was defined as primary school third and fourth-grade students in Kayseri during the 2018-2019 academic year. The research sample consisted of 705 third and fourth-grade pupils from three central districts of Kayseri in the autumn semester of the 2018-2019 academic year. The sample was selected using the typical case sampling method. According to Büyüköztürk et al. (2018, p.94), "The typical case sampling method involves collecting information from a sample by identifying a situation that is representative of many similar situations in the population, related to the research topic". The study examined the science lesson-focused responsibility levels of primary school students based on various demographic characteristics. Demographic information and the students' interest in science lessons are provided in Table 1.

Table 1

Demographic characteristics of the sample group

Variable	Group	n	%
Gender	Girl	330	46.8
	Boy	375	53.2
	Total	705	100
Grade	3rd Grade	363	51.5
	4th Grade	342	48.5
	Total	705	100
Number of siblings	Only child	52	7.4
	2 siblings	371	52.6
	3 siblings	212	30.1
	4 siblings or more	70	9.9
	Total	705	100

Birth order	1st	304	43.1
	2nd	276	39.1
	3rd	90	12.8
	4th or higher	35	5.0
	Total	705	100
Preschool experience	Experienced	618	87.7
	Did not experience	87	12.3
	Total	705	100
Maternal education level	University	164	23.3
	Upper secondary	142	20.1
	Lower secondary school	152	21.6
	Primary school	229	32.5
	Illiterate	18	2.6
	Total	705	100
Paternal education level	University	175	24.8
	Upper secondary	121	17.2
	Lower secondary school	130	18.4
	Primary school	223	31.6
	Illiterate	56	7.9
	Total	705	100
Interest in science lesson	I do not like it	35	5.0
	I like it a little	38	5.4
	I like it	632	89.6
	Total	705	100

The number of primary school third and fourth-grade students attending education in the city of Kayseri, which constitutes the population of the study, in the 2018-2019 academic year was obtained from the data system of the Ministry of Education, Department of Strategy Development. The relationship with the sample size was examined (Ministry of Education, Department of Strategy Development, 2019). In this context, the data about the research population and sample are given in Table 2.

Table 2

Research population and samples

Grade	Population	Samples
3rd grade	23 665	363
4th grade	22 906	342
Total	46 571	705

Table 2 shows that there was a total of 46 571 students at the 3rd and 4th-grade level in Kayseri in the 2018-2019 academic year. 23 665 students were in the 3rd grade, and 22,906 were in the 4th grade in primary school. The number of students in the sample group for the application phase of the study shows that 363 were in the 3rd grade and 342 were in the 4th grade, with a total of 705 students participating in the sample. According to the relationship between population and sample numbers, the total number of students included in the sample is close to the 95% confidence interval accepted for a population with approximately 20,000 participants according to the .05-significance level (Cohen et al., 2007). In this context, it may say that the sample size is sufficient.

Data Collection Tools

The data were collected with the use of the personal information form and the "Science Lesson-Focused Student Responsibility Scale" developed by the researcher (Açıkgöz & Demirci Güler, 2021).

Personal Information Form

With the personal information form, information about gender, grade level, number of siblings, birth order, preschool experience, parents' education status, and science course interest levels were collected.

Science Lesson-Focused Student Responsibility Scale

The scale developed by researchers aimed to determine the science course-focused responsibility levels of the children (Author[1] & Author[2], 2021). In scale development, the sample consisted of 870 students. For the scope validity of the items, 11 experts' opinions were consulted. The content validity ratios of each item were calculated according to the Lawshe technique (Lawshe, 1975). For construct validity, exploratory factor analysis and confirmatory factor analysis were used.

As a result of the analysis, a Likert-type scale was developed with 17 items and with four factors. These four factors are "conscious resource consumption", "health awareness", "safety awareness" and "environmental awareness".

Scales' Cronbach Alpha internal consistency coefficient is .87, and the scale explains 50.83% of the total variance.

Data Collection

In this study, we decided to use a descriptive survey model. Firstly, we researched studies about the relationship between responsibility and science lessons in literature. We noticed that responsibility is an essential value for the science lesson. And we set two research problems. Then, we used a data collection tool and personal information form, which we developed, to answer the research problems. We obtained permission from the education authorities to carry out the research at primary schools. We collected data from 705 third and fourth-grade students in 3 central districts of Kayseri city in the fall semester of the 2018-2019 academic year.

Data Analysis

We tested the normality of data for demographic features and student responsibility levels. As a result of the normality tests for each sub-problem, we did not determine normal distribution ($p>.05$). For this reason, we tested the Mann-Whitney U test, which is one of the non-parametric tests for binary relationship, and the Kruskal-Wallis H test for two or more relationship. We examined the hypothesis test of the Kruskal-Wallis H test for relationship with significant differences (Büyüköztürk, 2018; Can, 2017).

The score ranges for the data collection tool were calculated using the n-1/n(n= Likert number) formula to determine the level of responsibility of pupils focused on the science lesson. Since the scale has 3 items and 2 even intervals, a value of 2/3 = 0.66 was obtained. Likert levels obtained according to the score ranges are never = 1 point (1.00-1.66), sometimes = 2 points (1.67-2.33), and always = 3 points (2.34-3.00).

The validity-reliability analysis of the data collection tool and analysis of data from the implementation phase was carried out using IBM SPSS Statistics 25 package programs.

Results

In this section, information about students' science lesson-focused responsibility levels regarding various demographic variables is presented. The science-focused responsibility level scores are shown in Table 3.

Table 3

Science lesson-focused responsibility level of primary school 3rd and 4th grade pupils

Factor	f	$\bar{X}$	sd
Science lesson-focused student responsibility scale	705	2.64	.32
➢ Conscious resource consumption	705	2.61	.44
➢ Safety awareness	705	2.78	.31
➢ Health awareness	705	2.59	.42
➢ Environment awareness	705	2.60	.40

Table 3 shows that the arithmetic means of pupils' responsibility level is 2.64. Students' responsibility level in the safety awareness factor is the highest ($\bar{X}$=2.78), and responsibility in the health awareness factor is the lowest ($\bar{X}$=2.59). According to the information obtained, pupils' responsibility levels are in the high-level range for the overall scale and each sub-factor ($2.34<\bar{X}<3.00$).

We examined the relationship between gender and pupils' responsibility level, shown in Table 4.

Table 4

Science lesson-focused responsibility levels of primary school 3rd and 4th grade students according to gender

Group	f	Average rank	Rank sum	U	p
Girl	330	378.39	124869.5	53495.5	.002
Boy	375	330.65	123995.5		

Table 4 shows there is a significant difference between the science lesson-focused responsibility levels of girls and boys (U=53495.5; $p<0.05$). By Average ranks, the science-focused responsibility levels of girls (X=378,39) were higher than those of boys (X=330.65).

We examined the relationship between responsibility sub-factor levels and gender, shown in Table 5.

Table 5

Mann-Whitney U Test results of science lesson-focused responsibility level sub-factors according to gender

Factors	Gender	f	Average rank	Rank sum	U	p
Conscious resource consumption	Girl	330	368.20	121507.00	56858.000	.055
	Boy	375	339.62	127358.00		
Safety awareness	Girl	330	361.82	119400.50	58964.500	.242
	Boy	375	345.24	129464.50		
Health awareness	Girl	330	388.21	128109.00	50256.000	.000
	Boy	375	322.02	120756.00		
Environment awareness	Girl	330	371.50	122595.00	55770.000	.021
	Boy	375	336.72	126270.00		

Table 5 shows that in the sub-factors of "conscious resource consumption" (U= 56858.0; p>0.05) and "safety awareness" (U= 58964.5; p>.05), there is not a significant difference between the responsibility levels of girls and boys. There is a statistically significant difference in favour of girls students for the sub-factors of "health awareness" (U= 50256.0; p<.05) and "environmental consciousness" (U= 55770.000; p<0.05). These results show that the "health awareness" (X=388.21) and "environmental awareness" (X=371.50) responsibility levels of girls are higher than the "health awareness" (X=322.02) and "environmental awareness" (x=336.72) responsibility levels of boys.

We examined the relationship between responsibility level and grade levels, shown in Table 6.

Table 6

Mann-Whitney U Test results for science-focused responsibility levels of primary school 3rd and 4th grade Students

Grade	f	Average rank	Rank sum	U	p
3rd	63	404.63	146881.00	43331.000	000
4th	42	298.20	101984.00		

Table 6 shows that there is a statistically significant differences between the responsibility levels and grade level (U = 43331.0; p <0.05). According to the Average ranks, the responsibility levels of third-grade pupils (X=404.63) are higher than the fourth-graders (X=298.20).

We examined the relationship between responsibility sub-factor levels and grade levels, shown in Table 7.

Table 7

Mann-Whitney U Test results of science lesson-focused responsibility level sub-factors according to grade level

Sub-factors	Grade	f	Average rank	Rank sum	U	p
Conscious resource consumption	3	363	396.09	143781.50	46430.500	.000
	4	342	307.26	105083.50		
Safety awareness	3	363	389.61	141430.00	48782.000	.000
	4	342	314.14	107435.00		
Health awareness	3	363	378.80	137504.00	52708.000	.000
	4	342	325.62	111361.00		
Environment awareness	3	363	393.01	142662.00	47550.000	.000
	4	342	310.54	106203.00		

Table 7 shows that there is a statistically significant differences in favour of third-grades in the responsibility sub-factors of "conscious resource consumption" (U= 46430.5; p<0.05), "safety awareness" (U= 48782.0; p<0.05), "health awareness" (U= 52708.0; p<0.05) and "environmental awareness" (U=47550.0; p<0.05). These results show that the "conscious resource consumption", "safety consciousness", "health awareness" and "environmental awareness" responsibility levels of third-grade pupils are higher than the responsibility levels of fourth-grade pupils.

We examined the relationship between responsibility level and the number of siblings, shown in Table 8.

Table 8

Kruskal Wallis H Test results for science-focused responsibility levels of 3rd and 4th grade students according to number of siblings

Sibling number	f	Average rank	df	X^2	p
Only child	52	348.37	3	1.140	.767
2	371	347.42			
3	212	356.95			
4	70	374.04			

Table 8 shows that there is not a statistically significant difference between responsibility levels and the number of siblings ($X^2_{(3)}$ = 1.140; p>.05). However, as the number of siblings increases the average responsibility scores increase. In this case, as the number of siblings increases, individuals take more responsibility in large families.

The sub-factors of the students' science-focused responsibility levels were examined according to the number of siblings, shown in Table 9.

Table 9

Kruskal Wallis H Test results for science lesson-focused responsibility level sub-factors according to the number of siblings

Sub-factors	Sibling number	f	Average rank	df	x^2	p
Conscious resource consumption	Only child	52	340.75	3	2.274	.518
	2	371	344.65			
	3	212	363.74			
	4	70	373.84			
Safety awareness	Only child	52	345.23	3	.167	.983
	2	371	352.13			
	3	212	356.41			
	4	70	353.04			
Health awareness	Only child	52	358.90	3	.874	.832
	2	371	349.18			
	3	212	351.88			
	4	70	372.23			
Environment awareness	Only child	52	336.24	3	1.951	.583
	2	371	349.15			
	3	212	354.43			
	4	70	381.52			

Table 9 shows that there is not a statistically significant differences between the number of siblings and responsibility sub-factors of "conscious resource consumption" ($X^2_{(3)}$ = 2.274; p>0.05), "safety awareness" ($X^2_{(3)}$ = .167; p>0.05), "health consciousness" ($X^2_{(3)}$ = .874; p >0.05) and "environmental awareness" ($X^2_{(3)}$ = 1.951; p>0.05).

We examined the relationship between responsibility level and birth order, shown in Table 10.

Table 10

Kruskal Wallis H Test results for science-focused responsibility levels of 3rd and 4th grade students according to birth order

Birth order	f	Average rank	df	X^2	p
1st child	304	350.13	3	.236	.972
2nd child	276	357.24			
3rd child	90	348.44			
4th child	35	356.27			

Table 10 shows that there is not a statistically significant difference between responsibility levels and birth order ($X^2_{(3)}$ =.236; p> 0.05). This result parallels the relationship between science lesson-focused responsibility level and the number of siblings.

We examined the relationship between responsibility sub-factors levels and birth order, shown in Table 11.

Table 11

Kruskal Wallis H Test results for science lesson-focused responsibility level sub-factors according to birth order

Sub-factors	Birth order	f	Average rank	df	X^2	p
Conscious resource consumption	1st	304	350.14	3	.121	.989
	2nd	276	355.78			
	3rd	90	353.78			
	4th	35	353.97			
Safety awareness	1st	304	362.18	3	2.288	.515
	2nd	276	344.89			
	3rd	90	338.22			
	4th	35	375.17			
Health awareness	1st	304	358.37	3	.783	.854
	2nd	276	352.59			
	3rd	90	343.70			
	4th	35	333.50			
Environment awareness	1st	304	338.54	3	2.959	.398
	2nd	276	363.45			
	3rd	90	360.92			
	4th	35	375.83			

Table 11 shows that there is not a statistically significant differences between the birth order and responsibility sub-factors of "conscious resource consumption" ($X^2_{(3)}$ =.121; p>0.05), "safety awareness" ($X^2_{(3)}$ =2.288; p>0.05), "health awareness" ($X^2_{(3)}$) =.783; p >0.05) and "environmental consciousness" ($X^2_{(3)}$ = 2.959; p>0.05).

We examined the relationship between responsibility level and preschool experience status, shown in Table 12.

Table 12

Mann-Whitney U Test results for science-focused responsibility levels of primary school 3rd and 4th grade students and preschool experience

Group	f	Average rank	Rank sum	U	p
Experienced	618	349.13	215765.00	24494.000	.178
Did not experience	87	380.46	33100.00		

Table 12 shows that there is not a statistically significant difference between responsibility levels and preschool experience (U = 24494.0; p>0.05). However, according to Average rank, responsibility levels of students who have not preschool experience are had higher than students who have preschool experience.

We examined the relationship between responsibility sub-factors levels and preschool experience, shown in Table 13.

Table 13

Mann Whitney U Test results for science lesson-focused responsibility level sub-factors according to preschool experience

Sub-factors	Group	f	Average rank	Rank Sum	U	p
Conscious resource consumption	Experienced	618	351.76	217385.50	26114.500	.656
	Did not experience	87	361.83	31479.50		
Safety awareness	Experienced	618	351.15	217010.50	25739.500	.486
	Did not experience	87	366.14	31854.50		
Health awareness	Experienced	618	345.02	213223.50	21952.500	.004
	Did not experience	87	409.67	35641.50		
Environment awareness	Experienced	618	349.48	215976.00	24705.000	.211
	Did not atten	87	378.03	32889.00		

Table 13 shows that there is not a statistically significant differences between the preschool experience and responsibility sub-factors of "conscious resource consumption" (U= 26114.5; p>0.05), "safety awareness" (U= 25739.5; p>0.05) and "environmental awareness" (U= 24705.0; p>0.05). However, there is a statistically significant difference between the preschool experience and "health consciousness "sub-factor (U= 21952.5; p<0.05) in favour of those who have not preschool experience.

We examined the relationship between responsibility level and maternal education status, shown in Table 14.

Table 14

Kruskal Wallis H Test results for science-focused responsibility levels of primary school 3rd and 4th grade pupils and maternal education status

Education status	f	Average rank	df	X^2	p
University	164	346.11			
Upper secondary	142	362.62			
Lower secondary school	152	368.42	4	4.107	.392
Primary school	229	337.35			
Illiterate	18	408.78			

Table 14 shows that there is not a statistically significant difference between responsibility levels and maternal education level ($X^2_{(4)}$ = 4.107; p>0.05). However, according to Average ranks, the responsibility levels of children whose mothers are illiterate are higher than those whose mothers have other educational levels.

We examined the relationship between responsibility sub-factors levels and maternal education level, shown in Table 15.

Table 15

Kruskal Wallis H Test results for science lesson-focused responsibility level sub-factors according to maternal education level

Sub-factor	Education status	f	Average rank	df	X^2	p
Conscious resource consumption	University	164	363.13	4	6.122	.190
	Upper secondary	142	367.19			
	Lower secondary school	152	358.27			
	Primary school	229	329.02			
	Illiterate	18	409.36			
Safety awareness	University	164	337.41	4	3.804	.433
	Upper secondary	142	353.69			
	Lower secondary school	152	361.32			
	Primary school	229	352.86			
	Illiterate	18	421.17			
Health awareness	University	164	336.72	4	5.915	.206
	Upper secondary	142	354.23			
	Lower secondary school	152	383.10			
	Primary school	229	341.65			
	Illiterate	18	381.83			
Environment awareness	University	164	345.09	4	1.922	.750
	Upper secondary	142	369.74			
	Lower secondary school	152	357.90			
	Primary school	229	343.90			
	Illiterate	18	367.28			

Table 15 shows that there is no statistically significant differences between the maternal education levels and responsibility sub-factors of "conscious resource consumption" ($x^2_{(4)}$ = 6.122; p>0.05), "safety awareness" ($x^2_{(4)}$=3.804; p>0.05), "health awareness" ($x^2_{(4)}$= 5.915; p>0.05) and "environmental consciousness" ($x^2_{(4)}$ =1.922; p>0.05).

We examined the relationship between responsibility level and fathers' education status, shown in Table 16.

Table 16

Kruskal Wallis H Test results for science-focused responsibility levels of primary school 3rd and 4th grade students according to paternal education levels

Education status	f	Average rank	df	X^2	p
University	175	365.51			
Upper secondary	121	352.09			
Lower secondary school	130	343.51	4	1.177	.882
Primary school	223	352.43			
Illiterate	56	340.19			

Table 16 shows that there is not a statistically significant difference between responsibility levels and father education levels ($X^2_{(4)}$ = 1.177; p> 0.05). However, according to average rank, the responsibility levels of students whose fathers with university graduates were higher than those whose fathers with another educational level.

We examined the relationship between responsibility sub-factors levels and fathers' education level, shown in Table 17.

Table 17

Kruskal Wallis H Test results for science lesson-focused responsibility level sub-factors according to paternal education level

Sub-factors	Education status	f	Average rank	df	X^2	p
Conscious resource consumption	University	164	358.95	4	2.018	.732
	Upper secondary	142	369.47			
	Lower secondary school	152	353.21			
	Primary school	229	344.35			
	Illiterate	18	332.78			
Safety awareness	University	164	364.10	4	2.035	.729
	Upper secondary	142	342.57			
	Lower secondary school	152	337.70			
	Primary school	229	358.30			
	Illiterate	18	355.25			
Health awareness	University	164	370.72	4	2.283	.684
	Upper secondary	142	347.07			
	Lower secondary school	152	353.37			
	Primary school	229	346.74			
	Illiterate	18	334.47			
Environment awareness	University	164	359.85	4	.580	.965
	Upper secondary	142	349.32			
	Lower secondary school	152	343.29			
	Primary school	229	354.79			
	Illiterate	18	354.94			

Table 17 shows that there is not a statistically significant differences between the maternal education levels and responsibility sub-factors of "conscious resource consumption" ($x^2_{(4)}$ = 2.018; p>0.05), "safety awareness" $x^2_{(4)}$= 2.035; p>0.05), "health consciousness" ($x^2_{(4)}$= 2.283; p>0.05) and "environmental consciousness" ($x^2_{(4)}$ =580; p>0.05).

We examined the relationship between responsibility level and science lesson interest levels, shown in Table 18.

Table 18

Kruskal Wallis H Test results for science-focused responsibility levels of primary school 3rd and 4th grade students focused on science lesson interest levels

Interest levels	f	Average rank	df	X^2	p	Significant difference
(1) I do not like it	35	174.99				
(2) I like it a little	38	264.75	2	37.640	.000	1-3 2-3
(3) I like it	632	368.16				

Table 18 shows that there is a statistically significant difference between responsibility levels and interest level of science lesson ($X^2_{(2)} = 37.640$; $p<0.05$). According to the results of the hypothesis test, the science lesson-focused responsibility levels of the pupils are significantly different in favour of those who "like" the lesson. According to mean rank, as the interest level increases, responsibility level increase.

We examined the relationship between responsibility sub-factors levels and interest level of science lesson, shown in Table 19.

Table 19

Kruskal Wallis H Test results for science lesson-focused responsibility level sub-factors according to interest level of science lesson

Sub-factor	Interest levels	f	Average rank	df	X^2	Kruskal Wallis p	Hypothesis test p	Significant difference
Conscious resource consumption	(1) I do not like it	35	231.09	2	21.054	.000	.960	1-2
	(2) I like it a little	38	277.08				.000	2-3
	(3) I like it	632	364.32				.024	1-3
Safety awareness	(1) I do not like it	35	261.36	2	17.844	.000	1.00	1-2
	(2) I like it a little	38	268.71				.005	2-3
	(3) I like it	632	363.14				.008	1-3
Health awareness	(1) I do not like it	35	247.24	2	16.148	.000	1.00	1-2
	(2) I like it a little	38	287.24				.062	2-3
	(3) I like it	632	362.81				.002	1-3
Environment awareness	(1) I do not like it	35	186.37	2	31.823	.000	.108	1-2
	(2) I like it a little	38	284.29				.000	2-3
	(3) I like it	632	366.36				.041	1-3

Table 19 shows that there were statistically significant differences present. For the "Conscious Resource Consumption" sub-factor, there is a statistically significant difference between those who "disliked" the science lesson and those who "liked it", and between those who "liked it a little" and "like it" in favour of those who "liked" the lesson ($X^2_{(2)}$= 21,054; $p<0.05$). For the "Safety Awareness" sub-factor, there is a statistically significant difference between those who "disliked" and "liked" the science lesson, and "somewhat liked" and "liked" in favour of those who "liked" the lesson ($X^2_{(2)}$= 17,844; $p<0.05$). There was a statistically significant difference in favour of those who "liked" the lesson ($X^2_{(2)}$= 16,148; $p<0.05$) between those who "disliked" the science lesson and those who "liked it" for the "Health Consciousness" sub-factor. For the "Environmental Awareness" sub-factor, there is a

statistically significant difference ($X^2_{(2)}$= 31,823; p<0.05) between those who "liked" the lesson and "those who liked it a little" and those who "liked it a little" in favour of those who "liked" the lesson.

Discussion and Conclusion

This study aimed to determine the science lesson-focused responsibility levels of primary school 3rd and 4th-grade pupils in relation to various demographic variables. The results are discussed in light of the existing literature.

We calculated the arithmetic mean value for the science lesson-focused responsibility level of the children. This value was 2.64. This indicates a high level of responsibility ($2.34<\bar{X}<3.00$). The arithmetic mean scores for the sub-factors of responsibility levels were also examined. We found that the 'Safety Awareness' factor had the highest score (2.78), while the 'Health Awareness' factor had the lowest score (2.59). However, the responsibility scores for both sub-factors were within the range of 2.34 to 3.00, indicating high responsibility levels.

We analyzed the association between gender and responsibility levels and found that the responsibility levels of girls were higher than those of boys. Many studies in the literature on responsibility and gender have similarly reported that the responsibility levels of female participants (particularly adult females) were higher than those of males (Akbaş, 2004; Berkowitz & Lutterman, 1968; Golzar, 2006; Demirhan İşcan, 2007; Kraft & Singhapakdi, 1995, p. 321; Sağlam & Kaplancı, 2020; Şahan, 2011). Additionally, we examined the association between gender and the sub-factors of responsibility levels related to science courses. Our analysis revealed no significant difference between girls and boys for the sub-factors of "Conscious Resource Consumption" and "Safety Awareness." However, there was a statistically significant difference in favor of girls for the sub-factors "Health Consciousness" and "Environmental Consciousness." These results indicate that girls exhibited significantly higher responsibility levels than boys in terms of "Health Awareness" and "Environmental Awareness." In this context, our findings align with much of the research in the literature. However, our results differ from those of Güdürü (2021) and Özcan (2021), who found no significant relationship between responsibility levels and gender.

We analysed the relationship between students' grade levels and science lesson-focused responsibility levels. We found that the responsibility levels of the 3rd-grade pupils were higher than the 4th-graders. We examined the association between grade levels and responsibility level sub-factors. We found that there was a statistically significant difference in favour of third-graders for all sub-factors of the scale. Piaget suggested that range of 6-10 years old children think that the rules are set by a higher authority and cannot be changed, but the range of 10-12 years old children notice that the rules can be changed if they are compromised by individuals (Senemoğlu, 2003). In this context, considering that 3rd and 4th-grade children are in the transition period from the 6-10 age group to the 10-12 age group, 3rd-grade children are more closely attached to their responsibilities. Therefore, their level of responsibility is higher. Güdürü (2021) examined the relationship between secondary school student's level of responsibility, age, and grade level. He found that the level of responsibility of the students decreased as their grade level and age increased. Özcan examined the relationship between secondary school students' responsibility levels and grade levels. He found that the responsibility levels of the 5th and 6th-grade pupils are higher than the responsibility levels of the 7th and 8th-grade pupils. In this context, the results are similar to the results of research by Güdürü (2021) and Özcan (2021).

We analysed the relationship between the birth order of the students and their science lesson-focused responsibility level. We found that birth order did not affect the level of responsibility. We also analysed the relationship between birth order and responsibility level sub-factors. We found that there was no statistically significant difference between all sub-factors and birth order. The research results are consistent with those of Yıldırım (2016). However, Alfred Adler claimed that individuals have power struggles in their lives. This situation starts to occur in the family. Individuals strive to establish superiority among siblings and prove themselves. Therefore, Adler suggested that birth

order causes differences in the personality traits of siblings (as cited in Gustafson, 2010). In the literature, first-born individuals are defined as being responsible, perfectionist, independent, ambitious, aggressive, successful, having a leadership spirit, and being fond of their mother in studies of the relationship between birth order and personality traits. Middle children are defined as being extrovert, jealous, brave, and talkative, while last-born children are defined as being extroverted, compassionate, and less responsible individuals. Only children are selfish individuals who are fond of their freedom (Gustafson, 2010; Herrera et al., 2003; Nyman, 1995; Semerci, 2017). However, since the studies are the results obtained by referring to the opinions of individuals, the family's attitude towards child-rearing, environmental conditions, and many underlying factors need to be included in the research process.

We analyzed the relationship between the number of siblings of students and their responsibility levels. We found that the number of siblings did not affect the level of responsibility. However, as the number of siblings increased, the average responsibility scores also increased. This finding can be interpreted as individuals from larger families fulfilling their own responsibilities and taking on additional responsibilities as the number of siblings increases. We analyzed the relationship between the sub-factors of science lesson-focused responsibility levels and the number of siblings. We found that there was no statistically significant difference between any of the sub-factors and the number of siblings. Aladağ (2009) concluded that there was no significant difference between responsibility levels and the number of children of the family. Also, Yıldırım (2016) concluded no significant difference between the number of siblings and the level of responsibility in research examining the relationship between personal responsibility and mental health levels in secondary school students. Similarly, Güdürü (2021) examined the responsibility levels of secondary school students and found that there was no significant difference between the number of siblings and the level of responsibility of the students. The findings of this study are consistent with the research by Aladağ (2009), Güdürü (2021), and Yıldırım (2016).

We analysed the relationship between pupils' preschool experience and their responsibility level. We found that the preschool experience did not affect the level of responsibility. After, we examined relationship between responsibility level sub-factors and the preschool experience. We found that there were no statistically significant differences between "Conscious Resource Consumption", "Safety Awareness", "Environmental Awareness" sub-factors and preschool experience. The "Health Consciousness" sub-factor showed a statistically significant difference in favour of those who had no preschool experience, contrary to expectations. Preschool experience is preparing children for primary school and significantly contributes to cognitive, affective, psycho-social, psychomotor, self-care, and language development (Bütün Ayhan & Aral 2007). In literature, it is concluded that preschool-experienced students are better level in multiple areas of development than those who have not, in the later stages of their educational lives. But there are no findings in the context of responsibility in the studies conducted (Oktay, 2007; Stipek & Byler, 2001; Yoleri & Tanış, 2014).

We analyzed the relationship between maternal education and the student's responsibility levels. First, we found that there were no statistically significant differences between the maternal educational level and the student's responsibility level. Then, we analyzed the correlation between the responsibility level sub-factors and the maternal education level. We found that there were no statistically significant differences between the maternal educational level and the responsibility level sub-factors. The research results are similar to the results of research by Yıldırım (2016) and Aladağ (2009). On the contrary, our research results are different from the results of research by Güdürü (2021). He examined the level of responsibility of secondary school 5th, 6th, 7th, and 8th-grade students whose mother was primary school graduate and whose mother was illiterate. And he found that the level of responsibility of the students whose mother is a primary school graduate is higher than that of those whose mother is illiterate.

We analyzed the relationship between the father's education and the student's responsibility levels. First, we found that there did not have statistically significant differences between the father's

educational level and the student's responsibility level. Then, we analyzed the relationship between the science lesson-focused responsibility level sub-factors and the father's education level. Likewise for paternal education, we found that there did not have statistically significant differences between the father's educational level and the responsibility level sub-factors. The results are similar to the results of research by Yıldırım (2016) and Güdürü (2021). On the contrary, the results are not similar to those of studies conducted by Aladağ (2009) and Uyanık et al. (2016). These studies found that increasing the father's educational status contributes more positively to the children's responsibility levels and personality development.

We examined the relationship between the pupils' science lesson interest levels and their responsibility level. We found that as the level of interest increases, their responsibility levels increase. Then, we examined the relationship between the responsibility level sub-factors and interest level. We found that there was a statistically significant difference between all sub-factors and interest levels ("I like it," "I like it a little," and "I do not like it") in favour of those who "I like it" the lesson. Interest is an influential and significant factor in learning (Harty & Beall, 1984, p. 423). As interest increases, success increases. Therefore, learning is fast and permanent (Laçin Şimşek & Nuhoğlu, 2009). Based on research in the literature about the relationship between science education and interest/curiosity, Koran and Longino (1982) concluded that learners with high interest-curiosity have higher levels of understanding the information than those with low levels of interest. Interested pupils can keep the acquired information in memory for a long time, perform complete learning, and are more successful in lessons.

Suggestions

According to the research results, boy students' level of responsibility is lower than girl students. For this reason, teachers can assign tasks to boy students to increase their level of responsibility.

According to the results of the research, student's interest in science lessons positively affects their level of responsibility. Responsibility, interest, and motivation are essential components to o increase academic success (Brecke & Jensen, 2007; Martel et al., 1987). Therefore, the science curriculum and lesson books should be prepared based on practices that increase students' curiosity and interest.

Teachers can carry out social assistance studies in order to give students individual and social responsibility. They can increase their awareness of their socioscientific problems and encourage them to produce solutions with argumantation based activities for this problem.

Families are role models for children. For this reason, the fact that parents are responsible people is an important factor for their children to be responsible individuals. Before we started our research, we thought that as the level of family education increased, the level of responsibility of the students would increase. However, our research results surprised us. As a result of our research, we found that there was no significant difference between parental education status and student responsibility levels. We examined studies in the literature that found a significant difference between these two concepts. For this reason, future researchers can conduct studies that examine the relationship between parental education level and responsibility in detail.

In our research, we found that there was no significant difference between birth order and level of responsibility. Similarly, in many studies in the literature, no significant relationship was found between birth order and responsibility. However, many educators and parents think that birth order affects the level of responsibility. Therefore, future researchers can examine the relationship between birth order and level of responsibility in more detail by considering other variables with an ethnographic research design, which is a qualitative research design.

Preschool education is an important education period that prepares students for primary school life and provides them with various skills. Although we think that preschool experience has a significant effect on responsibility, we found that there was no significant difference between the level

of responsibility and preschool education experience in our research. For this reason, future research can conduct research that will examine the relationship between these two concepts in detail.

Conflicts of Interest

There are no conflicts of interest to declare.

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