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INCREASED AWARENESS OF SHARK KNOWLEDGE AND PERCEPTION AMONG CHILDREN IN GHANA: AN EDUCATIONAL APPROACH

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Abstract

The significant increase in shark catches has made shark conservation a global problem. Although several studies on sharks have been conducted in Ghana, there is a dearth of information on the use of educational approaches for shark conservation. This study aimed to assess schoolchildren's knowledge of sharks and shark fisheries, attitudes toward shark conservation, and the factors that affected their knowledge and attitudes. From March to April 2023, two basic schools from the Western region of Ghana were visited. These schools were two Primary and Junior High Schools. From these schools, 99 students were given questionnaires to fill out with the help of a local teacher. According to the survey, more than 60% of students were aware of sharks' predatory function in the ecosystem but oblivious to their ecological significance. From the study, schoolchildren demonstrated a fair amount of understanding of shark fisheries and fishing in Ghana due to their proximity to the fishing community. However, the misunderstandings that some of these children hold about sharks may lead to poor participation in shark conservation activities. Correlation analysis between knowledge and attitude indicated an increase in knowledge about sharks would increase the attitude of children towards shark conservation. Therefore, it is crucial to incorporate shark conservation topics into the curriculum of these children, establish shark conservation groups, and engage them in citizen science projects to foster their desire for shark conservation.

Key words: Fishermen, Junior High School, Marine Protected Areas, Primary School, Shark catches,

Introduction

Shark populations have dramatically decreased over the past ten years because of increased catches in global shark fisheries, climate change, overfishing, ocean mining, and pollution from the dumping of ocean waste, among other factors (MacKeracher et al., 2021; Ferretti et al., 2020). Since sharks are crucial to maintaining

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the equilibrium of marine ecosystems, these circumstances have had an impact on them (Amponsah et al., 2023).

In Ghana, where many fishermen rely on shark meat and fins for a living, shark fishing is still a common activity (Seidu et al., 2022). Just two of the measures the government has implemented to regulate shark fishing in Ghana include the institutionalization of the closed season and the prohibition of shark finning. Illegal fishing is still a significant problem because management measures are usually ineffectively enforced (Gulmira et al., 2022). Developing effective conservation and management strategies is also difficult due to insufficient information on shark population dynamics in Ghana (Ackah et al., 2022). Because of this, there are a few management measures specifically made for species like sharks in Ghana (Sekey et al., 2022). Even though shark fishing may have a short-term financial benefit (Brobbey et al., 2021), fishing of these marine species at an unsustainable level may have long-term effects on the marine environment and the livelihoods of dependent fishing communities. Sekey et al. (2022) suggest that initiatives aimed at shark conservation in Ghana should take into account educating and raising awareness of sharks among fishermen.

Though many people enjoy the benefits accrued from the maritime environment, when it comes to learning how they feel about protecting the habitat, many people are unsure of the necessity of conservation (Garla et al, 2015). Community support for protecting aquatic resources is necessary for the implementation of measures for the conservation of aquatic biodiversity, and stakeholder participation is also essential for the management of these resources. There is a need for public engagement, which may be accomplished through classroom interaction, outdoor as well as outreach activities, and public support for any applicable biodiversity conservation and management strategies (Thu & Minh, 2013). By promoting an improved understanding of and attitudes toward local environmental preservation, nature-based educational programs aim to influence children's attitudes and behaviour toward the environment (Pooley & O'Connor, 2000). Though education in biodiversity conservation programs can increase knowledge, and skills, and develop critical thinking, information alone does not necessarily transfer into changes to more ecologically aware behaviour (Smith-Sebasto and Cavern 2006). In contrast to their peers in Western schools, some African children do not learn about marine animal ecology, the types of marine resources found locally, or the importance of these resources (Erhabor and Don 2016). This is true even though their community or family livelihoods may be heavily

dependent on the local environment (Kioko, Kiringe, and Wahungu 2010). The absence of formal education about knowledge of the ecology of animals and the natural resources in their local surroundings is of concern in this respect (Erhabor and Don 2016). Nevertheless, children must have access to this type of information as well, both in educational institutions and other contexts like the tourist sector (Hariohay et al. 2018). The constructivist hypothesis states that children's ideas and interpretations of a subject will affect how they comprehend reality. There is a wide range in the public's acceptance of and attitudes regarding sharks. In order to boost support for conservation efforts, a fuller understanding of public attitudes and behaviour toward sharks is urgently required in view of the dire situation facing many shark populations worldwide (Acuna-Marreo et al., 2018). According to research (Garla et al., 2015), one's level of knowledge can strongly determine their unique attitudes and behaviours regarding conservation. According to some studies, adults' environmentally aware decisions are based on lessons they obtained as children (Ajiboye and Silo, 2008). In Ghana and other rural parts of Africa, little is known about children's attitudes toward and engagement in environmental conservation concerns (Kioko & Warui Kiringe, 2010).

The study aimed at i) evaluating school children's knowledge of sharks and shark fisheries, ii) their attitudes towards sharks and perspective on shark conservation, and iii) any factors that would have an impact on their knowledge and attitudes towards shark conservation to promote education on sharks among children for the management and conservation of these globally endangered species. The knowledge acquired from this study will help in developing the necessary methods for increasing involvement in and generating the necessary support for shark conservation along Ghana's coast.

Material and Methods

Study Area

The study was carried out in two landing communities along the coast of Ghana. These include Axim and Dixcove (Figure 1). Ghana is a Western African nation bordered by Burkina Faso to the north, the Republic of Côte d'Ivoire (Ivory Coast) to the west, the Togolese Republic (Togo) to the east, and the Gulf of Guinea to the south. Axim is located in the Nzema East District (N 04.8665° N, N 04.2409° W). There are 13,509 households in the district with a household population of 59,250, Axim alone has about 5,001 households with 2,951 houses with a population size of over 9,623

(GSS, 2014). Axim consists of 12 landing beaches with over 5,405 fishermen (Dovlo, 2016). Dixcove community falls within the Nzema East Municipality and Ahanta West. The artisanal fishing port of Dixcove located in Ghana's Western Region (N 04.79368°, W 01.94612°) consists of three landing beaches namely the Upper Dixcove, lower Dixcove, and Eurom with over 1,081 fishermen (Dovlo, 2016). Farming is an important source of livelihood, with about 90% of men engaged in fisheries. Most women process and sell fish.

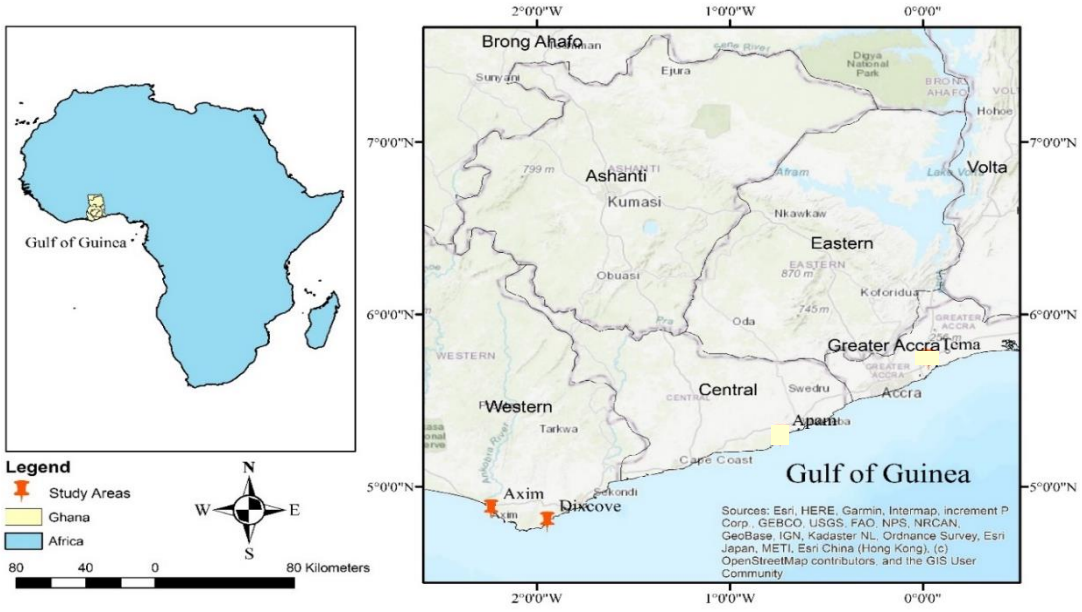

Figure 1. A map showing the study areas

Research technique

The content of the questionnaire for the study was validated by considering the following precautions, namely; i) that all questions cover all the areas under research, ii) absence of grammatical errors, iii) test items for likert scale are in one direction and iv) the instructions on the headings agree with the test items. The validated questionnaire was administered to students from two primary and Junior High Schools from March to June 2023. The schools were selected based on their location (i.e. within the sampling communities).. In determining the sample design, the question of the specific population parameters, which are of interest, were considered (Kothari, 2004). The criteria for selection of respondents included i) must be a student at the primary or Junior high school level and ii) must be between the ages of 10 years to 18 years. . From the study, 99 respondents were interviewed with the assistance of their class

teachers. The respondents were discreetly and amiably asked whether they would mind doing a quick survey for a few minutes. A likert scale and yes/No type of quantitative questionnaire was constructed in a single language, English. There was a total of four sections contained in the questionnaire, each representing Section A-Socio demographics, Section B-shark knowledge, Section C- shark fisheries knowledge and Section D-attitudes. These sections were adapted and revised to suit the local study sites.

Data analysis

The normality test was carried out before data analysis to ascertain if the sample data was normally distributed. After the interviews, open-ended quantitative questions were coded to offer a quantitative analysis of the responses collected. By analyzing all response frequencies, the study's objectives were satisfied. The proportion of binary replies (Yes/No) was examined using Pearson chi-square. Given the goals of the study and the survey's methodology, this was more suitable. All analyses were performed using the SPSS version 26, and Pearson correlation was utilized to evaluate the link between attitudes and knowledge among students at a significance level of 5%.

Results

The mean age of 50 Junior High School (JHS) students was 15 ± 0.2 years with a range of 12 years to 17 years. For the 49 students at the Primary level, the mean age was 13 ± 0.2 years, spanning between 11 years – 15 years. The mean difference in ages between students JHS and Primary students was significant ($t = 9.503$, $df = 97$, p-value < 0.001, two-tailed). The magnitude of the difference in the means was very large (eta squared = 0.48). From Figure 2a, a little less than 50% of the respondents from the primary schools were females while almost 50 % of JHS students were found to be females. On the contrary, more than 50 % of males were found at the primary level whereas the male students at the JHS level were less than 50 % (Figure 2a). For both JHS and Primary levels, less than 30 % reported not staying close to the beach while more than two-thirds of the students affirmed staying close to the beach (Figure 2a).

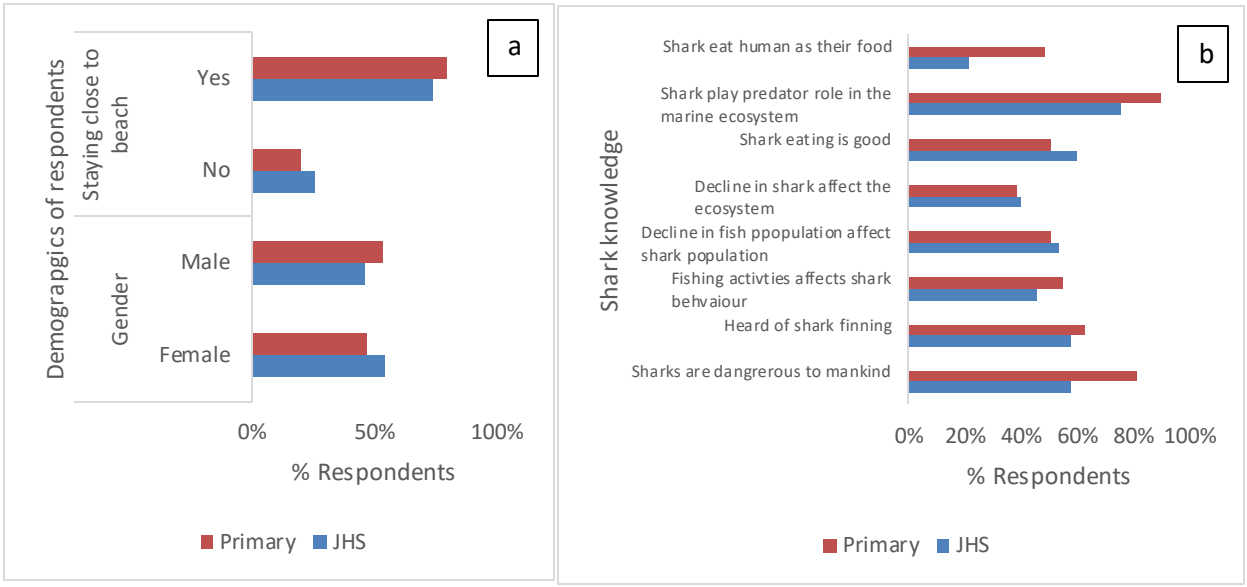

Figure 2. a) Demographics of respondents b) Knowledge of sharks among school children

From the study, more than two-thirds of the students at the Primary level i) agreed that sharks are dangerous to mankind; ii) they have heard of shark finings and iii) sharks play the predator role in the ecosystem (Figure 2b). At the Junior High School (JHS) level, i) more than two-thirds believed that shark eating is good and ii) sharks play predator roles in the ecosystem (Figure 2b). However less than half of the students at both levels of education, i) believed that sharks eat humans as food and ii) the decline in sharks affects the ecosystem (Figure 2b). From Figure 3a, more than half of the students at the Primary and JHS level agreed that the main food item for sharks is fish with a few selecting seaweeds and humans as the food items for sharks. More than 70 % of the students at the Primary and JHS level believed that i) shark fishing occurs in Ghana, ii) shark population affects the catch of fishermen and iii) shark products are consumed locally (Figure 3b). In addition, two-thirds of the students pointed out that shark catches by fishermen are the main cause of the decline in shark population (Figure 3c). Almost all the students (i.e. > 80.0%) knew that creating MPAs will aid in the conservation of sharks (Figure 3d). More than 50% of the students did not agree to stop shark fishing in Ghana (Figure 3d). When asked about which brings more money, almost all the students (90 %) believed that shark ecotourism will generate more revenue than fishing for sharks (Figure 3d). Concerning stopping shark fishing, a little over 50 % of the Primary students agreed while only 22% of the students at the JHS level did not give an affirmative answer (Figure 3d).

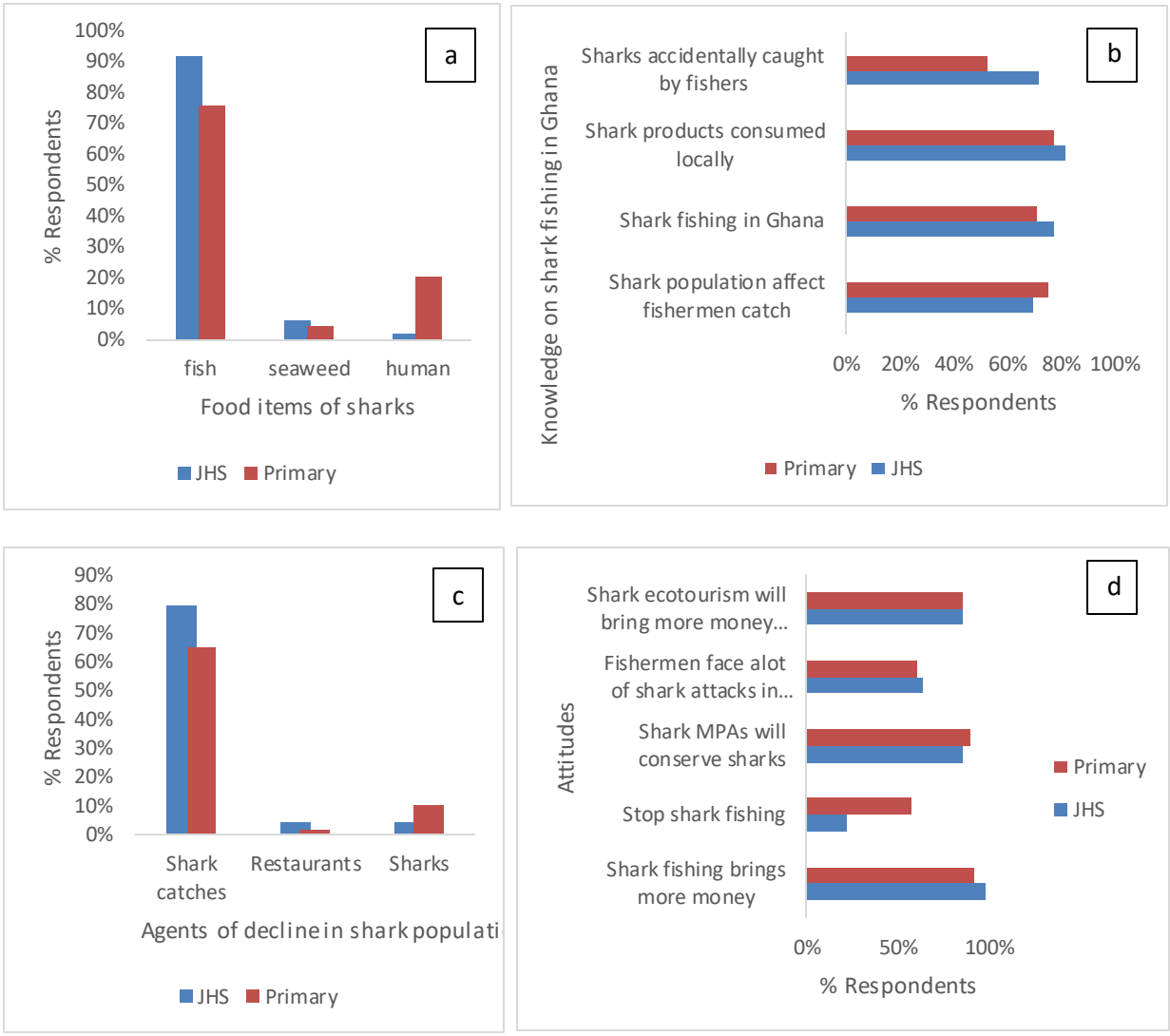

Figure 3. Children's knowledge of a) food items of sharks, b) shark fisheries, c) agents of shark population decline, d) attitude towards shark conservation

The mean index of knowledge and attitude was 66.6 ± 2.88 and 69.5 ± 13.08 respectively. Sample T-test analysis did not reveal any significant difference between the index of knowledge and attitude ([N (14,4)]; df = 3, t-stat = -0.213, p-value = 0.84). The correlation matrix showed a weak positive relationship between the index of knowledge and the index of attitude (Table 1).

Table 1: Correlation matrix between the index of knowledge and index of attitude

Index	Knowledge	Attitude
Knowledge	1	
Attitude	0.34	1

Discussion

This study offers the first data on how well-aware Ghanaian pupils are of shark ecology, biology and shark fisheries in Ghana, with a focus on Primary and Junior High Schools (JHS). From the study, students at both levels of education revealed that shark fishing is common in Ghana and that shark populations have an impact on the catches of fishermen. The majority also said that shark fishing is widely practised in Ghana and that shark populations have an impact on fishermen's catches. Furthermore, several of these students accurately identified how fishing and fish population loss affect shark behaviour. The fact that many parents of pupils are fishermen and that they live close to fishing towns may explain why so many of them have this knowledge.

Unfortunately, the majority of students believed that Ghana is where shark items are most commonly consumed. These kids' misunderstanding that shark items are consumed locally may have been aided by the availability of less expensive shark products like salted goods on the market. It is incorrect since important shark products, such as dried fin products, are widely consumed on a global scale (Brobbey et al., 2021; Sherman et al, 2022). When the majority of these students said that fishermen only inadvertently catch sharks in Ghana, it was once more clear that they had little awareness of the shark fishery there. On the contrary, shark fish on the coast of Ghana are highly targeted by local fishermen due to the high value of their fin at the international markets (Amponsah et al., 2023; Seidu et al., 2022; Sall et al., 2021; Agyeman et al., 2021). Additionally, the majority of these kids pointed out another misunderstanding, which was that sharks are harmful to humans. This misunderstanding may have been fueled by media outlets through the production of films in which sharks were represented as enormous, monstrous predatory monsters that preyed primarily on human flesh (Beall et al., 2022). According to research by Tsoi et al. (2016), the great white shark is regarded as one of the most mysterious and feared animals in the world, which lends weight to this conclusion. Furthermore, many JHS and elementary pupils agreed that sharks have a function as predators in the environment. Unfortunately, it seems that these pupils are unaware of the ecological significance of their predatory role. This result supports the contention made by Garla et al. (2006) that the ecological importance of sharks in the marine ecosystem is routinely disregarded. Many pupils may have been misled into thinking that the integrity of the marine environment will not be impacted by shark reduction due to a lack of information in this area. Unknown to most of these children, when the number of sharks

reduces, the cascading impact on the ecosystem is enormous which has the propensity of throwing the trophic interactions out of balance (Dillion et al, 2021; Brown et al., 2021; Sherman et al., 2020; Zemah-Shamir (2021); Sabbagh et al., 2019). Less than half of the pupils felt that the shark population in Ghana is declining, demonstrating once more the students' lack of understanding of shark status. However, numerous studies done in Ghana (e.g. Seidu et al., 2022; Ackah et al., 2022; Sekey et al., 2021) have provided scientific proof that shark species in Ghana are declining drastically making their products more expensive (Agyeman et al., 2021). These youngsters do not have access to crucial information on the state of shark species in Ghana, even though recent fisheries capture shows the massive drop in shark populations caused by overexploitation (Ackah et al., 2023; Sekey et al., 2020). These pupils are likely to have a somewhat low level of interest in shark conservation due to several shark-related misconceptions they may hold. In order to effectively conserve sharks in Ghana, it is crucial to integrate conservation problems into the classroom. It is important to keep in mind that various populations have varying degrees of environmental awareness, attitudes, and values. As a result, public perceptions of conservation-related issues are not consistent while developing tactics to bring shark conservation to the doorsteps of children. To raise awareness for shark protection, several tactics must be designed for both elementary and JHS pupils, taking into account their level of comprehension. The majority of these students hold the opinion that shark ecotourism will be more profitable than shark fishing when it comes to attitudes toward shark conservation. Studies by Ziegler et al., (2021); Gonzales-Mantilla et al. (2021) and Zimmerheckal et al (2019) have documented the enormous benefit of shark tourism in the form of scuba diving to local communities, which have fostered shark conservation, largely in the form of protected areas.

This finding could be consistent with the alluring qualities that sharks have for people. Other research, such as those by Acuna-Marrero et al. (2018), and Knight (2008), found that a shark's morphological characteristics are among the most crucial factors in luring animals to people, predicting attitudes, and igniting support for species conservation. The need to portray sharks as majestic creatures with a significant ecological function in the environment, as opposed to the negative perceptions of savage man-eaters that already exist on social media (Johnson et al., 2023), is necessary to promote shark ecotourism among youngsters and the public. The fact that the majority of kids think Marine Protected Areas (MPAs) would help with shark

protection also shows how effective MPAs are in managing resources, as has been demonstrated elsewhere (Albano et al., 2021; White et al., 2017). However, further research is required to determine which regions are scientifically viable before shark MPAs may be established (van Zinnicq Bergmann et al., 2022;). MPAs for shark conservation in Ghana will not exist until such scientific studies are carried out. The concept of shark conservation may not be fully accepted given that the majority of students believe that Ghanaian fishermen frequently experience shark attacks. Children need to be taught that shark attacks on fishermen are almost non-existent. According to Shiffman et al. (2020), shark attacks are mostly rare. More than 90% of shark species do not attack humans, even fishermen (Kraft et al., 2021). The majority of pupils, especially JHS students, think that shark fishing earns more money, however, this assertion may be based on the fact that many of these kids help their parents with their shark trade during the pre- or post-fishing stages. These kids, therefore, have a decent understanding of the cost-benefit analysis of the shark trade. However, it's possible that the majority of these students rejected the idea of banning shark fishing in Ghana because they shared this perspective. It is necessary to provide youngsters with the scientific evidence—which is now unavailable to these students—that suggests that target fishes produce more money than sharks in an effort to dispel this impression. Studies by Seidu et al., (2022) revealed that over 60 % of fisherfolks in Ghana are dissatisfied with income from shark products because recently it has become very difficult to catch sharks. Pham (2007) suggested that factual information could be the most effective way to induce cognitive alterations. Scientists and Fisheries officials should work to educate the public about the fact that there is actually little chance that sharks would attack fishermen in Ghana.

According to the study, parents' occupations and proximity to the shore were the main factors that may have influenced kids' awareness of shark fishing, sharks, and attitudes toward shark conservation. Additionally, the slight positive correlation between the knowledge index and attitude index implies that if children have access to factual information supported by research, their attitudes about shark conservation will either significantly change or improve. The positive relationship between the index of knowledge and the index of attitudes towards the conservation of sharks has been supported by Papageorgion et al., (2022); Musiello-Fernades et al., (2021) and Guay et al., (2023).

Conclusion

Students generally have some understanding of sharks, according to the study, but several myths need to be dispelled to increase student awareness of shark protection. This research suggests that one's degree of education may not always affect their attitude toward shark conservation. However, more information about sharks may influence people's attitudes toward their protection and ethical use. According to Acuna-Marrero et al. (2018), education on the ecological importance of sharks and their susceptibility to overfishing can help build support for shark conservation. Finding ways to increase students' awareness of sharks and shark fishing in Ghana may thereby change their attitudes toward shark conservation.

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Conflicts of interest

The author(s) declare(s) that they have no competing interests.

Data availability statement

Data is available upon request.

Informed consent statement

The consent of all the students was sought verbally before the questionnaires were administered.

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Perspectives of Doctoral Students on Quality in Turkish Higher Education: A Qualitative Study

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Abstract

This study aimed to examine the views of doctoral students on quality in Turkish higher education. In this qualitative study, the participants were doctoral students enrolled in the field of Educational Administration. Criterion sampling technique, one of the purposeful sampling methods, was employed in determining the participants. The research data were collected using semi-structured interview forms developed by the researcher based on the relevant literature and expert opinions. During the data collection process, face-to-face interviews were conducted with the participants. The data were analyzed using content and descriptive analysis methods. The findings indicated that doctoral students consider quality in higher education as a multidimensional concept involving various factors. They emphasized competent academic staff, suitable physical facilities, social opportunities, recognition, and educational quality as key attributes of a high-quality university. Furthermore, the study revealed that most of the participants were dissatisfied with the current state of higher education quality in Türkiye and some of them expressed pessimism about its future improvement. Additionally, they demonstrated limited awareness of quality-related studies in Turkish higher education.

Key words: Quality, higher education, quality in higher education

Introduction

Among the various service sectors, education, particularly higher education, significantly contributes to both the economic and social progress of society (McArthur, 2011). Within this framework, the importance assigned to education is escalating, leading to a rapid evolution of the education sector. Presently, higher education is widely recognized as an integral component of the service industry (Galeeva, 2016). With the growing interest in higher education, the number of students and institutions has also increased and public resources have become insufficient in response to increasing costs. Universities have adopted a competition-oriented

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approach in order to meet the increasing demand with the diminishing public resources (Tezsürücü & Bursalıoğlu, 2013). This competition has exerted pressure on higher education institutions not only at national but also at international level to increase their effectiveness (Ekinci & Burgaz, 2007). Universities should be able to meet expectations and respond to the needs of students in an increasingly competitive environment (Tayyar & Dilşeker, 2013). Therefore, the quality of services provided by higher education institutions is becoming increasingly important in today's context (Gencel, 2001). Universities have been compelled to innovate in order to appeal to both students and financial stakeholders (Orshinger, 2006). Furthermore, the substantial role played by higher education institutions in the economic and social development of nations has underscored the imperative need for the enhancement of higher education systems (Bakioğlu & Hacıfazlıoğlu, 2016). The internationalization of higher education and the proliferation of private universities are additional factors driving the restructuring of higher education systems at both national and international levels (Halai, 2013). Quality serves as a cornerstone of this restructuring and transformation process (Özer, 2012).

Since the 1980s, the topic of higher education quality has been the focus of many debates (Bakioğlu & Hacıfazlıoğlu, 2016). In order to effectively compete in the education market, institutions of higher education have endeavored to distinguish themselves from others by delivering superior quality services. Fulfilling the needs of students through the provision of high-quality education has become the primary objective for universities (Telford & Masson, 2005). In addition to race for innovation and research, universities are also expected to grant high quality services (Yousapronpaiboon, 2014). Additionally, the establishment of a quality-centric higher education system encompassing research, education, and societal contribution is imperative. With the proliferation of accessible information facilitating global expansion, universities are striving to ensure that the quality of their services meets national or international standards (Ekinci & Burgaz, 2007). Consequently, the concept of quality is now being addressed within the framework of harmonization and the attainment of specific standards (Hacıfazlıoğlu, 2006). The basic standards of the quality cycle in higher education are education and instruction, academic staff, administrative structure, management and physical facilities (Bakioğlu & Hacıfazlıoğlu, 2016).

Today, the opinions and experiences of students are acknowledged as significant criteria in the comprehensive evaluation of higher education. The adoption of a student-centered approach in decision-making and implementation processes

within universities is regarded as the foundation of the quality assurance mechanism (Bakioğlu & Hacıfazlıoğlu, 2016). Crossley and Watson (2003) assert that student experiences form the core of quality assessment in higher education. The transition of universities towards a more student-centric structure is cited as one of the driving factors behind this paradigm shift (Hill et al., 2003). Since students are the direct beneficiaries of the services provided by universities, they are considered as customers of these institutions. Generally, parents, administrators, industry and society are considered to be second-order customers of universities, whereas students are considered to be first-order customers. Hence, it is imperative that the quality of services provided by higher education institutions be evaluated from the perspective of students (Teeroovengadum et al., 2016). Enhancing the service quality to align with students' interests and needs will prove effective in bolstering their loyalty to their universities and facilitating the attainment of their educational objectives (Özgül & Devebakan, 2005). Furthermore, student opinions and experiences provide stakeholders of higher education institutions with important clues for obtaining solid data about universities and making decisions (Hill et al., 2003).

Although there has been a significant focus on the quality of higher education, the investigation of this topic from the perspectives of students remains comparatively scarce in both international literature (Douglas et al., 2006; Hill et al., 2003; Teeroovengadum et al., 2016) and within the Turkish context (Hacıfazlıoğlu, 2006; Özçetin & Gök, 2017; Tayyar & Dilşeker, 2013; Topsakal & İplik, 2013). In this study, it is posited that students' evaluations regarding the quality of higher education in Türkiye, within both present circumstances and future projections, will provide essential data for university administrations and policy makers. Moreover, the insights derived from doctoral students' perspectives on quality can significantly enrich the quality enhancement endeavors within higher education institutions. Therefore, this study seeks to conduct an in-depth analysis of doctoral students' perspectives regarding the notion of quality in higher education, delineating the attributes of a high-quality university and assessing the quality of higher education in Türkiye. The present study sought answers the following questions:

1- What comes to the mind when thinking of quality in higher education?

2- What characteristics does a quality higher education institution have?

3- How is the current quality of higher education in Türkiye?

4- How will the future quality of higher education be in Türkiye?

5- What is currently known about quality studies in higher education in Türkiye?

The Concept of Quality

Quality is a concept that has been pondered throughout history and is currently the subject of intense scrutiny and focus. It is derived from the Latin word "Qualis" and has different definitions according to its area of use (Tezsürücü & Bursalıoğlu, 2013). While records of quality considerations exist in prehistoric times, the emergence of quality as a concept occurred in the 19th century (Karaca, 2008). It is difficult to articulate a precise definition of quality (Hacıfazlıoğlu, 2006). Throughout history, quality has been defined in various ways, including excellence, value, compliance with standards, and meeting customer expectations (Reeves & Bednar, 1994). Brysland and Curry (2001) conceptualized quality within the realm of service as an abstract notion that fulfills customer expectations and instills a sense of worth. Juran and Godfrey (1998) delineated quality through two fundamental perspectives. Firstly, quality is construed as the attributes of goods that satisfy customer requirements, thereby ensuring customer contentment. The alternative conceptualization involves rectifying shortcomings that lead to inefficiencies and discontent. Crossby (1979) defined quality as a production system that produces services or products in an economic way and meets customer demands, while Feigenbaum (1983) defined it as conformity to conditions.

Quality in Higher Education

There is no clear definition of quality in education and it is a controversial concept. Indicators of educational quality vary from person to person (Hughes, 1988). While some emphasize the quality of inputs in education systems, others highlight process and output quality. Sometimes quality is assessed within the context of suitability for use, and fulfillment of the needs of strategic stakeholders, including policymakers, parents, teachers and students. Therefore, it has been argued that educational quality is a multidimensional concept and cannot be measured by a single marker (Cheng & Tam, 1997). Cheng (1995) defined educational quality as the characteristics of the inputs, processes and outputs of the educational system. This definition emphasizes the provision of services that fully satisfy the needs of both internal and external strategic stakeholders by meeting explicit and implicit expectations. Therefore, the quality of educational institutions may vary according to the perceptions of stakeholders.

Today, with the expansion of higher education and the growing number of institutions and students, there has been a notable increase in the importance placed on quality within universities. Nevertheless, due to the complex nature of higher education, there exists no consensus on the definition of quality or the methodologies for its measurement (Özer et al., 2011). Barnett (1992) addressed the quality of higher education through three primary approaches. First of these is the objective concepts approach. This approach relies on the principle that higher education quality is evaluated according to certain performance indicators by determining a common method for all institutions. Secondly, the relative concepts approach defines quality as adherence to intended purpose, without specifying standardized criteria or metrics for measurement. Quality perception is subjective, varying among individuals. Thirdly, within the developmental concepts approach, quality assessment entails an internal evaluation of organizational processes aimed at enhancing the overall work quality of the organization (Bakioğlu & Hacıfazlıoğlu, 2016).

Gencel (2001) outlined the basic principles on which quality management of higher education institutions has been grounded. The first is the focus on quality. Educational institutions should adopt the understanding of quality for lifelong learning, increasing the welfare level of the people and creating a democratic culture. Another element is customer orientation. In higher education, the demands and needs of internal customers such as teaching staff and management staff and external customers such as students, graduates and parents should be taken into consideration (Crossby, 1979). Another principle is continuous improvement. During higher education, education programs, plans, students and educators should be continuously monitored and improvements should be made when necessary. There should be a team spirit in higher education institutions. All stakeholders should take part in decision-making processes to improve service quality. Top administration should have effective leadership skills. The selection of administrators should prioritize individuals with a strong educational background and technical expertise (Gencel, 2001). Bakioğlu and Hacıfazlıoğlu (2016) also underscored the importance of fostering a culture of quality within higher education institutions, noting that such a culture is indispensable for internalizing the concept of quality.

The adoption of quality-oriented approach in higher education is of great importance for the effectiveness and efficiency of the services provided. In this context, quality practices within higher education have emerged and progressively expanded on a global scale. An understanding of the quality of higher education has become

increasingly significant, particularly concerning its contribution to the national economy through the cultivation of skilled individuals (Karahan & Kuzu, 2014). The reasons for the quality issue are the rising number of students and institutions, the expansion of the autonomy of state universities, international student mobility and the free movement of the economy. In this context, the discourse on quality has transcended national boundaries to encompass the international arena, becoming one of the fundamental elements shaping inter-country relations (The Council of Higher Education [YÖK], 2007). Studies on quality, which started in the USA in the 1980s and in the UK in the 1990s, have gradually spread all over the world (Kalaycı, 2008). Developed countries have established "National Quality Assessment Agencies" within the scope of quality assurance studies in higher education. They are founded by the state or as independent organizations. The objectives of such agencies are to build an understanding of quality assurance, to evaluate institutions of higher education, to determine the strengths and weaknesses of these institutions, to make recommendations and to inform the public. Subsequently, efforts were made by the European Union countries to create a European Higher Education Area. As a result of these efforts to adopt a common understanding of quality assurance in higher education, the European Association for Quality Assurance in Higher Education (ENQA) was established in the 1990s. The Lisbon and Bologna processes also supported quality assurance studies and accelerated them (YÖK, 2007).

Quality Studies in Turkish Higher Education

With the Regulation on Academic Evaluation and Quality Development in Higher Education Institutions, published in the Official Gazette dated 20 September 2005 and numbered 25942, Commission of Academic Evaluation and Quality Development in Higher Education Institutions (YODEK) was founded and the first practices for quality assurance were initiated. This regulation was prepared in accordance with the Standards and Principles of European Quality Assurance. Later, within the scope of the same regulation, “Academic Evaluation and Quality Development Board” (ADEK) was established and higher education institutions were held responsible for preparing reports every year. Due to the developments in higher education, some amendments were made to the Higher Education Law No. 2547 in 2011. Internal and external quality assurance studies were initiated for the improvement and refinement of education. On 23 July 2015, the Regulation on Higher Education Quality Assurance was published,

YODEK was abolished and the Turkish Higher Education Quality Council (YOKAK) was established. Within the scope of the relevant legislation, the formation of quality commissions for each institution of higher education has been made compulsory. In Türkiye, student participation in quality assessment processes is at a high level. Students actively engage in managing YODEK, participating in internal and external evaluations of higher education institutions, and preparing self-assessment reports (YÖK, 2010).

Method

Research Design

In this study, a qualitative descriptive design was employed to investigate the perspectives of doctoral students regarding the concept of quality in higher education, the attributes of a quality university, and the quality of higher education in Türkiye with the aim to conduct a more in-depth exploration. Qualitative research involves an in-depth exploration of participants' views and perceptions within their natural context, presented in a comprehensive manner (Yıldırım & Şimşek, 2011). Qualitative descriptive studies are used for getting straightforward and mostly simple answers to questions that are important to practitioners and policymakers (Sandelowski, 2000).

Participants

In this study, participants were selected using criterion sampling, one of the purposeful sampling methods, to ensure representation. Criterion sampling involves selecting units with specific characteristics (Büyüköztürk et al., 2013). The criterion for participant selection in this study was defined as enrollment in doctoral education. It was presumed that doctoral students possess considerable insights into the quality of higher education. Consequently, the researchers deemed it advantageous to explore the perspectives of doctoral students. This research involved 12 doctoral students pursuing studies in the field of Educational Administration, consisting of seven women and five men, ranging in age from 29 to 38.

Data Collection

In the present study, a semi-structured interview form was used for gathering data. Initially, a literature review on quality in higher education was carried out and a semi-structured interview form was developed by the researcher to examine the perceptions of doctoral students on quality in higher education. The interview form

consisted of two parts. The first part included information on demographic variables such as age and gender. In the second part, five questions were formulated to ascertain the perspectives of doctoral students regarding quality in higher education. The questions were designed to be flexible and open-ended, supplemented with probes for additional depth when necessary. The objective of the questions in this section is to determine doctoral students' views on the concept of quality in higher education, the characteristics of a quality university and the quality of higher education in Türkiye.

Data Analysis

In this study, content analysis and descriptive analysis were employed to analyze the data collected from participants. Content analysis is a method that is generally used in social sciences and allows working on human behaviour in non-linear ways (Büyüköztürk et al., 2013). Descriptive analysis involves carefully examining and understanding data using predefined themes (Yıldırım & Şimşek, 2011). To bolster the validity and reliability of the present study, Lincoln and Guba's (1985) credibility, transferability, dependability, and confirmability strategies were applied, as recognized benchmarks in qualitative research. In order to ensure the credibility of the research, the interview period was kept as long as possible to collect robust data. Furthermore, direct quotations were incorporated to accurately convey the perspectives of the participants. To ensure transferability, each phase of the study was elucidated, employing clear and accessible language throughout the research process. To maintain dependability, every stage of the research was carefully documented by establishing audit trails. Additionally, both the researcher and experts reviewed the findings to ensure confirmability.

After completing the interviews with the participants, five themes were identified based on the questions in the interview form. Codes were generated corresponding to these themes, revised with input from two experts, and prepared for analysis. In this study, the open coding technique, where coding is conducted based on concepts derived directly from the data was utilized (Corbin & Strauss, 1990).

Throughout the analysis process, responses from participants were meticulously scrutinized and matched with their respective codes. Each answer was counted as one frequency, allowing for comparisons between codes based on responses from all participants. Ultimately, all codes and frequencies were analyzed, leading to the derivation and interpretation of findings.

Findings

The five themes identified from the literature review and the analysis of the interview forms are; perception of quality in higher education, quality university, current quality of higher education, future quality of higher education and quality studies in higher education. Research findings will be presented within the scope of these themes.

Perception of Quality in Higher Education

The theme, derived from the responses to the first question is outlined in Table 1, along with the associated codes.

Table 1

Participants' Views on the Concept of Quality in Higher Education

Theme	Codes	*f*
Perception of Quality in Higher Education	International recognition	7
	Producing scientific studies	4
	Qualified academic staff	3
	Efficient services	2
	Accreditation	2
	Finding solutions to the social problems	2
	Continuous self-renewal and development	2
	Competitiveness	1
	Contribution to academic development	1
	Providing qualified labour force	1
	Contributing to social development	1
	Meeting expectations and needs	1
	Providing a new vision	1

More than half of the participants (*f* = 7) stated that the concept of quality in higher education evoked international recognition. Less than half of the participants (*f* = 4) perceived it as producing scientific studies, three participants as qualified academic staff, two participants as efficient services, accreditation, finding solutions to the social problems, and continuous self-renewal and development. Very few participants (*f* = 1) mentioned competitiveness, contribution to academic development, providing qualified labour force, contributing to social development, meeting expectations and needs, and providing a new vision. In support of these findings, a participant (P9) stated as follows:

> "*Raising individuals who are qualified to compete at the international level, who have the capacity to constantly renew themselves and lead innovation are the basic elements of quality in higher education.*"

The statement of another participant (P3), who addressed the concept of quality in higher education in the context of academic staff, is as follows:

> *"When I think about it, what comes to mind is the execution of teaching activities aligned with contemporary trends and requirements, led by globally competent academic personnel."*

In summary, the findings revealed that the participants' views of the concept of quality in higher education are primarily centered on the importance of international recognition for institutions, the emphasis on conducting rigorous scientific studies and research and the crucial role played by qualified and experienced academic staff members in delivering effective teaching and learning experiences.

Quality University

The theme accompanied by the related codes extracted from the responses to the second question is delineated in Table 2.

Table 2

Participants' Views on the Characteristics of a Quality University

Theme	Codes	*f*
Quality University	Qualified academic staff	11
	Suitability of physical conditions	11
	Social facilities	10
	Recognition	9
	Quality of education and instruction	7
	Management support	7
	Democratic management	3
	Publicity activities	2
	Library facilities	2
	Cooperation with different institutions and sectors	1
	Innovation	1
	Research and development projects	1
	Objectivity	1

Almost all of the participants (*f* = 11) stated that qualified academic staff and the suitability of physical conditions, and the majority (*f* = 10) stated that social facilities are the characteristics of a quality university. The statements of some participants can be given as examples to support the findings:

> *"The academic staff at a quality university should be open to continuous development, embrace innovation, think globally, and maintain a sense of inner peace." (P10)*
>
> *"The physical conditions of a quality university should not only meet the needs of individuals but also provide an environment that motivates them and enables them to use their energy correctly." (P7)*
>
> *"Quality universities should offer social opportunities that facilitate students' socialization. Moreover, I believe that the university environment should also*

benefit from these social opportunities and activities to foster integration within the community." (P12)

Regarding the characteristics of a quality higher education institution, most of the participants (*f* = 9) stated that quality universities are internationally recognized institutions. In addition, more than half of the participants (*f* = 7) listed the quality of education and instruction and management support as the characteristics of a quality university. In support of these findings, some of the participants' statements on the subject are as follows:

"A quality university should adopt an approach that considers the educational requirements of students and other stakeholders. Higher education institutions that make innovations and provide easy access to information can be considered as exemplifying quality." (P12)
"A quality university is an internationally recognized institution that can offer its students the opportunity to get to know different countries." (P4).
"In a quality university, management should actively engage stakeholders in the decision-making process. Furthermore, administrative staff should demonstrate courteous behavior towards students." (P7)

Less than half of the participants (*f* = 3) emphasized a democratic management approach as a characteristic of a quality university. A small number of participants (*f* = 2) mentioned publicity activities and library facilities, and very few participants (*f* = 1) mentioned cooperation with different institutions and sectors, innovation, R&D projects and objectivity. In support of these findings, the statements of some of the participants on the subject are as follows:

"A quality university has a rich library and access to international resources." (P7)
"Quality universities are institutions that attach importance to publicity activities that enable them to integrate with the society and have a stronger image." (P10)

In summary, the participants' perspectives on a quality university mainly point to the competence of academic staff, the quality of physical infrastructure, the availability of social amenities, the comprehensiveness of educational programs, and the degree of recognition received. This reveals that a quality university is primarily perceived as having highly qualified academic staff, alongside well-developed physical and social resources, comprehensive educational offerings, and a strong reputation.

Current Quality of Higher Education

The theme identified from the responses to the third question alongside the corresponding codes is presented in Table 3.

Table 3

Participants' Views on the Current Quality of Higher Education

Theme	Codes	*f*
Current Quality of Higher Education	Insufficiency	6
	Characteristics of the university	4
	Characteristics of the city	2

Half of the participants (*f* = 6) stated that the current quality of higher education is insufficient, while less than half of the participants (*f* = 4) stated that it varies from university to university. Very few of the participants (*f* = 2) stated that the current quality of higher education varies according to the city where the universities are located. This situation is clearly seen in the statements of some participants:

> *"I do not currently perceive the quality of higher education in Türkiye to be sufficient. I attribute this to factors such as the lack of scientific freedom, financial challenges faced by universities, and the absence of university autonomy." (P10)*
>
> *"We can say that quality of higher education in Türkiye actually differs from university to university currently. Indeed, we can witness that some universities provide quality services in both academic and institutional terms. However, unfortunately, it is not possible to talk about a quality understanding at this level in most universities." (P12)*
>
> *"While the quality of services provided in big cities is quite high in Türkiye's standards, I do not think that we can achieve the same quality in provincial universities." (P1)*

In summary, the dominant perspective among participants reflects dissatisfaction with the current quality of higher education in Türkiye, with many considering it inadequate. Furthermore, some participants highlight the nuanced nature of university quality, noting variations based on factors such as location and the specific institution. This shows that the perception of higher education quality in Türkiye is multifaceted, with participants acknowledging both inadequacies and the localized differences in quality across cities and universities.

Future Quality of Higher Education

The theme, derived from the responses to the fourth question, is outlined in Table 4, along with the associated codes.

Table 4
Participants' Views on the Future Quality of Higher Education

Theme	Codes	*f*
Future Quality of Higher Education	Not promising	8
	Better than today	4

A majority of the participants (*f* =8) expressed a pessimistic view, believing that the future quality of higher education is not promising and is unlikely to improve compared to the present state. This is clearly seen in the statements of some participants:

> *"When I consider our current situation, it becomes evident that adapting to changing conditions is crucial, as the outcomes may vary depending on our actions. However, I personally find the future prospects to be less than promising." (P5)*
> *"I think it is not promising. The quality will not be ensured in the future except for a few universities that plan well, and that universities will turn into places where people study for a few years more." (P4)*

Less than half of the participants (*f* = 4) stated that they think that the future quality of higher education will be better than the current situation. Some of the participant views that support this finding are as follows:

> *"I am not hopeless. I believe that other universities can develop over time by taking existing quality universities as a model. Of course, the employment of qualified academics and financial support for these universities are of urgent and vital importance." (P9)*

In summary, the prevailing sentiment among participants is a critical assessment of the current quality of higher education, with a majority expressing negative opinions. Key factors contributing to this outlook include the centralized structure of higher education, unfavorable physical conditions, a perceived lack of qualified academic staff, and a noted difficulty in keeping pace with innovations and advancements.

Quality Studies in Higher Education

The theme along with the related codes extracted from the responses to the second question is delineated in Table 5.

Table 5

Participants' Views on Quality Studies in Higher Education

Theme	Codes	*f*
Quality Studies in Higher Education	Limited knowledge	5
	Bologna process	5
	Accreditation practices	3
	Turkish Higher Education Quality Council	2
	Projects	2
	ECTS (AKTS)	2
	Patent studies	2

Almost half of the participants (*f* = 5) said that they have limited knowledge about quality studies in higher education. Bologna process (*f* = 5), accreditation studies (*f* = 3), Turkish Higher Education Quality Council (*f* = 2), projects (*f* = 2), ECTS (*f* = 2) and patent studies (*f* = 2) were the issues that the participants mentioned about quality studies. In support of these findings, the statements of some of the participants on the subject are as follows:

> *"Actually, I do not know so much about higher education quality studies in Türkiye. However, if there is such a quality study, it is seen that such an understanding does not take place in practice. In other words, what is wanted to be done in terms of quality service is most likely to remain on paper and cannot go beyond formalities." (P9)*

> *"I know that although some initiatives have been taken by Turkish Higher Education Quality Council, most of them remain on paper and many departments of universities cannot be accredited." (P10)*

In summary, nearly half of the participants indicated a limited understanding of quality studies in higher education. Conversely, the remaining participants demonstrated a more nuanced knowledge, particularly centered around topics such as the Bologna process and accreditation standards. This demonstrates the varying levels of awareness and expertise among participants regarding quality studies in higher education.

Discussions, Conclusions and Recommendations

The first finding of the present research pertains to participants' perspectives on the concept of higher education quality. The majority of participants view higher education quality in terms of international recognition, with a strong emphasis on producing scientific research and having qualified academic staff. This finding suggests that participants perceive quality in higher education as a multifaceted

construct encompassing various factors, and they associate quality primarily with attaining international recognition. Hughes (1988) stated that quality indicators in education differ from person to person. Similarly, Cheng and Tam (1997) stated that educational quality has a multidimensional structure and cannot be handled with a single indicator. In this context, the present finding seems to be in line with the literature in terms of the diversity of the participants' views on quality. Furthermore, the findings of this research align with the findings of Topsakal and İplik (2013), who similarly observed that university students associate perceived quality with the competence of academic staff. Devecioğlu (2015) stated that the recognition of universities can be achieved not only through national research but also through international publications and studies, and emphasized the importance of universities becoming internationally respected institutions. Therefore, it can be argued that higher education institutions should prioritize policies aimed at achieving international recognition. Douglas et al. (2006) stated that the academic dimension is the main service offered by universities and greatly affects student satisfaction. Consequently, recruiting proficient academic staff can significantly improve the quality of higher education by elevating the standards of scientific research.

Regarding the second research question, an analysis of participants' perspectives on the attributes of a quality university revealed a recurring emphasis on several key factors. These included the presence of qualified academic staff, the adequacy of physical infrastructure, the availability of social facilities, recognition and the quality of education and instruction programs. This finding is consistent with the results of Tayyar and Dilşeker's (2012) study, which indicated that academic staff is the most influential variable affecting student satisfaction in universities. Moreover, Kalaycı et al. (2011) concluded that the concepts that students associate with quality are well-trained academics, strong academic staff, physical structure suitable for the requirements of the age and the environment necessary for socialization. Özer et al. (2011) argued that so as to increase the quality in higher education, physical strengthening and personnel improvements should be made in addition to structural arrangements. Hacıfazlıoğlu (2006) emphasized that the effectiveness of teaching activities within an institution is closely tied to the quality of academic staff. The author highlighted the significance of carefully selecting and adequately training teaching staff in universities. Ekinci and Burgaz (2017) underscored the significance of international recognition, noting that universities pursue this path to showcase their service quality. Bakioğlu and Hacıfazlıoğlu (2016) emphasized that the basic standards of the quality

cycle in higher education are education and instruction, academic staff, administrative structure, management and physical facilities. In this context, the findings of this study align with the existing literature, as students' perspectives on the attributes of a quality university mirror themes commonly highlighted in scholarly research. The research findings suggest that both the Council of Higher Education (YÖK) and universities should implement improvements and adopt measures aimed at enhancing the quality of services provided, as part of their quality development initiatives.

As a response to third research question, half of the participants claimed that the current higher education quality in Türkiye is not sufficient. The rest stated that the quality of higher education varies according to the university and the region where the university is located. Commonly perceived negativities regarding the quality of higher education among participants include financial problems, inadequate academic staffing, limited university autonomy, and challenges faced by provincial universities. A series of studies in the literature argue that the numerical growth in the number of institutions brings along some problems in terms of academic and administrative staff, which negatively affects the quality of higher education. For example, Özer (2013) underscores that the concentration of academic staff in major cities leads to imbalances among universities, resulting in a decline in both educational and academic quality. Arap (2010) contends that there is a lack of systematic planning in the establishment of universities, highlighting that the simultaneous establishment of a large number of universities imposes a significant burden on the country's budget and leads to challenges in financing resources. Doğan (2013) asserts that newly established universities have problems in providing students with sufficient socialization opportunities and quality of life. Altınsoy (2011) argues that institutions located in major urban centers prioritize enhancing service quality within a competitive environment. They gain advantages by leveraging the opportunities available in their surroundings. In addition, it is also known that these universities are more preferred by students because they have fewer problems concerning academic staff and infrastructure. Özer et al. (2011) emphasized that the higher education system in Türkiye currently operates under a centralized structure and advocated for universities to transition towards greater autonomy. In this context, it is crucial to identify and implement policies that will empower all higher education institutions to deliver quality services.

Addressing the fourth research question, this study unveiled that participants' perspectives regarding the future quality of higher education in Türkiye predominantly

lean towards the notion that future quality will not surpass the current state. Çetinsaya (2014) states that there are optimistic and pessimistic views about the current situation and future of universities today. The pessimistic views of the participants primarily stem from concerns related to universities' challenges in adapting to innovations, the centralized structure of higher education, shortage of academic staff, and insufficient planning. Arap (2010) emphasized the importance of economic, physical and personnel preparation phases for universities to become qualified institutions and stated that it does not seem possible for newly established institutions to reach the basic criteria that they should have in the short and medium term. According to Özer et al. (2011), higher education in Türkiye is undergoing a growth phase, cautioning that rapid growth can also bring challenges. They emphasized the importance of taking careful steps to improve quality in the face of this growth. The accelerated expansion in higher education has underscored the need to enhance the quality of education and research. In this context, it can be argued that restructuring quality processes is necessary to enhance the competitiveness of Turkish higher education system in the international arena and to address societal needs. As long as these processes are not improved and current practices continue, it appears unlikely for the Turkish higher education system to attain a satisfactory level (Çetinsaya, 2014). Given the ongoing expansion of higher education in Türkiye, it becomes imperative to establish an effective quality assurance mechanism within higher education. This is crucial for enhancing international recognition of universities, positioning them as esteemed institutions globally in the scientific realm, nurturing the development of academic staff, and meeting the evolving needs of students and society.

The final finding of the current research is the limited knowledge of participants regarding quality studies in higher education in Türkiye. Almost half of the participants expressed a lack of substantial knowledge about quality studies. Conversely, the other participants exhibited a focus on topics such as the Bologna process, accreditation standards, and the Turkish Higher Education Quality Council. This situation can be interpreted as that the knowledge of doctoral students about quality studies in Türkiye is limited to basic concepts. Özer et al. (2011) highlight the absence of accountability mechanisms of universities to society as a primary concern within higher education in Türkiye. In light of this, it is crucial for universities to engage in transparent communication with all stakeholders, particularly students, regarding initiatives aimed at enhancing service quality.

While quality in higher education has been extensively discussed at a theoretical level, there is a noticeable scarcity of studies that delve into this issue from the perspective of various stakeholders. In this context, conducting various studies that explore the concept of higher education quality from the viewpoints of students is crucial. This allows universities and policymakers to take into account these perspectives in their efforts to enhance the quality of higher education. Similar studies should be conducted with faculty members, administrative staff and undergraduate students to obtain more findings in order to make more robust analyses on the subject. Quantitative and mixed model research addressing the concept of quality in higher education can also be conducted. The limitation of the current study being conducted with participants from a single higher education institution is acknowledged. It is deemed essential to conduct similar studies across different universities to ensure robust and comprehensive data collection.

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THE IMPORTANCE AND PLACE OF WRITING AWARENESS ACTIVITIES IN PRE-SCHOOL EDUCATION AS PART OF SCHOOL ADAPTATION AND EARLY LITERACY

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Abstract

In this study, factors that have an impact on adapting to school have been examined. The importance of early literacy education and the variety are also discussed. In many studies, early literacy skills will have a profound impact on future literacy and academic skills. The social and academic impact of the classroom event on children is discussed in this context. Early literacy education has improved the development of children in all areas. In this context, families have been identified as a result of research that requires children outside the school to support early literacy education.

Keywords: preschool education, write awerness, skills development, school compliance, early literacy

Introduction

The preschool education institution is the institutions where children benefit from formal education for the first time. Some children start this process earlier, some start a little later, and some children do not benefit from preschool education. For every child who has benefited from preschool education for at least a year, it is only possible to get out of a safe home environment and start, continue and continue pre-school education, to have a happy and self-made process at that institution, but to adapt to school (Polat,

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2021). From a broader perspective, it prepares the grounds for children to become themselves by preparing them for social life and supporting their holistic development. It is also an important point in communicating correctly and effectively with individuals in the social environment and environment. Compliance is expressed as the participation of children in school and education activities in the broadest definition (Chase, Hilliard Geldhof, Warren and Lerner, 2014). According to Garcia-Sellers (1999), school compliance, family expectations and orientation, child cognitive and sociological characteristics, family and school harmony and school-provided support are expressed in a harmonious way.

In the literature, children who can establish and maintain balanced and effective relationships with themselves and their environment are identified as "children who are compatible", "children who have difficulty in establishing and maintaining balanced and effective relationships with themselves and their environment (Doğan, Kelleci, Sabanciogullari and Aydın, 2008). School adaptation can be complicated within the framework of children, family, society, school.

The reason for this complexity is that the concept of adaptation to school is not clearly understood by individuals, that there is insufficient knowledge of the expectations of family, school, society and child, and that stakeholders cannot continue to work together. According to Margetts (2014), for children and their families who have just started school, the school includes adapting to a number of new experiences and expectations related to physical, social, emotional, academic environments and gaining new identity and social status. Adaptation to school involves responding to the diversity of children and families entering the school as well as to the community context within the school. The most clear information about whether the school adaptation process has been successful can be obtained from the child.

We can review the factors that affect school harmony in three headlines:

Children related Factors in School Compliance:

In some studies related to the school compliance process, it is stated that compliance varies according to gender. But what's important here is not gender, it's teacher's way of taking into account the individual differences of children.

In the research, where relations between age and school compliance are examined, there is a significant difference in the likelihood that there will be an increase in

developmental maturity with age and the possibility that another orchid had previously benefited from education (Gülay-Ogelman and Ertan-Sarıaya, 2013; Kaya and Akgün, 2016). According to this information, teachers should set expectations in accordance with their age and development levels. They should, in addition, be able to activate the school adaptation process by supporting the development of children according to their preparation.

Yoleri (2014) found that the tempers of children have an important relationship with school harmony and academic success. As a result of all these research, all of the children's biological, personal and social characteristics are related to school compliance. In order to adapt to the school, individual differences must always be studied without being ignored by a holistic point of view.

School Compliance Factors:

Children who are starting school in the process of adapting to the school need to work in coordination with school administrators, teachers and staff to get out of the house and feel safe in school, which is the safest environment for them (Polat, 2021). Research has shown that the school climate has significantly affected the psychoeducational development and school adapts of children. In addition, the school's acceptance of the child is one of the key factors in the process of adapting to the school. The school should accept the child and the school administrators and teachers should have detailed academic and practical knowledge of school compliance. Because to fit into the school, the pre-preparation of the school, the pre-knowledge of children and families, a program on school compliance, an early intervention program for children who are at risk of adapting to school, and possible solutions to the problem of adapting to the school (Polat, 2021). Activities in the early weeks of school have an important impact on children's adaptation to school.

School family cooperation, peer relations, the physical suitability of the school for the development and safety of the child, the attractions and curiosity of the child in educational environments, and the ability to support their development, are one of the features that we can explore under the topic.

Home/Family Factors in School Compliance:

According to research, the child's safe connection to the mother facilitates school compliance. Parental attitudes also have a significant impact on school compliance.

For example, it negatively affects the social skills and school compliance levels of parents with authoritarian parental attitudes and parental attitudes. It is known that parental behavior and attitudes are effective in developing many skills that will ensure children are easy to fit into school. These factors are skills in social and emotional areas such as the development of child's empathy skills, socialization skills, social skills, commitment status, self-control and self-regulation skills. Because children model their families through their development process (Polat, 2021).

SCHOOL IS READY AND EARLY LITERACY

School readiness does not mean that just keeping the pen right, knowing the numbers, or developing cognitive skills. Being ready for school is a wide range of attention, being able to go to the bathroom without help, sitting at a certain distance and upright, cooperating with friends, staying away from home/family during school hours. Readiness to write is defined in the MEB Pre-School Education Program (2013) as “a whole of the work that is equally supported in all areas, including social and emotional, motor, cognitive, language and self-care skills during the time children continue to preschool education institutions”. It is important for children to be ready for school, to have emotional maturity that can meet the requirements of primary school, to manage themselves and their relationship with other children in the classroom. For children who have not developed enough skills in these matters, their chances of academic success are also reduced.

For families, it has priority meanings such as meeting the school's requirements and becoming independent from the family, and developing self-care skills for teachers and developing skills that can adapt to classroom activities (Grimmer, 2018).

The concept of early literacy was first discussed by Clay (1966) and defined as “reading and writing development in early childhood” (Çetin, 2019; Polat, 2021). Whitehurst and Lonigan (1998) expressed the concept of early literacy as the skills children have gained from pre-reading experiences before they entered the literacy process. Stagelin (2002) described this concept as "literacy skills acquired by the child in the period before taking formal literacy training, in efforts to understand the written and verbal language." However, the concept of early literacy was expressed as a general name

for everything children know about reading and writing from birth before active participation in the reading process.

Stating the concept of early literacy as a process in which the relationship between the skills of children to be able to read and the skills necessary to start reading is established, Gupta (2009) stated that early literacy skills are vocabulary skills, vocabulary, voice awareness, visual differentiation skills, letter awareness, he expressed it as writing awareness and understanding skills. According to him, these skills help the child to more easily adapt to the reading and writing process and learn more easily to read and write. Through pre-school education, during the fastest period of brain development, the child is presented with rich life and supports the development of the child and increases mental functions. It also positively supports self-perception, personality structure, creativity, communication skills and social emotional harmony by influencing social, emotional, physical, language and all other development areas. With all these support, a good start to the child's life is being made and it has felt its impact for the rest of his life (Dry Turan, 2007).

The quality of the child's experience in early literacy in the preschool period is one of the key factors in their future potential to be competent literate. Early literacy skills are seen as one of the key prerequisites to be a good reader.

THE DEVELOPMENT OF EARLY LITERACY SKILLS

Reading ability is one of the requirements that support and provide the individual's lifelong learning. The early childhood has a critical period in terms of the development of their ability to use language accurately and fluently, listen, understand what they are reading, gain reading habits, express themselves verbally and in writing. From early childhood, the thinking, cause-effect relationship building, sorting, generalization, visual-auditory differentiation and language skills of children are developing (Cevher Kalburan, 2010).

In early childhood, the child's early literacy awareness develops at different stages according to age. As soon as they're born, babies are beginning to learn about literacy. First 0-3, he can recognize certain books on his cover, keep the book right, listen to the story, and produce drawings similar to writing. In this process, children continue to configure their knowledge of verbal language and literacy through their home, school

and social lives (Wortham, 2006). Children aged 3-4 know that letters in the alphabet have names and are different from their pictures (Çetin, 2019).

However, they recognize some environmental writings, tell stories through images or images, answer questions about the story being told, and sort the events that are in the story. At this age, the child is focused on an object, recognized the voice, recognized the writings he saw, experimented with various paints and pencils as part of early literacy (Whitehurst & Lonigan, 2001). at 5-6, children show the first word in the sentence, the first letter in the word, and a letter in the text, and recognize the rhyming and similar sounds. At this age, children can recognize and name all upper and lower case letters. When taught, they can type most letters and names (Cetin, 2019).

Stegelin (2002) illustrated these behaviors as follows:

- 0-6 months old baby nods her head as she listens to the rhyme her mother reads to her every night while she sleeps.
- From 6-12 months to 30 months, the baby makes a pleasant sound when she sees her favorite book in the hands of her father, who comes to the nursery and day care.
- 6-12 months in a room, a child with a hard cover picks up her book and extends it to her sitting next to her, doodling.
- The little boy from 12-24 months to 6 months shows him pictures from the book while his mother reads to him.
- The little boy from 24-36 months to 6 months keeps repeating certain words from his great-brother's favorite book to him.
- The 3-year-old sits behind the car and tells his grandmother about the street signs he sees all the time on the way, and knows some of the local logos.

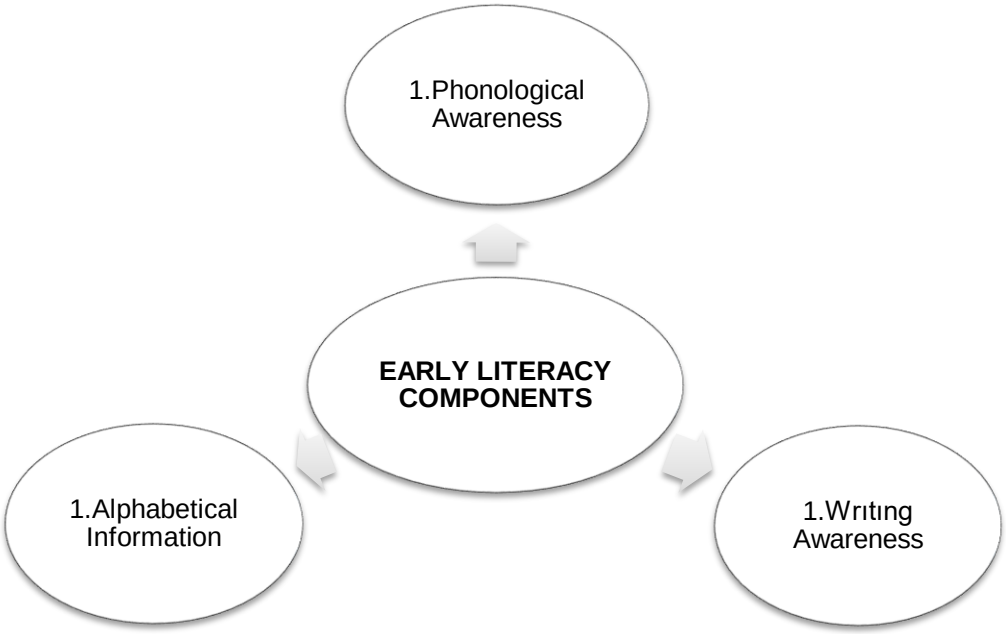
As you can see, early literacy begins with birth and develops more in the years ahead. Preschool education is the key to this development. In this process, the teacher performs planned activities to support these skills, demonstrating literacy behaviors, becoming a model and encouraging them to do so. In the meantime, children reinforce their learning by sharing with each other.

VARIOUS APPROACHES TO EARLY SCHOOL CONCEPT

From 1920 to 1950, readiness to write has been suggested as a result of biological maturation. According to this view, it is argued that there is a period in the development of the mental skills required for reading and that literacy is self-developed by the time of this period.

The concept of biological maturity began to be questioned, and the idea that children could be affected by pre-reading experiences even if they were biologically ready to read at the beginning of 1950 and 1960, the importance of experience was emphasized in preparing to read and write. In this period, the readiness approach to reading is argued that with appropriate experiences, the child's readiness to read and write will be accelerated. it was adopted that the interest of preschool children in 1970 was caused by adult role models. In this period, studies have been conducted that show that children's doodles, boots, random letters and read like a book are early forms of reading skills. As research on literacy increased in 1980, the concept of early literacy became an important part of the pre-school curriculum, given that the support of reading skills at an early age could be detrimental. This has enabled the development of reading and writing preparedness activities based on children's daily lives. Recently, media and popular cultural products have increased children's awareness of early literacy. There are many studies done on these matters. These show the power of popular culture in developing early literacy in children, from writing the names of superheroes to reading digital texts in video games. In order to use this power over children of the digital age in a positive way, it must be one of the most important tasks of teachers, families and society in short.

EARLY LITERACY COMPONENTS



Early literacy skills can be expressed in the most basic narrative as the basic skills that the child should have gained before learning to read and write (Polat, 2021). The field article shows that these skills are classified in various ways:

PHONOLOGICAL AWARENESS

Phonological awareness is a term that covers many different concepts of sound being heard in the environment as well as sounds in the language of speech. Fonological awareness includes recognizing the initial sounds in words, recognizing words in compound words, producing simple rhymes, and recognizing the rhyming words, and saying the individual units of the words made up of three sound units (Vukelich, 2008 akt; Polat, 2021). Learning to read requires a serious awareness of the sound structure of verbal speech.

Although the phonological awareness usually occurs spontaneously, it has to be part of the pre-school education to support its development.

A child with advanced phonological awareness,

- lable to define and create rhymes,
- The phrase may be spelled, spelled, and combined,
- It can distinguish between the first, middle and last sound of a word,

- He can recognize words that start and end with the same voice,
- He understands that changing the voice in a word can change the meaning of the word (Gibney, 2019).

WRITING AWARENESS

Writing awareness is stated as the development of the child's perception of the form and function of the article and understanding the relationship between written and verbal language. Writing awareness, which mainly includes understanding of written language and rules of spelling, is different from writing preparedness, and is not just about books. Writing awareness includes understanding signs, menus, logos. It is important that the child understands that there are different types of writing and that the purpose of each type is different (Ezell Justice, 2005). The development of writing awareness is created by sight and listening in the newborn period.

Especially when babies read books to themselves are about one year old, they can follow the story with the development of visual and auditory skills and begin to recognize the difference between writing and painting. By the age of two or three, children can recognize a few letters on the boards or signs they see around them (Whitehurst Loniga, 2001). Children pretend to write by giving meaning to drawings or doodles similar to writing at an early age. This behavior is one of the ways that it leads to writing awareness, and it shows that the child knows that what they wrote before learning to write is meaningful (Whitehurst Loniga, 1998 acts. Polat, 2021).

The ability of a child to show the front or back of a book, show where the name of the book is, express what the name of the book is for, show where to read, show where to start reading on the page, show a word on the page, show short and long words, show a letter, Skills such as uppercase and lowercase display and a sentence on pages are one of the skills of writing awareness and these skills gradually develop (Ezell Justice, 2005).

ALPHABETİCAL INFORMATİON

His first attempt to use the language of writing begins with the markings he made on paper, simple scribbles. The children then understand the letters that make up the language's speech and writing coding (Wortham, 2005).

At the basic level, alphabet knowledge requires the ability to distinguish letters. It also includes many functions such as attention, memory, thinking skills, problem cocking skills and learning strategies (Whitehurst & Lonigan, 1998; Çetin, 2019).

VERBAL LANGUAGE SKILLS AND VOCABULARY

Verbal language is one of the early reading skills. These skills include the ability to respond appropriately to speech, listening and events, understand the cycle in the language of speech, understand the narrative, vocabulary, understand what the word means, use complex sentence structures. Children learn vocabulary skills by talking and listening to adults.

When learning the language spoken around the child, it tries to understand the structure of the language; it takes a set of assumptions to resolve them. This way, the child develops a set of rules that are open to continuous changes and can actively play a role.

This system determines the way the child communicates and the language structures that the child uses, and is also affected by new experiences that the child has gained from communicating with the environment. Pre-school children can be developed with various activities and games, especially vocal language skills and other reading skills.

Children play games with language sounds and repeat similar things. Through these games, the child's ability to voice awareness is improved. The development of the child's voice awareness skills plays an important role in reading and writing.

READ AWARENESS: LISTENING-UNDERSTANDING-UNDERSTANDING SKILLS

It is one of the prerequisite skills of their ability to understand that they are reading listening, understanding and understanding skills. Therefore, early literacy skills are considered important. The ability to listen is defined as the ability to deduce from a text that is described or read by someone else.

Gibne (2019) defines three basic skill levels required to fully understand what is read or read:

Literary (Lithuanical) understanding:	**Subtractive (Inferantial) understanding:**	**Cognitive (Metacognitive) understanding:**

Understanding the general meaning of the text and the general meaning of the text, the main idea, the purpose. (What is this story about?)	Understanding between lines in the text that the child listens to means understanding the background information based on the information given clearly. (Did the rabbit really like the sound of the giraffe?)	The child interprets what he listens by noticing his own thoughts. (Was it true what the rabbit did in the story? Is that what I would do?)

Early literacy skills are known to have progressively improved in children who are encouraged to read books and interpret written materials in the preschool period. Whitehurst & Lonigan (1998) states that early childhood experiences with books make children realize that characters and events in books are a copy of the real life, and that these experiences improve their verbal and written language awareness.

SUPPORT OF EARLY SCHOOL SKILLS

Readiness to read is a whole part of the work that children are equally supported in all areas, including social and emotional, motor, cognitive, language and self-care skills during the course of preschool education. Work in this area should cover all areas of development from the first day the child has started the preschool education institution and be added on one another (MEB, 2013). There is an perception that readiness to read and write is only seen as work done at the table, and this perception is completely wrong.

However, studies are carried out with many different types of activities. In pre-school education, the aim is not to teach children to read and write, but to give them the skills necessary to learn to read and write quickly in primary school. It is important that children first understand the need to read and write and their relationship to real life.

This will support children to develop a positive perception of reading and school. To raise awareness and enthusiasm for literacy is crucial for the purpose of the work to be done.

To improve early literacy skills of children in the preschool period, it is essential to support the skills listed below (Oktay & forgetkan, 2003):

- Readiness skills (reading and pre-writing skills, voice recognition, attention intensification, hand-eye coordination) are required.
- Maths skills (recognize numbers 0-20, create sets, learn colors, shapes, sort, etc.)
- Scientific thinking skills,
- Motor skills (large and small muscle development),
- Emotional skills (properly articulate their own feelings, express their senses in a socially acceptable way, communicate with others and empathize with others, etc.),
- Self-maintenance skills (such as meeting their needs, cleaning, feeding, self-maintenance work, being able to protect yourself from accidents, wearing and removing clothing).

The multi-dimensional support of preparation is the support of studies that can not only be done by school but also by families at home. What we're talking about is not only family participation studies that are guided by the school, but also this multi-dimensional work that can support reading skills and school readiness in the home environment.

Results

In some studies with preschoolers, it has been determined that one of the strongest skills in estimating the reading skills children will gain during their formal reading-and-writing studies is their writing awareness (Simsek Çetin, 2014). It is stated that the development of the children's writing awareness skills started by recognizing the words and signs they often see around them, showing interest in the writing and symbols around them (Bayraktar & Temel, 2015, p. 65).

It is expressed that writing awareness is an early literacy skill developed in an environment rich in writing materials and where writing activities are frequently done, where children are given the opportunity to try writing by individuals around the child, and in the event that they are guided by the child to improve their writing awareness and interact with visual and printed materials (Kargin, Ergül, Buyukozturk & Guldenoglu, 2015; Sarica et al., 2014). It is stated that preschool is the fastest development of children, the most affected by their environment, a period where literacy skills-rich experiences can be experienced, and that the society where children interact with the community and the environment and are present is in parallel with the

literacy experience of the environment. (Ari, Bayhan, ustun & Akman, 2002; Karaman, 2013, p. 2; Şahin, 2015, p. 107).

It is also emphasized that children are aware of the effectiveness of the family and environmental factor in the learning and skills of literacy, as well as the possibility of experiencing academic, social, behavioral and emotional problems in the future with early literacy developments for children in the hazard group (Akoğlu, Ergül & Smoke, 2014; Baydik, 2003; Edwards & Willis, 2000; Erdil, 2010; Ergül, et al., 2013; Ergül et al., 2014; Gül, 2007; Kandir & Kocak Tumer, 2013; Karaman, 2013; awake & Kandir, 2010). It is expressed that children inform about the development of the level of understanding the purpose and shape of the writing, as it reflects the initial emergence of their ability to interact with writing (Yıldız, ataş, Aktaş, Yekeler & Donmez, 2015).

Discussions

The event, “I match words”, has played an important role in children's awareness of writing. Writing awareness is the basis for developing the child's perception and understanding the relationship between written and verbal language. Warner and Sower (2005) defined their basic skills before writing as “recognizing the written state of the child’s name, understanding the meaning of the writing, solving the meaning of a book through images, doodling and discovering writing”. In this event, children are targeted to gain basic skills before reading and writing. The activity during this period of awareness, in which children will notice the shapes, names, sounds and eventually words of the letter, represents the final step of these stages. In the pre-school period, the goal is not to teach children to read and write, but to prepare for reading.

This activity will guide children to learn letters in primary school, combine letters, create words, and finally establish sentences. Children will have no trouble doing this event. The activity is carried out in groups of two.

Children can do it easily by themselves. While children learn to collaborate, time will be saved. The activity is not just readiness to read and write. It is integrated into the game activity so that children can be interested and learn by having fun during the event.

Conclusions and Recommendations

It's not teaching children to read and write in preschool education. The goal is for children to have the prerequisite skills necessary to learn reading easily and quickly.

Early literacy skills include all kinds of behaviors that generally resemble children's reading and writing actions (prior, 2003; Jalongo, 2007). Early literacy skills that children have acquired in pre-school education institutions enable them to easily learn their reading and writing skills and to create a positive attitude toward reading and writing. This also supports future literacy skills (Epspinosa and Burns, 2003).

Children's readiness to read and write skills are parallel to their skills in other development areas (visual, auditory, mind, social, emotional). It is important to introduce children to books and reading and writing materials from an early age. So when we look at children's mind development, the ability to solve problems is developing, realizing that numbers, letters are represented by symbols, the imagination is expanding, learning to have a cause-effect relationship between events; in terms of language development, vocabulary expands, learns to ask questions, answer questions, recognize voices, letter-to-voice relationships, learn to use more complex sentences when expressing itself.

1. The impact of pre-school education institutions on children's writing preparation and writing awareness skills has a noticeable effect. For this reason, it is necessary to put more emphasis on the work to ensure that pre-school education is covered in compulsory education and to allow children to prepare for further education levels.
2. In-service training programs can be organized to improve the knowledge of reading preparation work of preschoolers and primary school first-class teachers, improve attitudes and behaviors in the face of special circumstances, and determine the situations children need in preparing to read and write.
3. They can co-operate in reading and writing preparation of preschool teachers and primary school primary school teachers to organize activities that will ensure each other's continuity. In order to ensure that this continuity is healthy, workshops can be organized that teachers can share with the program about their work.
4. It is recommended to do research that compares the impact of scripted play and interactive book reading methods on writing awareness skills.
5. It is recommended that this relationship be supported and developed by doing research that addresses its development over time to establish the relationship between writing awareness and reading writing.

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EXAMINATION OF 3D DESIGNS PREPARED IN TİNCERCAD PROGRAM IN TERMS OF SUSTAINABILITY AND ITS RELATION WITH CREATIVE THINKING

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Abstract

This study examines the perceptions of 8th grade middle school students towards the concept of sustainability in the context of their 3D designs and how the creativity of students who make 3D designs is related to 3D design making. In the study in which exploratory sequential design, one of the mixed method designs, was used, 24 students studying in the 8th grade represented the study group. The data collection tools were the 3D designs made by the students for sustainability, the Scientific Creativity Scale and semi-structured interviews to determine the students' views on sustainability and the process. When the designs of the students are analyzed; renewable energy sources, recycling, clean environment and green space are emphasized. It is seen that there is a moderate, positive and significant relationship between the students' creative thinking test scores and their average scores from 3D designs.

Key words: 3D design, creativity, sustainability, sustainable development.

Introduction

In the current century, many new concepts are being constructed as well as re-evaluating existing concepts (Ülker & Yalçın, 2024). Sustainability is one of these concepts. The concepts of sustainability and sustainable development emerged with the realization of the deterioration of the natural balance in the face of human needs (Suna, 2023). The use of the concept of sustainability in the literature dates back to the 18th century. It gained its current recognition with the "Our Common Future" report

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published by the United Nations' World Commission on Environment and Development in 1987 (Wiersum, 1995). In this report, sustainability is defined as "meeting the needs of the present generation without compromising the ability of future generations to meet their needs" (WCED, 1987, p.27). In addition to ensuring continuity, sustainability aims to ensure the longevity of limited natural resources used to meet human needs (Özgen, 2019). While ensuring the continuity of resources in a sustainable life, it is also aimed to achieve prosperity in human life (Gökmen, Solak, & Ekici, 2017). Sustainable development is a result/product, while sustainability is a process (Akgül, 2020). The idea of sustainability is a multifaceted concept that includes economic, environmental and social dimensions (Kılıç, 2012).

For the existence of sustainable life and the realization of sustainable development, this issue is addressed in many different fields, especially in the field of education (Suna, 2023). The concept of "sustainable development education", which is frequently encountered today, offers solutions to the damage to nature and the environment through education (Korkut Demir, 2023). Today, one of the most important duties of individuals is to carry out nature-human interaction without negatively affecting the natural balance and to leave a more livable world to future generations. Raising individuals who have undertaken these duties is only possible through education (Engin, 2010). Individuals, institutions, societies and countries acting in line with common goals for sustainable development, protecting and developing our environment and preventing problems that may occur in the future will be provided by sustainable environmental education (Akgün, 2021).

Education for sustainable development can provide opportunities for critical thinking, greater awareness and greater empowerment, which are necessary for exploring new visions and concepts and developing new methods and tools (UNECE, 2004). Recognition of the importance of education for sustainable development came in 2002 when the UN declared the period 2005-2014 as the "Decade of Education for Sustainable Development". Today, many educational organizations all over the world are working on the direction of education programs to include sustainability (UNESCO, 2005). In our country, sustainability is among the concepts that individuals should acquire in the 2013 Science curriculum (MoNE, 2013). The Ministry of National Education Science Curriculum was updated in 2018 and 10 objectives were determined. When these 10 objectives are examined, there are four objectives

emphasizing sustainable development education and these objectives are given below.

1. To recognize the interaction between the individual, the environment and society; to develop awareness of sustainable development of society, economy and natural resources,
2. To adopt scientific process skills and scientific research approach in the process of exploring nature and understanding the relationship between human and environment, and to produce solutions to the problems encountered in these areas.
3. To take responsibility for daily life problems and to use science knowledge, scientific process skills and other life skills to solve these problems,
4. To arouse interest and curiosity about the events occurring in nature and its immediate surroundings and to develop attitudes (MoNE, 2018, p.9).

Sustainable development is also the basis for the development of information technology in the transition to a knowledge economy. In this context, information technologies are used as a resource to facilitate the learning process and provide efficiency, as well as in evaluation processes in terms of sustainable development (Öztopçu, 2018). It is important to integrate technology into education and to realize educational practices in accordance with the requirements of the age. The increasing prevalence of computers in social life shows that the future will be more complex and advanced than today. The fact that individuals have the skills to recognize and use computers helps them keep up with the world (Yüksel, 2015).

It is important to prepare environments that will focus on providing students with design and production skills and to create processes for the development of these skills (Çetin, Berikan, & Yüksel, 2018). In recent years, researchers in the field of education have been working on fun environments and activities that emphasize design and production processes in order to gain these skills (Selena & Neil, 2017; Somyürek, 2015). 3D design environments are one of these environments. Three-dimensional modeling of objects using computer graphics through special programs is defined as 3D design (Dizman, 2018). 3D design is also defined as 3D modeling of objects using realistic dimensions and depths in a virtual environment (Pakman, 2018). Tinkercad is a free online 3D modeling and design tool that is web-based and can be accessed through an internet browser. A three-dimensional design platform established in 2011, millions of designs have been made so far and this number is increasing over time. Individuals such as teachers, students, designers, adults, and children can use the

software to create prototypes, houses, toys, home decorations, Minecraft models, jewelry and jewelry designs, and any other design they want easily and simply. The Tinkercad program used in the research is an easy-to-use and enjoyable tool among the programs used to create 3D designs (Dere, 2017).

Students can make 3D design to produce a solution to a problem in their environment. 3D design can develop students' creativity and make learning in education concrete and permanent (Dizman, 2018). In addition, 3D design efforts develop analytical thinking methods and decision-making power in individuals (Allen, 1978). The design process has parts such as situation determination, analysis, definition, elimination, implementation and evaluation. Since the perception styles of individuals who watch and use the design are different, there is an interaction between design, designer and user (Gümüş. 2015). From this point of view, one of the aims of this study is to examine the perceptions of middle school 8th grade students towards the concept of sustainability in the context of 3D designs.

Creativity, which has been a subject of curiosity for many years and the subject of many researches, has an impact on educational policies today (Gençer, 2023). Creative thinking is defined by OECD (2019, p.8) as "the ability to participate productively in the generation, evaluation and improvement of ideas that can lead to original and effective solutions, advances in knowledge and effective expressions of imagination" (Caynak, 2024). Creative thinking skills are very important for individuals to produce solutions to new situations, to communicate effectively, and to produce useful ideas, ways or alternatives to improve themselves (Karlıdağ, 2018). Creative thinking skills enable individuals to produce solutions to problems that they have encountered before or have never encountered in their lives (Doğanay, 2000).

Creative thinking is a way of thinking that seeks innovation, can bring new solutions to problems, is inventive and unique to the individual (Özben & Argun, 2005). Individuals who think creatively are able to predict the events they experience and show a systematic approach to the problems they face (Aslan, 2016). Creative thinking, as an important quality unique to human beings, is of interest to many branches of science (Dikici, 2006; Erten-Tatlı, 2017; Katılmış, 2024). Torrance (1974), one of the pioneers of creative thinking skills in the literature, defines creativity as "Being sensitive to problems, inadequacies, lack of knowledge, unavailable elements, incompatibilities; identifying difficulties, searching for solutions, making predictions and hypothesizing about deficiencies or changing hypotheses, choosing one of the solutions and trying,

retrying, and then revealing the results." When the literature is examined, it is seen that scientific creativity has four main dimensions (Chien & Hui, 2010). These dimensions are: fluency, flexibility, originality and elaboration.

Fluency

According to Torrence (1980), fluency is the ability to find the maximum number of thoughts, ideas, alternatives or solutions on a concept or topic within a certain period of time (Torrence and Horng 1980). When another definition is examined, the fluency dimension is the individual's ability to successively list the alternatives that can solve the problem when faced with a problem. In this case, the more the number of solution alternatives produced, the more fluency the individual is considered to have (Önder, 2017). Activities such as brainstorming are used to develop the fluency dimension of creativity, and the use of such activities, especially in childhood, is very important for the development of creativity (Kandemir, 2006).

Flexibility

Flexibility dimension refers to the ability to think in a multidimensional way away from uniformity by adapting to changing situations (Öncü, 1989). In other words, flexibility is defined as the ability to generate ideas that can be categorized in different fields or the ability to change ideas and approaches (Yenilmez & Yolcu, 2007). A person with developed flexibility can adapt to new situations without difficulty and can easily switch from one behavior or approach to another (Oğuzkan, Demiral, & Tür, 1999).

Originality

This dimension of creativity is defined as the ability to produce ideas or solutions to a problem or issue that have not been tried before and can be called different (Öncü, 1989). Looking at another definition, Üstündağ (2014) associates originality with "making an invention" unlike other definitions. According to Üstündağ, originality is the ability to produce new and different ideas and, as a result, invaluable products and ideas (Üstündağ, 2014).

Elaboration

The elaboration dimension of creativity also appears in the literature with titles such as capacity to deepen, enrichment and elaboration (Gençer, 2023). The elaboration dimension includes many skills that affect each other, such as the ability to think in multiple ways, to look from different angles, to empathize, and to think in reverse (Kuru Turaşlı, 2020). Elaboration, in its most general definition, is the capacity

to change, develop and beautify an idea or thought by adding details to it (Kontaş, 2015). The extent to which a person's elaboration dimension is developed is related to the extent to which he/she can enrich and elaborate the answers he/she gives about a subject or the solutions and alternatives he/she produces in the face of problems (Yenilmez & Yolcu, 2007).

Creativity is considered a universal ability and it is stated that this ability, which is basically present in everyone, can be developed through education (Yavuzer, 1996; Kılıç ve Yalım,2023). Programs at all levels of formal education, from primary school to university, aim to develop creativity and creative thinking skills of individuals (Akan, 2022). It is very important to implement activities that contribute to the development of creative thinking skills, which are part of the existing potential of human beings, in learning and teaching environments (Katılmış, 2024). For this reason, creativity and creative thinking skills that can be developed through education are considered important outcomes of educational systems (Akan, 2022).

The relationship between 3D design and creativity is often emphasized in the literature. In this study, this relationship is discussed in the context of the concept of sustainability. The reason why sustainability is preferred is because it is a concept that should be acquired by individuals, it concerns future generations, and it has characteristics such as finding creative solutions to existing environmental problems. Within the scope of this study, another aim of the study is to examine how the creativity of students who make 3D designs for the concept of sustainability is related to 3D design making. It is believed that this study will contribute to the related literature as it deals with the mentioned concepts together.

Methods

Research Model

In this study, in which both quantitative and qualitative data are handled together, the research model is mixed method. Mixed methods research is an approach in which researchers integrate quantitative and qualitative data sets to better understand research problems and make inferences using the benefits of this integration (Creswell, 2021, p.2). In this study, exploratory sequential design, one of the mixed method designs, was used. The purpose of using the exploratory sequential design is to collect qualitative data after quantitative data and to provide the opportunity

to examine the research problem in more detail (Creswell & Plano Clark, 2020). Mixed research method can also be defined as the analysis and integration of data obtained by using quantitative and qualitative data collection methods (Creswell & Plano Clark, 2020, p.5).

Working Group

24 8th grade students represent the study group. Easy accessibility of the study group was prioritized. The study group consisted of 24 students, 17 girls and 7 boys.

Application

Within the scope of the research, the 3D design program was first introduced to the students and how to use the program was explained through sample applications. After the introductory lessons, the students were asked to make three designs: 'a sustainable house design', 'a sustainable shelter design' and 'a free design addressing sustainability'. Students realized their designs in the coding classroom at the school. They were given 2 class hours for each design task. During the design process, each student made their designs separately and it was tried to prevent them from being influenced by each other. During the design process, the teacher supported the students in case of difficulties caused by the program or the computer. However, no intervention was made during the design process. After these three applications, a creative thinking test was applied to examine students' creative thinking skills. Then, semi-structured interviews were conducted with six students to get their thoughts on both the concept of sustainability and the design process.

Data collection tools

3D designs

The 3D designs made by the students for sustainability constitute one of the quantitative data collection sources of this research. The elements used by the students in their designs, themes, the living and non-living figures they chose, the dimensions they emphasized on sustainability and the details they revealed their perceptions towards sustainability were discussed.

Scientific Creativity Scale

Another quantitative data collection tool, the scientific creativity scale test, was developed by Hu and Adey (2002) and adapted into Turkish by Kadayıfçı (2008). In this study, it was applied to determine students' creative thinking skills.

In the scale, fluency, flexibility and originality scores are collected in the first four questions. The fluency score is obtained by calculating the separate answers given by students regardless of their quality. The flexibility score is obtained by calculating the number of each domain or approach used in the answer. The originality score is developed by tabulating the frequencies of all the answers obtained. Students who score in the top 5% of all correct answers receive 2 points; students who score between 5% and 10% receive 1 point. Zero points are given for the other correct answers. In the fifth question, students in the top 5% of all correct answers receive 3 points, students between 5% and 10% receive 2 points, and the others receive 1 point each. The sixth question is the sum of flexibility and originality scores. The maximum score for flexibility is 9 for each correct method. 3 points can be taken from the tool, 3 points from the principles and 3 points from the way followed. As before, the originality score is calculated as 4 points if the percentage is less than 5% of the answers given, 2 points if the percentage is between 5% and 10%, and 0 points if the percentage is greater than 10%. Scoring of the seventh question apple picking machine.

Semi-structured interview

Semi-structured interviews were conducted to determine students' views on sustainability and the process. While preparing the interview questions, the developmental levels of the students were taken into consideration and the necessary corrections were made by presenting them to the expert opinion. After finalizing the interview questions, care was taken to ensure that the interview questions were appropriate, clear and understandable for the level of the students. The interviews with the identified students were recorded with a voice recorder.

Data analysis

Analysis of quantitative data

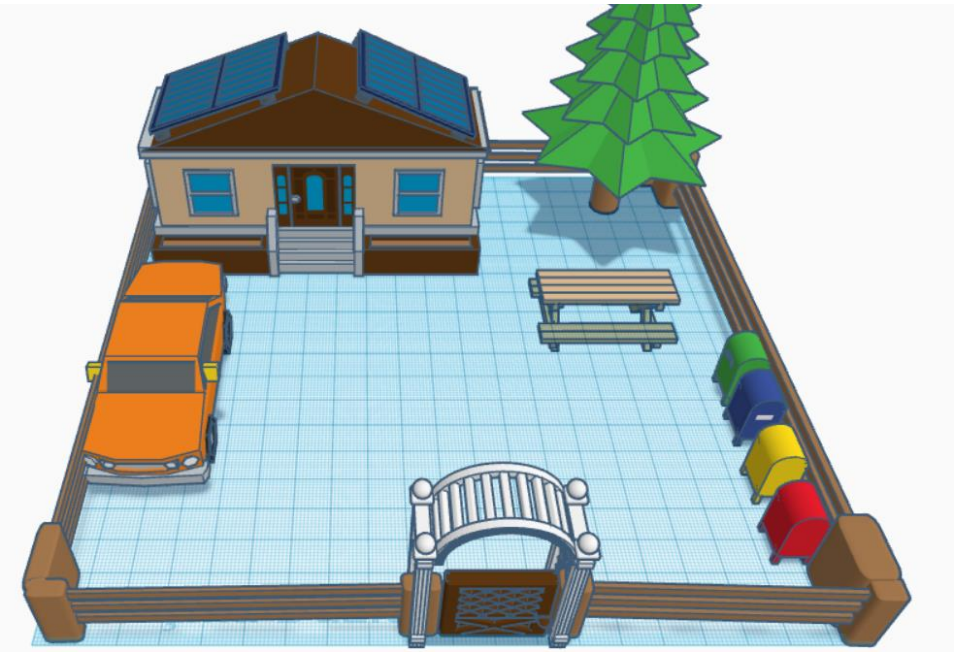
Analysis of Data Obtained from 3D Designs

3D designs were subjected to descriptive analysis. Descriptive analysis is a type of qualitative data analysis that involves summarizing and interpreting the data obtained through various data collection techniques according to predetermined themes (Yıldırım & Şimşek, 2003). General evaluations were made by looking at the suitability of the design for the purpose, detailing, composition and color emphasis. In addition, the emphasis on sustainability in the designs and the themes used for sustainability were examined. Finally, it was evaluated according to criteria such as the appropriate use of the figures used for the use of technology, the absence of unnecessary figure use, and the effective use of technology. Designs that were not suitable for the purpose of the study were excluded from the scoring. The designs were scored in the context of the determined criteria. The scoring was done separately by three researchers. Then, the researchers came together and conducted detailed studies on the designs and scoring. The scoring key created by the researchers is given in Table 1.

Table 1. 3D designs rubric

General assessment				Emphasis on sustainability	Sustainability dimension	Sustainability	Using Technology	Total points
Fit for purpose	**Elaboration**	**Composition inclusion**	**Emphasis on color**					
In this section, it is evaluated whether the student's design is made for sustainability. Scoring is done with a minimum of 0 and a maximum of 5.	In this section, it is evaluated whether elaborations such as detailing the design and explaining the design using notes are made. Scoring is done with a minimum of 0 and a maximum of 5	In this section, it is checked whether the combination of the elements in the design is random or not, whether the design elements are used in a way to form a whole or not. Scoring is done with a minimum of 0 and a maximum of 5	In this section, it is checked whether color emphasis is made while making designs. For example, using green color when designing the environment, using black or dark color tones when depicting a dirty environment, etc. Scoring is done with a minimum of 0 and a maximum of 5.	In this section, it is determined how many emphasis is placed on sustainability. And 1 point is scored for each emphasis.	In this section, it is determined which dimension of sustainability is emphasized. Environmental, cultural and economic sustainability are scored as 1 point for each emphasis.	In this section, the themes of recycling, energy saving, sustainable energy, green space, clean environment and saving are given 1 point for each theme.	In this section, it is examined whether the students use the program effectively while making their 3D designs. Their competencies in the use of the program such as using the same objects, designing unique objects are examined. Scoring is done with a minimum score of 0 and a maximum score of 5.	All the scores obtained are summed to form a total score.

How the scoring of a 3D design is made within the scope of the specified criteria is explained below through an example design.



In the design given for sustainable house design, firstly, general evaluation criteria are examined. The suitability of the design for the purpose was evaluated and it was determined that it was a suitable design for the purpose. The score for fitness for purpose is scored as 5. For the detailing of the design, it was determined as 4 because the elements in the design were designed in detail (parts of the house such as doors, windows, stairs, benches placed to show that there is a garden, etc.). At this stage, 1 point was deducted due to the fact that the student did not use the explanatory notes in the program, as it was stated that they should also use them. The composition score was scored as 5 because the elements in the design were in integrity and the design reflected a sustainable home environment and its surroundings. In addition, the color emphasis score was scored as 5 because the elements in the design were colored and the color emphasis in the recycling bins was made. It is seen that the design emphasizes recycling, clean environment, green space and renewable energy by using solar panels. Although 1 point was scored for each emphasis, the total sustainability emphasis score was scored as 4. All of the emphases made in the elements in the design were designed for environmental sustainability and received 5 points from the sustainability dimension criterion. In terms of the degree to which each of the sustainability themes is emphasized, recycling, clean environment, green space, sustainable energy themes received 5 points each. Finally, in the context of the

criterion of using technology, it was determined that each figure was used in accordance with the purpose and that no unnecessary figures were used, and it was specified as 5 points. Thus, the total score of the student who realized this design was calculated. The scores obtained for this design are given in Table 2.

Table 2. Sample design scoreboard

Name Surname		**Sustainable Home**
General Assessment	**Fit for Purpose**	5
	Elaboration	4
	Composition Inclusion	5
	Emphasis on color	5
	Emphasis on sustainability	4 (recycling, clean environment, green field, solar panel)
Sustainability	**Environmental sustainability**	5
	Economic Sustainability	
	Cultural Sustainability	
Sustainability	**Recycling**	5
	Energy savings	
	Green field	5
	Clean environment	5
	Sustainable energy	5
	Savings	
Using Technology	**Appropriate use of figures for the purpose**	5
	Lack of unnecessary use of figures	5
	Effective use of technology	5
Total points		63

Analysis of the data obtained from the Scientific Creativity Test

The data obtained from the creativity test were evaluated in terms of the flexibility, fluency and originality sub-dimensions of the answers given to each question and scored in accordance with the scoring criteria.

In order to score the scale, the frequency of students' responses to each item was tabulated. In order to calculate the originality scores, the frequency of the answers was determined and tabulated. Hu and Adey (2002), in the calculation of the authenticity score of the first four items of the scale, give 2 points to students who fall within 5% of all correct answers and 1 point to students who fall between 5% and 10%. The other correct answers receive 0 points. The scoring criteria for the questions are given in Table 3.

Table 3. Scientific Creativity Scale Scoring Criteria

Questions	Fluency	Flexibility	Originality
Question 1	1 point for each answer obtained	+1 point for each different suggested answer	Out of all accepted responses, those within 5% get 2 points, those between 5% and 10% get 1 point, those more than 10% get 0 point
Question 2	1 point for each answer obtained	+1 point for each different suggested answer	Out of all accepted responses, those within 5% get 2 points, those between 5%-10% get 1 point, those more than 10% get 0 point
Question 3	1 point for each answer obtained	+1 point for each different suggested answer	Out of all accepted responses, those within 5% score 2 points, those between 5%-10% score 1 point, those more than 10% score 0 point

Question 4	1 point for each answer obtained	+1 point for each different suggested answer	Out of all accepted responses, those within 5% score 2 points, those between 5%-10% score 1 point, those more than 10% score 0 point
Question 5	1 point for each answer obtained	No scoring	Among the answers given, 3 points for 5%, 2 points for 5%-10%, 1 point for more than 10%
Question 6	No scoring	3 points within the method tool, 3 points for principles, 3 points for the path followed	Among the answers given, those ranked within 5% received 4 points, those ranked between 5% and 10% received 2 points, and those ranked more than 10% received 0 points.
Question 7	No scoring	3 points are awarded for each separate function of the machine.	A score between 1 and 5 is given based on a comprehensive overall impression.

Correlation analysis was performed to determine the relationship between the findings obtained from the creative thinking skills test and the scores obtained from the 3D designs for sustainability.

Qualitative Data Analysis

Analysis of data obtained from semi-structured interviews

The data obtained from semi-structured interviews were subjected to content analysis. Content analysis is a method mainly used to analyze written and visual data (Özdemir, 2010). The answers given by the students were formed from codes, themes were created based on these codes and their frequencies were extracted.

Results

Quantitative Findings

Findings for 3D designs

The data obtained from the analysis of the designs made by middle school students using the 3D design tool are included. In addition, different examples of these designs are given. Data and examples for 'sustainable house design', one of the design tasks, are given below.

Figure 1. Sustainable house drawing examples

When these designs are examined, it is seen that the students include renewable energy sources with solar panels placed on the roofs of the houses in their

sustainable house designs, emphasize recycling by placing recycling bins in front of the houses, and emphasize clean environment and green space by designing green subfloor and trees in their designs. In addition to these, there are also elements for energy biodiversity. Examples of designs for sustainable shelter design are given below.

Figure 2. Sustainable shelter drawing examples

When these designs are examined; renewable energy sources, clean environment and green space emphasis are also seen in sustainable shelter design. In addition, it is seen that there is quite a lot of living diversity in the designs of the students regarding biodiversity in the designs.

Examples of the designs made by the students for the last design task, free design, are given below.

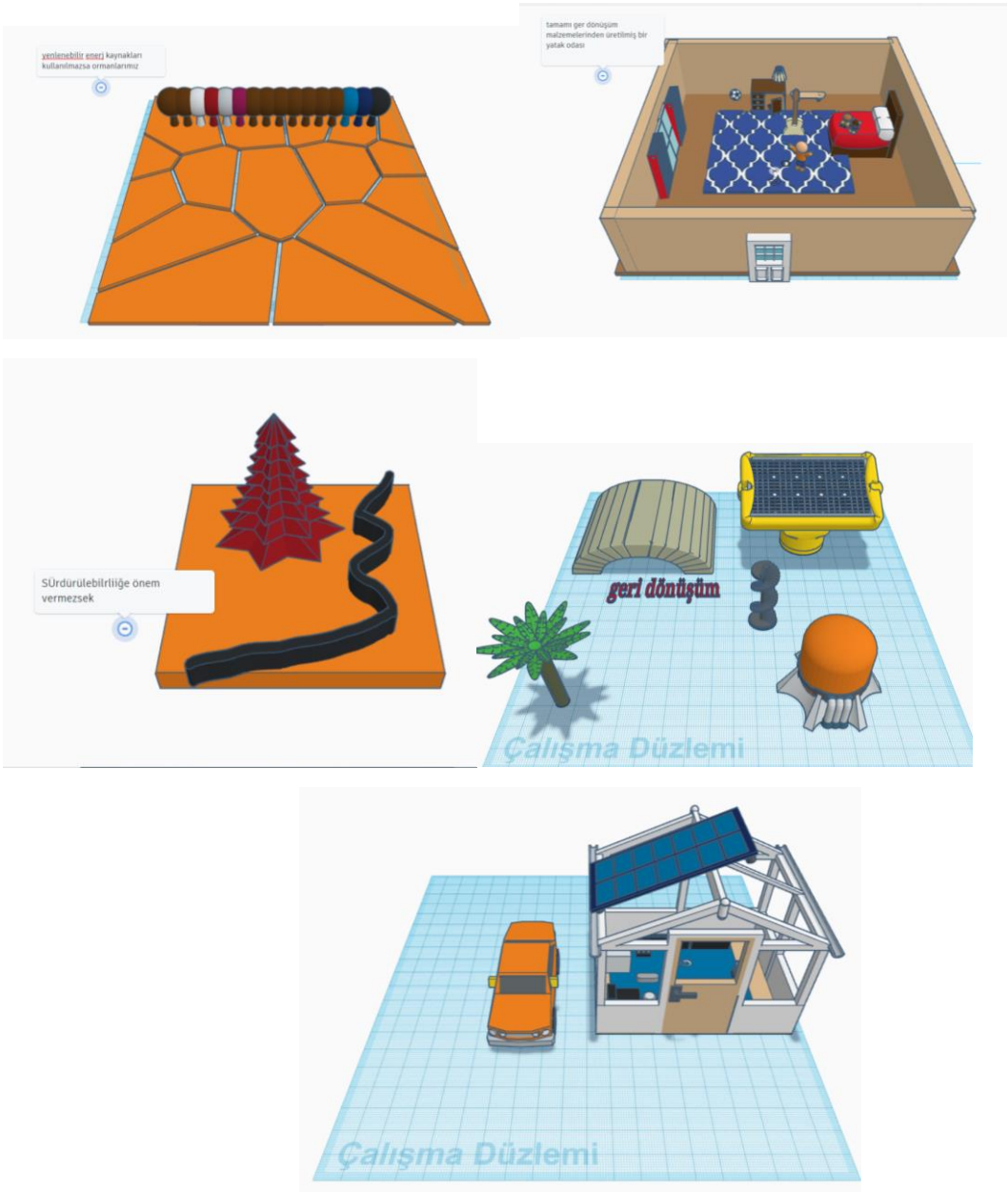


Figure 3. Freehand Drawing Examples

When these designs are analyzed; it is seen that they emphasize green space, clean environment and recycling. In addition, biodiversity and sustainable energy are also included in the designs. In the free design task, unlike the other designs, the learners also transferred what could happen if there was no sustainable life to their designs.

The average of the free designs for sustainability is given below.

The 3D designs prepared by middle school students with the themes of 'sustainable house', 'sustainable shelter' and 'free design' were evaluated separately. Then, the scores that the students received from each design and the averages of the scores were calculated. The data obtained as a result of scoring are given in Table 6.

Table 6. Findings on the evaluation of middle school students' 3D designs

	Total points for sustainable home design	**Total points for sustainable shelter design**	**Total points from free design**	**3D designs average score**
Ö1	57	49	36	47
Ö2	63	51	49	54
Ö3	53	18	37	36
Ö4	62	42	29	44
Ö5	51	53	18	41
Ö6	54	56	22	44
Ö7	44	59	46	50
Ö8	47	41	41	43
Ö9	37	26	0	32
Ö10	48	50	50	49
Ö11	42	60	51	51
Ö12	50	52	51	51
Ö13	50	44	47	47
Ö14	26	22	30	26
Ö15	50	52	48	50
Ö16	45	40	50	45
Ö17	49	45	53	49
Ö18	42	40	44	42
Ö19	50	55	45	50
Ö20	49	40	58	49
Ö21	55	50	60	55
Ö22	25	30	20	25
Ö23	39	43	35	39
Ö24	42	44	40	42

Findings related to creative thinking

Findings Related to Scientific Creativity Scale

In order to evaluate the scientific creativity test scores of middle school students, their averages were calculated. The mean scores are given in Table 7.

Table 7. Findings on the evaluation of creativity scores of middle school students

Name of student	Creativity test score
Ö1	40
Ö2	42
Ö3	36
Ö4	25
Ö5	17
Ö6	37
Ö7	52
Ö8	58
Ö9	0
Ö10	32
Ö11	43
Ö12	50
Ö13	20
Ö14	11
Ö15	52
Ö16	0
Ö17	22
Ö18	14
Ö19	24
Ö20	40
Ö21	25
Ö22	9
Ö23	16
Ö24	14

Findings on the relationship between design score and creativity

Spearman's correlation analysis was performed to determine the relationship between the mean 3D design scores of middle school students and the creativity scale score, and the results are given below.

Table 8. The relationship between design score and creativity score

		Creative thinking test score
3D Design average score	P	,632**
	P	,000

p<0.01, ρ<0.01

According to the data obtained as a result of Spearman's correlation analysis in Table 8, a statistically significant and positive relationship was found at the 0.01 level

between the mean 3D design scores of the students and the creative thinking test score ($\rho = 0.632$; $p<0.01$).

It is seen that there is a moderate positive and significant relationship between the students' creative thinking test scores and their average scores from 3D designs. According to this, at the end of the application, the scores that the students received from 3D designs and the scores they received from the creative thinking test are consistent with each other. In other words, it was concluded that the more the students' creative thinking skills increase, the higher their average 3D design scores will be.

Qualitative Findings

As a result of the content analysis of the data obtained from the semi-structured interviews conducted to determine the students' views on sustainability and the process, it is seen that 3D designs are formed based on the contribution of the 3D design process to the student and awareness of sustainability. The results of the analysis based on the theme codes and frequencies resulting from the analysis are given in Table 9.

Table 9. Findings from semi-structured interviews

	Theme	Code	Frequency
Emerging themes for design	Design considerations	Recycling	3
		Renewable energy	5
		Afforestation	2
	Contribution of designs to the environment/individual	Financial contribution	2
		Positive impact on human life	2
		Energy savings	3
		Renewable energy	1
Themes emerging for its contribution to the student	Desire to learn in a sustainable environment	Yes	6
	Contribution of the process to the student	Sensitivity	2
		Savings awareness	2
		Contribution to sustainability	1
		Learning to save	1
	Difficulties in designing	Due to the program	2
Emerging themes for sustainable environmental awareness	Sustainable Development Concept	Savings	2
		Renewable Energy	3
		Correct use of resources	1
	Ensuring economical use of resources in daily life	Yes	1
		No	4
		Undecided	1
	Taking into account the needs of future generations	Yes	0
		No	6
	Sustainable aspects of the environment	Recycling activities	3
		Efficient use of resources	1
		No use of fossil fuels	1
		Lamps with sensors	1
	Unsustainable aspects of the living environment	Lack of use of renewable energy sources	2
	Sustainable development	Positive	6
	The contribution of sustainable development to everyday life	Savings	2
		Long-lasting items	1
		Sensitivity	1
		Awareness	1
		Consciousness	1
	Individual/societal actions for sustainable development	Savings	2
		Conscious use of resources	1
		Recycling	1
		Community awareness raising	2
	Sustainability	Requirement	6

When the findings on the determination of their views based on sustainability were examined, it was determined that the students defined sustainable development as saving, renewable energy and economical use of resources. While one student defined sustainable development in terms of solar panels with the statement "*When I think of sustainable development, I think of solar panels.*", another student defined sustainable development in terms of energy saving with the statement "*When I think of sustainable development, I think of a sustainable life where we spend less energy.".*

The majority of the students (n=4) stated that the resources available in the home or school environment were not used economically. All students (n=6) stated that the needs of future generations were not sufficiently taken into account in the context of sustainability. One student said, *"We use resources sparingly, for example, we do not leave the water on while brushing our teeth. We try to save both money and water. Otherwise, there will be no water resources left for future generations."* While one student stated that resources are used sparingly, another student stated that resources are used partially sparingly with the statement *"Sometimes I use sparingly. For example, I use water sparingly. If I do not use sparingly, environmental pollution may occur."*

Students mentioned recycling activities (n=3), economical use of resources and sensor lamps as sustainable aspects of the environment they live in, while they stated that the lack of renewable energy sources and environmental pollution are not taken into account sufficiently as unsustainable aspects. One student said, *"Not very much. It is at a medium level. Sensor lamps are one of the sustainable aspects of the place where I live",* while one student cited sensor lamps as an example of sustainable aspects, and one student said, *"The unsustainable aspect of the environment where I live is that we do not use renewable energy resources sufficiently... The problem of air pollution is not taken into account in my environment for sustainability."* He emphasized the insufficient use of renewable energy resources.

Students stated that they paid attention to recycling (n=3), renewable energy (n=5) and afforestation (n=2) while doing their design assignments. Students stated that the structures such as schools, houses, and shelters they designed contributed to the environment, affected human life positively, saved energy, and included the use of renewable energy sources. For example, one student emphasized solar energy with the *statements "I paid attention to generate electricity from solar energy while*

designing." and *"I used solar energy in my design, I used a solar heating system.",* while another student emphasized recycling with the statement *"I paid attention to use sustainable items in my design. I used recycling bins.".*

A student drew attention to the benefits of solar energy with the statement *"I placed solar panels, I placed solar panels to make them useful."* Another student emphasized recycling and solar energy with the statement *"I used solar panels, I used recycling bins, I used solar panels because it saves energy."*

The contributions of the designs to the students were that they gained sensitivity towards sustainability (n=2), learned about saving and became aware of saving (n=2), and contributed to sustainability. Students stated that sustainable development brought savings (n=2), long-lasting items, sensitivity, awareness and consciousness for daily life. This was stated by one student: *"This process made me more conscious, not to spend directly, to make investments for the future and to take care of them."* While stating that the process in which they realized 3D designs brought awareness and care, another student emphasized the awareness of saving with the statement *"In this process, I learned about saving for the environment, saving energy."* Another student emphasized the contribution of this process to savings with the statement *"I learned to use what we need without wasting."*

All of the students (n=6) stated that they wanted to study in sustainable environments where they realized their designs. While the majority of the students stated that they did not have difficulty in making their designs (n=4), some of them (n=2) stated that they had difficulty due to the program.

They stated that for a sustainable society, individual and social savings (n=2) and community awareness-raising (n=2) activities should be carried out, conscious use of resources and recycling activities should be carried out. In addition, all students (n=6) defined sustainable development positively.

One student said, *"We can increase our sensitivity both individually and as a society. Studies can be done on this."* Another student said, *"Individually, we should use our energy resources correctly. We should use buses as a society to reduce air pollution."* emphasized public transportation.

One student said, "*Individually, we should not leave the faucet open and the lights on. We should do these as a society."* While another student emphasized saving

with the *statement "We should follow the rules. We should ensure everyone's economical use."* emphasized saving.

One student said*, "Since there are more renewable items, there should be a more comfortable environment where we can breathe more. We can be more conscious as a society*." Another student said, *"Even if we do nothing, we should recycle the garbage we have. As a society, we can use electric vehicles."* emphasized recycling.

Discussions, Conclusions and Recommendations

At the end of the 3D design process, it was determined that students defined sustainable development as saving, renewable energy and the economical use of resources. It was also determined that the designs focused on the environmental dimension of sustainability. When examined in the literature, it is seen that academic studies on sustainability focus more on environmental sustainability (Ergün et al., 2023). Environmental sustainability is a fundamental part of sustainable development, as it is of vital importance for all living beings on earth and represents a common interest for future generations (Furat, 2024).

Students expressed that they paid attention to renewable energy sources, recycling, a clean environment and afforestation while doing their design assignments both in their designs and in interviews. In a study in the literature, in parallel to this, when the students' reflection of renewable energy and sustainability concepts in their daily lives is examined, it is seen that they prefer renewable energy sources, draw houses intertwined with natural environments, and drawings are made for biodiversity and waste control (Akgün, 2021).

Students stated that the structures such as schools, houses and shelters they designed contributed to the environment, affected human life positively, saved energy, and included the use of renewable energy sources. In addition, there was a moderate, positive and significant relationship between students' creativity scores and their average scores from 3D designs. Accordingly, at the end of the application, the scores that the students obtained from 3D designs and the scores they obtained from the scientific creativity test are consistent with each other. In other words, it was concluded that the more the students' creative thinking skills increase, the higher their average 3D design scores will be. These results are also supported in the literature, and providing students with experiences that allow them to express their ideas in 2D and 3D enables them to establish the link between form and content of creative design ideas (Onur, Zorlu, 2017). It has been found that moving 2D and 3D objects and parts

of these objects in space increases the spatial visualization ability of individuals (Olkun & Altun, 2003). Likewise, when the literature is examined, it is seen that students define the concept of 3D design in a positive sense (Dere, 2017). In addition, robotic activities, which are highly preferred to be used together with the 3D design process, increase students' scientific process skills (Sullivan, 2008). It is seen that coding, robotics, 3D design and game design education have many benefits for students (Dizman, 2018). In addition to all these, it is seen that the applications carried out with Tinkercad, a web-based 3D design tool, are also very effective on the spatial visualization and mental rotation skills of middle school students (Dere, 2017). Considering the results of this study, it was determined that creating 3D designs can improve students' creativity. Moreover, thanks to these designs, learning in education can be made permanent (Dizman, 2018).

The majority of the students stated that the resources available in environments such as home or school environment are not used economically. All of the students stated that the needs of future generations were not sufficiently taken into account in the context of sustainability.

Students mentioned recycling activities, economical use of resources, sensor lamps as sustainable aspects of the environment they live in. Students stated that the lack of renewable energy resources and environmental pollution were not sufficiently taken into account as unsustainable aspects of the environment they live in. The literature supports the view that the needs of future generations are not sufficiently taken into account in today's society (Brundtland, 1987).

When the contributions of the designs to the students are considered, they stated that they gained sensitivity towards sustainability, learned about saving and savings awareness, and contributed to sustainability. It is also supported by the literature that activities aimed at raising sustainability awareness in secondary school students positively affect students' awareness levels towards sustainable living (Suna, 2023).

Students stated that sustainable development brings savings, long-lasting items, sensitivity, awareness and consciousness for daily life. All of the students stated that they wanted to study in sustainable environments where they realized their designs. In addition to these, the students were interviewed about how the process affected them. While the majority of the students stated that they did not have difficulty in making the designs, some of them stated that they had difficulty due to the program. It is thought that this problem is due to the fact that they have not used any 3D design

tools before. In another study, it was observed that students had problems with the 3D design program Tinkercad, which was also used in this study, such as aligning objects (Dere, 2017).

Students stated that for a sustainable society, savings and community awareness-raising activities should be carried out individually and collectively, conscious use of resources and recycling activities should be carried out. In this sense, school administrators can positively support this process by sharing their views on cooperation and participation with stakeholders in the process of developing sustainability strategies, through practices such as information meetings, joint workshops and student participation (Üzel et al., 2024).

In addition, in this study, all students defined sustainable development positively. This result is quite positive. Because in another study, it was determined that students had difficulty in revealing the importance of renewable energy in the context of sustainability (Akgün, 2021).

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