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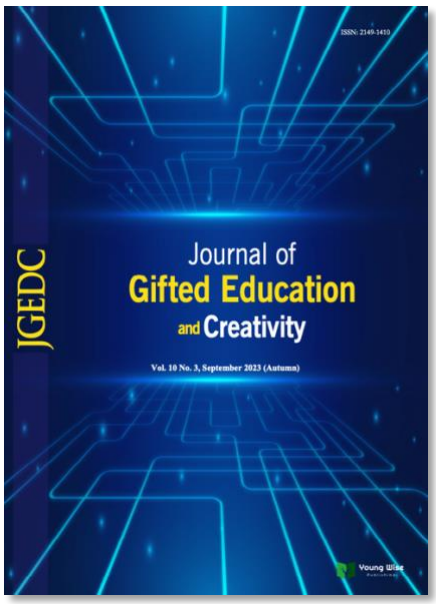

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Research Article

The failure of gifted education in Israel

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Abstract

Israel has offered free identification for giftedness test for all its students for decades. Since the early 70ies the financial burden caused by the programs for gifted students is substantial, but the results are very poor. In this article it is to be shown that neither the quantity nor the quality of programs offered to the gifted by the Ministry of Education justify their aspirations. In the last 30 years the achievements I all international examinations are low, and lately even deteriorated. Even students identified as gifted do not achieve as the top 5% of the world record students in international examinations. In addition, Israeli youths have won a low rate of international prizes. Many parents ae already aware of this situation, thus when their children are invited to participate in a gifted class choose to decline this opportunity. Israel has the highest rate of inequality in education among all developed countries. The fact that dozens of centers for enrichment gifted students are located in the periphery had not changed this situation. Quite often the Israel ministry of education sets new rules that prevent many high ability students from materializing their potential, for example, preventing high ability students from taking the matriculation examinations at an early age. In order to improve this situation research needs to be available, but research about gifted education hardly exists in Israel. There is lack of reliable research about the advantages of gifted classes in the long run. The best scientific, financial, and innovative Israeli achievements have been developed outside the education system. Computer science is the only subject learnt in school that keeps the economy of Israel ongoing, and has done so even during the covid-19 pandemic, but Israel has been developed as a high tech nation in spite of its education system rather than with its assistance.

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Introduction: The state of the art

Israel started its special education for the gifted in 1973 (David, 2017). For almost half a century substantial public money has been invested in it since then. Unlike in almost all other countries, where raising a gifted child puts a financial burden to an family's budget from the identification process throughout private education needed in order to fulfil the needs of the gifted, the identification for giftedness in Israel includes all its 2nd- 3rd graders.[2] The only exception are students learning in institutes that object to both the process of identification of giftedness and to their students' participation in the gifted program offered. These institutes include Ultra-Orthodox schools (see David, 2013a), private, Christian schools (David, 2014a, b). In some democratic and anthroposophical school, which are private, secular institutes, there

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[2] Until the second decade of the 21st century most Arab children were identified for giftedness in grade 3 and thus the Arabic special programs for the gifted started in grade 4, while most Jewish ones started a year earlier. In the year 2021 the division between children who are identified for giftedness in grade 2 and those in grade 3 has been done according to their geographical region: only children living in the northern part of Israel – where the majority of the population is Arabic but Jews consist of remarkable minority – has been identified in grade 3.

is no public policy "against" identification for giftedness, but rather lack of information given to the parents regarding this test, taken usually during the month of October of grade 2, and as a written consent from the parents is needed in most cases the schools inform the Ministry of Education that there are no candidates for the test. The Ministry of education has founded a special department for gifted and outstanding students; the only one in the whole world (Freeman, 2010). This article will show that the enormous investment of money and manpower is far from properly serving the well-being of the gifted in Israel.

Neither the quantity nor the quality of programs offered to the gifted by the Ministry of Education justify their aspirations

The so-called advantages of the investment in gifted education in Israel has already been questioned by bloggers (e.g. David, 2013c; Dracup, 2012a, b, c); journalists (e.g. Gross, 2018; Levi, 2009; Peled, 2015); parents (e.g. Daniela, 2011; Kessler, 2018); educators (e.g. Vidergor, 2010), and researchers (e.g. David, 2013d).

The failure of gifted education

Low achievements in the international examinations

According to the following international criteria, gifted education in Israel has failed. First – the achievements of Israeli children in the international examinations have been law in comparison to all other first world countries, and have been deteriorating gradually since 1963.

Comparatively low achievements of the best Israel students: Israeli students identified as gifted do not achieve as the top 5% of the world record students in international examinations

It should have been expected that in the PISA and TIMSS examinations at least 5% of Israeli students, those identified by the Israeli ministry as gifted or excelling (Excelling students – definition and characteristics, 2021), will achieve, in average, as highly as those of percentile 95 in the international examinations. This has not been the situation in the last 20 years.

- In 1999, percentile 95 students in Israel had the lowest mathematics achievements among percentile 95 students in ALL developed countries. Among the countries participating in the Third International Mathematics and Science Study at the Eighth Grade only Turkey, Jordan, Macedonia, Chile, the Philippines, Morocco and South Africa the top students scored lower than in Israel (Mullis et al., 2000, Table D.1). Only 5% of Israeli students scored at percentile 90 in this examination (ibid, exhibit 1.6).
- In 2006 Israel cored third among all 57 examined countries in within-school variance in the PISA examinations (OECD, 2007, Figure 5). Unlike in the two other countries with a similar level of inequity, where such inequity was accompanied with high a substantial amount of high achieving students - in New Zealand 4.0% and in the US 1.5% reached level 6 in science, only 0.8% of the Israeli students reached this level (ibid, table 1). That means that the reservoir of excellent students, many of which must have been gifted, is just about one fifth of that in New Zealand, half of that of the US, and practically smaller than in all developed – as well as many developing countries (ibid).
- In the TIMSS 2007 only 4% of grade 8 Israeli students reached the advanced benchmark – 625 points – in mathematics. All other European and non-European countries had higher rates of students at this level (Mullis et al., 2008, Exhibit 2.2). In that year the Israeli "sample" included less than the 90% minimal requirement, and thus is should have been assumed that the actual situation had been much worse, as the "weak" schools had been excluded by the headmasters refusing to participate (ibid, Appendix A).
- In PISA-2009 the percentile 90 Israeli students scored in reading less than the OECD average (OECD, 2010b, table 1.2.1.9 Part 1/1]: Mean score, variation and gender differences in student performance on the reading subscale non-continuous texts). In mathematics the results had been much worse: percentile 95 Israeli students scored just 615, 31 points below the OECD percentile 95 student, and exactly as the percentile 90 OECD

student! (ibid, table 1.3.3. part 1/1: Mean score, variation and gender differences in student performance on the mathematics scale). But the worst results were in science: percentile 90 Israeli student scored 590, in comparison to the 625 of the percentile 90 OECD student; percentile 95 student, who was expected to shoe at least "excellent" results, being identified as "gifted" or "excellent" by the ministry of education, scored 623, less than percentile 90 OECD student, and34 points less than the percentile 95 OECD one! (ibid, table 1.3.6: Mean score, variation and gender differences in student performance on the science scale).

According to OECD (2019),

- [...] over 25% of students, or more than 1 in 4 students, in 10 OECD countries – Chile, Colombia, Greece, Hungary, Iceland, Israel, Luxembourg, Mexico, the Slovak Republic and Turkey – performed below Level 2. (Figure I.5.1) (ibid, p. 92).
- In PISA 2018 the coverage of Israeli students had been compromised by two main reasons, the non-inclusion of ALL Ultra-Orthodox boys as most Ultra- Orthodox girls, as well as many Arabs (David, 2021b). Ultra-Orthodox Jews consist of about 15% of Israeli population and about half of it are under 16 (Statistical Report of Ultraorthodox (Haredi) society in Israel, 2017). In addition, more than 15% of Arabs living in Israel were not included in the sample; the East Jerusalem students, where the population is over 300,000 in comparison to ~2,000,000 Arabs who are Israeli citizens. According to OECD (2019), the coverage of Israeli students was almost the poorest among all participants: over 10%). In all OECD publications of the last 50 years there is a note stating that: "The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law". So it can be concluded that in spite of the fact that at least 25% of Israel's weakest students did not participate, it still scored at the bottom of OECD countries regarding students whose achievements that were not good-enough for building the future of the country academically, financially or industrially.
- While the average of the top performing among PISA 2018 participants – in at least one subject (levels 5 and 6) – was 15.7%, the Israeli one was just 15.2%. The average Share of low achievers in all three subjects was 13.4%, 22.1% of Israeli students did not reach level 2in all three subjects (ibid, Table I.1 [1/2:] Snapshot of performance in reading, mathematics and science). Only 2% of Israeli students scored at level 6 in reading (ibid, Table I.B1.1 [1/2] Percentage of students at each proficiency level in reading). In mathematics the picture was not any better: only 1.8% of Israeli students reached Level 6 (above 669.30 score points) in comparison to the 2.4% OECD average (ibid, Table I.B1.2 [1/2] Percentage of students at each proficiency level in mathematics). The worst result was in **science**: only 0.7% reached level 6 (ibid, Table I.B1.3 [1/2] Percentage of students at each proficiency level in science).

In summa: it should have been expected that a country with such a developed sustem for educating the gifted would be able to help them reach at least as any average OECD country. This did not happen in any of the 4 subjects examined in any of the international examinations in the 21st century.

Israeli youths have won a low rate of international prizes

As gifted education started in Israel almost 50 years ago, it should have been expected that the rate of international prizes of Israeli students would be increasing as more and more Israeli children are identified as gifted and get gifted education. Unfortunately, this has not been the case. Gifted children are the "natural" candidates for obtaining international prizes, especially in a nation with a long tradition of excellence and nurturing talent (e.g. David & Wu, 2008). Let us see the situation in the Mathematics Olympiads from this aspect.[3]

[3] This part of the work is partially based on David (2013b).

Israel had started participating in the *International Mathematical Olympiad* in 1979. During the 80s it scored from 14 to 26; during the 90s – from 13 to 26; in 2000 – it scored 11th, but since then the deterioration was observed annually, until in 2010 it scored 53th. Furthermore: the team of 2010 included only 5 youngsters; there were not even the minimal 6 talented youngsters who were good enough to be sent to the Olympiad (IMO, 2020). In addition, between the years 1992, just after the immigration to Israel from the ex-USSR was at its peak, until 2007, when even the youngest children of the immigrating Russian Jews were on the verge of adulthood, more than 53% of the participants in the IMO were either immigrant children or Israeli-born children of ex-USSR immigrants (ibid). 3 This is an extremely high rate, as the percentage of Russian immigrant Jews reached just about 20% of the population after 20 years of immigration, while their average birth rate was about half than the Israelis, ~1.5 and 2.88 respectively (Statistics, Israel, 1995, tables 3.12 and 3.14) Thus, in spite of the intensive contribution of high quality IMO participants Israel had been able to keep its previous high math level, but finally lost its former advantage and placed itself among third-world countries.

A dramatic change has occurred in 2011: Israel reached the 23rd place (IMO, 2020). This changed had nothing to do with the ministry of education or with any gifted program; it had ALL to do with Mr. Lev Radzilowski who started coaching the Israel team and had been doing it successfully since (The coaches of the Israeli mathematics team, 2021). Israel has not recovered its standing from the 70ies, 80ies or early 90ies, when the new immigrants from the ex-USSR counties won Israel medal sequentially, but is certainly doing much better. The main contributors to these better results are by no means the ministry of education, but rather individuals who dedicate their lives for the advancement of the gifted, not necessarily those identified by the ministry of education. In addition to Lev Radzilowski his father, dr. Vladimir Radzilowski, is one of these individuals, teaching high level mathematics to children from age 5 on, pushing them onto materializing their potential, trying to make them participate in the Beno Arbel program at the Tel Aviv University, and persuading them to do their best in order to "win against Iran in brain power". And indeed, in the second decade of the 21st century the gap between Iran in the International Mathematics Olympiad and Israel has substantially decreased...

Many parents whose children are invited to participate in a gifted class choose to decline this opportunity

In 1973, when public diagnosis for the gifted started in Israel, it was the initiative of parents of gifted children, who were special education that was to supply an answer to their children's needs. In December 1973 grade 4,5, and 6 special gifted classes were opened at the Tel Aviv Graetz school, as 3 such classes in Haifa, at the Leo Baeck school. The objection of the city, supported by Jerusalem parents led to the opening of a weekly enrichment program for the program rather than special classes (David, 1997, 1998).

But this situation, of a very small number of gifted classes has not substantially changes in the last half century. As to the 2020/21 school year, there are only 7 Israeli schools with gifted classes. In 2014 22 children identified as gifted were invited to participate in the 3rd grade gifted class that was to open in September 2014 at the Rokach school in south Tel Aviv. As most of these children were living in north- and the center of Tel Aviv, only 6 children – those who were from south Tel Aviv registered and the class did not open (Kashti, 2014). Furthermore, the situation in high school regarding classes opening in the periphery is not any better. As Dattel (3/9/2018) published, in 2018 almost all gifted junior- and senior high school classes for the gifted were in the center and south of Israel. The situation has not changed since.

There is a huge demand for enrichment programs, with 56 centers for such programs functioning both in the morning – for children identified as "gifted" and in the afternoon – for those who get the excelling" label. But as "Vox populi, vox Dei" we can conclude that due to many problems in these classes, from lack of appropriate teachers, to lack of professional expert counselors, no special programs that would suit man of the students and the high percentage of children with disabilities and emotional/behavioral problems learning in these special classes, many parents whose children have been chosen to learn there, decline that offer.

In addition to the high rate of declining the offer (David, 1997, 1998, 2014c), there is a high dropout rate in these classes. No statistics is available, the reason for it can be but speculated.

The department of gifted and excelling students at the Ministry of Education as an obstruction to the development of the gifted

In the last two decades the department of gifted and excelling students has been obstructing, even blocking the academic advancement of many gifted children. The main target of this department have been homeschooled gifted who had been prohibited from taking the identification for giftedness tests offered to all grade 2 or 3 Israeli children (David, 2020a; Special programs for the gifted, 2019), participating in the programs offered to those who have been successful in theses test (ibid), and participating in many university programs for the high school gifted (David, 2020a; Trabelsi-Hadad, 8/1/2020). According to Trabelsi-Hadad (2020), in spite of their being considered "the future brains of Israel", some of them get a university degree while still in their teens, the ministry of education ordered the universities not to accept homeschooled students to the special university programs. Even the rage of the university rectors, who defined these students as "the spearhead of the scientific research in the coming years" the ministry of education requires that they "first join the public education system".

Homeschooled children and youths are not allowed to participate in the Future scientists center (2021) program, in the Alpha (2021), Odyssey (2021), or Idea (2021) programs.

The only academic program open for homeschooled students is taking courses at the Open University. Wininger (2014) mentions this possibility as an option opened for gifted students (ibid, p. 7), but in fact this is the only option opened for homeschooled students who have not been identified as gifted because of being homeschooled; the Open University is the only academic institute that does not require the "gifted label" as an entrance condition.

Double discrimination against gifted from the periphery

For many decades, students who learnt at least 2 years during elementary school in a special gifted class, did not have to take any "entrance examinations" for a high school gifted class. This policy has recently changed, and starting from the year 2022 ALL candidates for a gifted junior class will have to take the Karni institute entrance examinations (Acceptance conditions to the special high school gifted classes, 2021). But until it changes, children who do not live in the center of Israel, the only area that until now has elementary school gifted classes, even when identified as gifted in grade 2 or 3 were quite often denied acceptance to high school gifted class either due to their "failure" in the new "giftedness exams" or because there was no vacancy for them, as the other students, who did not have to take any test, were automatically accepted to the high school gifted track.

In addition, in 2013 the ministry of education has changed the identification criteria for giftedness claiming that the old system, namely, that for each of the 50+ gifted centers and the few special elementary school classes the local top 1-3% percent of the age group were chosen. In the new system the criteria became national rather than local, and thus, in just four years, the number of Tel Aviv students who were identified as gifted increased by 250%; in Haifa by 200%, but in the periphery it decreased sharply (Trabelsi-Hadad, 2017). By this decision the Ministry of education, who has declared time and again about " closing the educational gaps among Israeli sub-populations" (e.g. Glanz, 2016; The program for reducing gaps and advancing equity in the education system, 2015). While the ministry of education invests hue amount of money in so-called "closing educational gaps" programs, programs that all seemed unsuccessful (e.g. Ayalon, Bllas, Shavit, & Feniger, 2019), the gifted in the periphery, suffering already from difficulties in access to practically ALL high level educational resources as well as financial problems, experience a continuing discrimination that reduces their prospects to materialize their abilities.

Homeschooled children cannot participate either in the identification for giftedness process free to all 2nd or 3rd grade Israel students, in the special enrichment programs taken place in over 50 centers in Israel, or in the elementary – or high-school special gifted classes

One of the most common solution families of gifted children chose in order to fulfil the academic needs of their children is homeschooling (e.g.). In Israel there is hardly any literature about gifted children who are homeschooled. Searching "gifted" in MASA – the web of Mofet institute (2021) – A Center for the Research, Curriculum and Program

Development in Teacher Education, Reveals but 32 items. *Only one of these items is about gifted homeschooled students* (Ray, 2014), which is actually a review of Murphy's book (2012).

In the first two decades of the 21st century homeschooling of the gifted has become a more central issue both in Israel (e.g. Dattel, 30/8/18) and abroad. But while all over the world the increasing number of children involved in homeschooling has resulting in a huge addition of literature dealing with this subject, as well as an increase in the number of works about homeschooling of the gifted (e.g. Conejeros-Solar, & Smith, 2018, 2021; Goodowens, & Cannaday, 2018; Goodwin, & Gustavson, 2009, 2015; Kearney, 1992; Kula, 2018; Morse, 2001; Murphy, 2012; Ray, 2014). But in spite of the fact that "[...] more than one-fifth of homeschool parents surveyed pointed to their child's "special needs" as a reason for homeschooling" and a substantial number of these families "[...] choose to homeschool because of their child's advanced academic abilities" (Kunzman, & Gaither, 2013, p. 12), Kunzman & Gaither (ibid), who cite Kunzman (2007) and Winstanley (2009) stated that: "While there exists a growing body of advocacy literature and anecdotal accounts of homeschooling gifted children, virtually no empirical research is available" (Kunzman, Gaither, 2013, p. 12)

Preventing high ability students from taking the matriculation examinations at an early age

The Ministry of Education has tried its best to prevent from young talented high school students to take the matriculation examinations, which are a must for full enrollment in higher education, earlier than their peers. This situation has been going on for decades, when each new minister sets new orders, and each time they are challenged by parents. Here are some examples.

On 15 June 2005, during the 258th sitting of the 16th Knesset – the Israeli parliament, the Parliament Member Ms. Mali Polishuk-Bloch presented the Minister of Education, Culture and Sport with the following parliamentary question: Why does the Ministry of education not allow school-students who are under 16 to take the matriculation examinations in subjects they are learning with students in higher grades? Neither the Minister nor her [Limor Livnat] deputy, but her deputy sent a written message according to which: "opening such an opportunity will result in pressure to be examined earlier, and thus the cancellation of the "school-grade" concept[4] enhancing the necessity of private tutors rather than making use of school teachers, inability to give a final grade in the annual report. "(ibid). In addition, the deputy minister stated that when students are examined at an early age they have higher prospects to fail.

Ifargan (2014) reported that a 13-year old excelling in English from Tel Sheva (or Tel as-Sabi, تل السبع) the Bedouin town in the Southern District of Israel, bordering the city of Beersheba, was recommendged by both his teachers and head the school headmistress to take the English matriculation examination, The Ministry refused because of his young age. In 2014 the Ministry policy was "allowing" excelling students to take the computers science, mathematics, physics and chemistry matriculation exams in grade 10 and in English only in grade 11.

Ifargan (ibid) also states that parents of 650 excelling students had "recently" served [submitted?] **a petition** to the High Court of Justice against the Ministry of Education and its Minister, Rabbi Shai Piron, demanding to allow their grade 9 children to take the high-level 5-point mathematics matriculation examinations. The petition, served by 23 parents representing of the 650 participating in the Bar Ilan program (Blumenfeld, 2014),

In an interview with Dr. Daoud Bshouty, the first Arab Technion Professor, an expert of complex analysis and mathematical statistics, taken place before the publication of the book "the gifted Arab child in Israel" (David, 2014b), Dr. Bshouty told me that he had no matriculation certificate. Skipping two grades, he was done with high school at age 16, after taking all matriculation examinations at the **Orthodox Schoo**l in Haifa belonging to the Greek Orthodox Church, a high prestige school considered one the best in Israel (e.g. Ratner, 2004). In 2019 it scored the first in the whole country, with 100% success rate in the entitlement to the matriculation certificate, 42% rate of excelling students, 100% of the students took the high level matriculation examination in English, and the passing rate of high level matriculation examination in civics, history and Hebrew [mandatory language in all Arab schools] had been 100%

[4] Ignoring the fact that in the US the opening of opportunities to learn in a variety of levels during high school grades had n o such consequences...

(Nishlis, 2019). In 2019 this school elegantly passed the Jewish ones considered the best in the Jewish sector, among them – the Leo Baeck school, which has a gifted track starting from grade 7. In 2017 the Orthodox school the Orthodox school had the highest matriculation achievements in Haifa as well, far better than those of the Leo Baeck school (Yaron, 2017).

After failing in the Arabic matriculation examination the 16-year old Daoud Bshouty won [received?] a conditional admission to the Technion, namely, he could participate in any course he wished but was told he had to pass the Arabic matriculation examination within a year. He did not. 3 years more passed and he did not get a "passing" grade in Arabic, and thus was not entitled to the BSc he won with honors. When speaking about it with his catholic Abe the pastor had "a talk" with the dean of the mathematics faculty who had exempted Bshouty from the Arabic test so he could receive his degree, go on with his studies and started climbing in the academic ladder until reaching its top.

The fact that at each year well over 1000 high school students learn in a variety of mathematics programs while no mathematics track exists in any of the gifted programs offered by the Ministry of Education (David, 2019), is a symptom of the failure of gifted education in Israel.

Lack of reliable research about the advantages of gifted classes in the long run

As there is no quantitative research about the graduates of all gifted programs in Israel since these classes first opened in 1974, measuring the "success" or failure" of these programs by "neutral" criteria, such as academic achievements, health, or mental wellbeing, as has been done for almost a century with the Termites (e.g. Hastorf, 1997; Jolly, 2008; Zuo & Cramond, 2001), is impossible. However, here are some testimonies of graduates of gifted programs as to their feeling towards their experience of being identified as gifted by the Israeli Ministry of Education and participating in a gifted classroom.

One such testimony is hereby given by graduates of a "MOFET" Ashdod program for excellent students in math and science (Amiel-Lavie, 2018). Here is a short description of the MOFET program:

> The MOFET program has been recognized by the department of education as an acceleration school-program, and as such outstanding participating students are allowed to take the highest 5-point level matriculation math examinations I the middle of the 11th grade instead of at the end of grade 12. Mathematics teachers of the MOFET program take part in a summer continuing education program which includes advanced math problems and preparing students to the math Olympiad, and subjects related to didactics of mathematics. (David, 2019, p. 66).

According to Amiel-Lavie (2018), eight years after high school graduation most of the graduates did not choose a technological track the were trained for, some did not choose any academic educational track, and almost all of them [recall?] remember their high school experience as "difficult". Being accepted to this class was highly selective: only students that graduated from elementary school with honors were interviewed, and only some of those interviewed were invited to participate during the summer holiday in a preparatory intensive program where they studied high level physics, English and mathematics. Those accepted had a very heavy learning load; as a result, one third of the students dropped out during the 6-year track. The rate of students taking the highest 5-point math matriculation examination was 32%, double of the rate in the general population, but the price was very high. Focusing on math-science subjects designed a false ideal according to which the only way to professional success is high level math and science, and thus – that humanistic and social subjects are a compromise made for the less talented. But in spite of this brainwashing only 6 students of the 30 who started the track [and the 20 who finished it) chose an engineering-scientific track.

This article (ibid) criticized the reform that the ministry of education had announced, namely, the focusing on learning high level math as a national strategic target, aimed to improve Israeli military, technological and economic strength. The graduates who had been interviewed complained about narrowing their horizons by directing all of them – without taking into consideration their preferences – to technology and science. One of the graduates even defined

herself as "a machine, that nobody asked whether she liked what she studied or missed many of the humanistic subjects that caused her current lack of knowledge".

According to Gruber (2017),

> One might assume that Israel's low scores can be attributed solely to the weaker segments of society, and that the People of the Book's higher-achieving pupils measure up to their counterparts elsewhere in the world. But that would be incorrect (p. 3).

Had the huge system of gifted education indeed worked, it would have been expected that even if the gaps among sub-populations had not been decreased (see, for example, David, 2020b), the highest achieving students, those identified as gifted and excellent by the ministry of education and receive special education for the gifted financed mostly by the government would have done at least as well as the OECD average. But this is not the case:

> there is no evidence of a narrowing of the gap. In fact, the gap widens. For example, the difference in scores between the 91st percentile of Israel's Hebrew-language test-takers and the 91st percentile of all countries is 13 points while in the top percentile, there is a 39 point gap. The disparity between Israel's Arabic education system and the average for all countries also widens in the highest percentiles, from a difference of 126 points in the 91st percentile to one of 139 points in the top percentile (ibid, p. 4).

Namely, even those who have been identified as gifted in Israel scored 39 point less than the average OECD student. Furthermore.

> Math enrichment activity, which generally entails substantial costs in terms of money and/or time, attests to the importance that pupils and their parents actually attach to the acquisition of math skills (ibid, p. 11).

Israel scores near the top of the number of weekly math enrichment hours reported by pupils in the various countries (ibid). Extra-curricular mathematics classes are offered to the Israeli students in a variety of places, levels, grade-classes, tracks, and paces (see, for example, David, 2019). Parents' education cannot be blamed either for the failure of gifted education, as Israeli mothers are more educated and have a higher awareness of the importance of mathematics learning than almost every other country (Gruber, 2017).

The failure of gifted education elsewhere

The failure of gifted education is not unique to Israel (see, for example, Bui, Craig, & Imberman, 2014; Callahan, Moon, & Oh, 2014, 2017; Plucker, & Callahan, 2014). The failure is due to several reasons, some are similar to those of Israel but some stem from different systems, different allocation of budgets, and cultural differences.

According to Jolly and Matthews (2018a), one of the main reasons for the emerging reason for home education in the United States is the inability of the school system to cater for children with special needs, including the gifted.

Jolly & Matthews (2017) presents a qualitative work of 4 mothers who chose homeschooling for their gifted children. Each of these mothers expressed in her blog her experiences and perceptions as the main educator in charge. Slater, Burton, & McKillop (2020) came to the conclusion that about 20% of homeschoolers in Australia are gifted children whose needs were not answered by the system.

Gertel (2019), who had written a recent report on the state of the art of homeschooling in Israel, presents the subject of Israeli homeschooled gifted in a 4-line paragraph (p. 34). That paragraph is a concise summary of the Jolly, Matthews, & Nester (2013) article, which itself is but a qualitative study done by interviewing 13 families who had chosen homeschooling after multiple unsuccessful trials to get a proper answer to their gifted children in the American public education system.

Israeli high technology: Israel best scientific, financial, and innovative achievement has been developed outside the education system

Israel has been known in the world for its highly developed high technology, has been named "the second Silicon Valley" (Today's High Tech Scene in Israel, 2010), and has an extraordinarily high rate of successful start-up companies (Devi ,2007). Bill Gates had referred to Israel explicitly as: "part of the Silicon Valley" (Plocker, 2005).
Arieli (2017) reports that "[...] it [Israel] has the highest density of startups per capita in the world and is ranked No. 2 in innovation, according to the World Economic Forum's competitiveness report". Citing Andreas Schleicher, Director for Education and Skills and Special Advisor on Education Policy to the Secretary-General at the OECD, when asked how come Israel has such high achievements in high technology while such low ones in the international examinations, the answer given is:

> You dont have more talent than other countries, but I checked it out thoroughly and I think that your secret is that you know how to take advantage of talent better than others," he answered thoughtfully.
>
> There is a gap between what is necessary to excel in standardized testing and what is required to succeed as an entrepreneur and innovator.
>
> PISA evaluates students based on their ability to provide specific answers on a standardized test. Neither the Israeli education system nor the Israeli culture is good at teaching children to do this.
>
> This *shortcoming* appears to motivate children to become innovators and entrepreneurs. (ibid)

Unlike the old belief – which is still held by many – that Jews are "the chosen people" and this explains their exceptional achievement in computer's science, the cyber world and high tech in general, or that our education system has contribute to these achievements, Schleicher, the European well know expert says it in so many words: Israel in successful in the only area that the education system has not, is not and probably will not contribute to. In an area where many a time students know more than their teachers, and where many students, still in their teens and sometimes their early teens make much more money than their parents, let alone their underpaid teachers...

Adi Shaharbani, who co-founded Skycure, the cyber security company in 2012 and sold it 5 years late for over 250 Million dollars (Hatony, 2017), of which each of the 2 co-founders got 28 million (Tzipor, 2017), explains this seemingly-contradiction (Arieli, 2017):

> Being open to new ideas is a great start, but children must be taught how to come up with new ideas by leveraging their knowledge, and then how to push these ideas forward. Unfortunately, these skills are not generally taught in public schools. Luckily, Israel is highly accommodating of informal educational programs with novel approaches.

Adi Sharabani, founder and CEO of Skycure, an army reservist and one of the programs' instructors, explains the advantage of his program, based on Gvahim (2021) and Magshimim (Accomplish) over any program – including those intended for the gifted, in supporting junior- and high school students – living all over the country – boys as well as girls – in becoming innovators (ibid):

> These extracurricular programs facilitate computer science and cyber learning for gifted children ages 12 to 18. They were initially founded to better prepare Israeli youth for the intelligence units of the Israel Defense Forces, but today these programs are partly responsible for educating Israel's skilled high-tech workforce (ibid). [...]
>
> "What we do in these programs is we take a child's ability and we make him or her run with it. The purpose, therefore, is not to teach the kids a certain skill in the sense of how-to. The purpose is the vector, the movement, the progress itself, as opposed to the final goal."

And indeed, the four goals of Magshimim as explained in their web, are: [acquiring] large knowledge in varied technological areas, [getting] tools for self-learning and team work, [having] an opportunity to be considered to some of

the most prestigious IDF units, and [being] exposed to the leading high-tech companies. As in the last 50 years the Israeli army – rather than education system – has been the engine of computer science leaning, computer-related industrial developments, and computer-related intelligence directed, regarding preparing, teaching, and directing manpower to a variety of tasks, and building weapons, anti-weapon-means and surveillance or tracking devices, these 4 aims are highly rewarded "prizes" for many young Israelis, especially from the periphery and from low socio-economic background, Unfortunately most graduates of the relevant army units, those who have contributed to the status of Israel as a "start-up nation", are from middle-upper class, who live in the periphery, and thus get better out-of-school education, as well as better school education in relevant areas – particularly math, physics and English, and programs such as Magshimis help but to part of them.

Sharabani says their secret lies in making the children get "stuck."

> "We want to figure out how to teach a child to take a skill that he has acquired and apply it to something completely different, how to transfer it to a new area. And the way to do that is by bringing him to a place where he is stuck, where he does not know the answer and no one will give it to him... Therefore, true growth, true teaching, comes from that place of not knowing the solution and having to come up with one anyway. (Arieli, 2017)"
>
> This approach goes beyond cyber or coding. It is applicable to all aspects of life. It's about putting oneself in a position where finding a solution is challenging and thought-provoking. The core of the program's success and popularity is based on the idea that true learning comes when one seeks knowledge for oneself.

As a graduated of the Israeli system who was blessed with both the opportunity to get good, solid higher education in a high level university rather than in one the second-rate Israeli colleges, where most students are from the periphery and/or minorities, and serving in an elite IDF unit that trains its soldiers properly and help them be connected to the main figures in computer industry in Israel, Sharhabani expresses his experience in the education system to which he contributed for over a decade, as such:

> "At first, when we started training schoolteachers, it looked like it was going to be a complete flop for the simple reason that the teachers did not have enough experience and expertise in the field.
>
> "But what happened next was fascinating. It created scenarios whereby teachers looked a kid in the eye and said honestly, 'I don't know.' This suddenly brings us to a place where teachers and students are actually in dialogue; they are brainstorming. One does not simply feed data to the other. Rather, they both grow together, and they reach places no one has been to. The teacher, in this approach, is not a funnel of facts, but a conveyor of methodology."

Looking at the histories of most of the main characters that had contributed to the special standing of Israel as the "high-tech nation" reveals and interesting though somewhat bothering picture: the IDF has successfully replaced the education system in educating and producing programmers, computers' engineers. And entrepreneur. Any list of "high-tach individuals" in Israel will prove it. For example: in the list of the 61 "reasons for pride: the greatest successes, unforgettable turning points, and standing-out monuments in the Israeli high-tech industry" published in the 61st Israeli independence day (Nes et al., 2009), many of the individuals listed had started their way in one of the IDF computers' units; the same as many of the managers, CEO's and entrepreneurs of start-ups and high-tech companies. Another recent list is in High-tech's Israeli military connection (19.1.2019). where three of the main characters in cyber security, explain these connections. Yoni Heilbronn, chief marketing officer at Tel Aviv-based Argus Cyber Security, said: "The entrepreneurial spirit came from there," referring to his company's roots in the IDF cyber unit. Zohar Fox, CEO at Aurora Labs, said he made lifelong connections in the IDF. "You serve three, or five, or seven or eight years, however long, and it becomes family, basically," and Dan Sahar, vice president of product development for the Israeli automotive

cybersecurity firm Upstream Security, is a former IDF major. He said that more than most military organizations, the IDF had a lot of improvisation and on-the-job high-tech training.

The path for advancement had, right from the beginning, open for women as well (see the interview with Ms. Ruth Alon, the president of NetVision: Zorman & David, 2000). In the 21st century the rate of Israeli females who climbed at the top of the "high-tech" ladder through their military service has been increasing substantially. For example: Michal Braverman-Blumenstyk, CEO of Microsoft Israel R&D Center, who had served in the Israeli Air Force Electronic Warfare, or Yael Wiesel, who " accumulated her topographic knowledge in the Israeli Air force" and turned it into Walmart exist (Dor, 2021).

In summa:

The fact that almost all Israeli children have access to gifted education has not contributed to close the inequity in computer-related professions, which are the best paid, that for decades have kept Israel from a deterioration of it financial standing in spite of its low education level, and the high level of unemployment – the rate of unemployment among Ultra-Orthodox men was 49.5% in 2019 (Waksman, 2019), that of Arab women – well over 60% (ibid)

But Israel excels not only in military-dependent or related high-tech. 39 of the 100 best companies for workers in 2020 were high technology companies (Klingbail, 2020). This did not include other companies that had a substantial number of high tech workers, such as finances and banks [15 more companies] and industry that employs high tech professional [17 more] (ibid). Even the covid-19 pandemic did not stop the development of the Israeli high-tech: actually it had given it a massive boost (e.g. Sonnefeld, 2021).

In summa:

It can thus be concluded that the only scientific subject-matter learnt in school that does not give any advantage to its students – computer's sciences – is also the only subject that keeps the economy of Israel ongoing, and has done so even during the covid-19 pandemic.

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Research Article

Investigation of relationship between creativity potential and scientific imagination of gifted children and comparing them with their peers

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Abstract

The aim of this study was to examine the relationship between the creativity and scientific imagination of gifted children in early childhood and to find out whether they differ from their typically developing peers. This study was designed in a correlational design, one of the quantitative research types. The research has two study groups. The first one is the group of gifted children determined by the homogeneous sampling method. The second group is the group of typically developing peers of gifted children determined by criterion sampling method. There were 30 children in each group, totaling 60 children aged between 71 months and 79 months. Gifted children are diagnosed using the Wechsler Intelligence Scale for Children (WISC-R) or the Stanford Binet Intelligence Test (IQ 130 and above). Within the scope of the study, data were collected through the Evaluation of Potential Creativity (EPoC) and the Scientific Imagination Inventory. Sample t test, Mann-Whitney U test, eta-square, logistic regression and Pearson correlation method were used to analyze the data obtained. As a result of the study, a significant relationship was found between EPoC sub-dimensions and Scientific Imagination Inventory sub-dimensions in the gifted, typically developing peers and the all group. In addition, significant differences were found between gifted children and their peers in the sub-dimensions of both data collection tools. Moreover, both some constructs from the EPoC sub-dimensions and some constructs from the Scientific Imagination Inventory sub-dimensions were found to be predictive of giftedness. There is no significant difference between the sub-dimensions of the EPoC and scientific imagination inventory sub-dimension scores according to the gender of the children in the gifted and typical development group.

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Introduction

The greatest source of strength of societies is the accumulation of trained and qualified people. It is generally believed that all the outstanding works of societies are created by gifted people with creative skills and imagination (Uzun, 2004). When the development of societies over the centuries from past to present is analyzed, it is understood that the individuals who lead them to move forward are usually among the gifted and talented individuals (Clark, 2013). It is emphasized that gifted individuals have characteristics and competencies such as creativity, productivity, leadership, capacity to understand more than their peers, advanced comprehension and observation (Clark, 2013; Davis et al., 2011). Therefore, gifted children should be given the opportunity to develop their talents and skills. Thus, enabling

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them to use their capacities efficiently is very important both for themselves and for the present and future of their countries (Ayvacı & Bebek, 2019; Cutts & Moseley, 2004).

The 21st century skills defined by organizations such as Partnership for 21st Century Skills (P21), International Society for Technology in Education (ISTE), Assessment and Teaching of 21st Century Skills (ATCS) are the subject of many studies. In general, these skills include learning and innovation skills, media and technology skills, life and career skills, exploratory thinking, communication and collaboration, ways of thinking, ways of working, working tools, creativity and innovation, and digital citizenship (Ananiadou & Claro 2009; Büyükyılmaz, 2022). Many of these skills also fall within the classification of life skills articulated by the World Health Organization (WHO), the United Nations Educational, Scientific, and Cultural Organization (UNESCO), the United Nations Children's Fund (UNICEF) and the Pan American Health Organization (PAHO) (Kaşkaya, 2018). When these skills are examined in depth, it is understood that many of them are related to the concepts of creativity and imagination. Considering the need for differentiation and enrichment in gifted education, 21st century skills and life skills should inevitably be addressed and examined in gifted education (Renzulli, 2012; Renzulli & Reis, 1997).

Imagination

Etymologically, the word imagination derives from the Latin word "imago" meaning image or mental representation. The act of imagining is often used in the sense of visualizing images. Imagination therefore means visualizing or picturing something in the mind (Jagla, 1994). In the dictionary of the Turkish Language Association, "imagination" is defined as "the ability of the mind to create imagination, imagination, imagery, fancy; the power to establish a connection between the elements of past experiences and present experiences; the ability to design an object without the object being in front of us" (TDK, 2023).

Imagination is a natural talent and needs to be developed in order to produce the creations necessary for social progress. Craft (2002) states that imagination can be a prerequisite for creativity. In this context, the individual utilizes his/her imagination in the process of solving a problem encountered in daily life. Individuals who use their imagination are more successful in dealing with life. Because thanks to imagination, which is a mental power, they can produce many designs and solutions for many social problems in their minds, turn them into dreams and test them. In this process, imagination offers the individual the opportunity to test before experience. This gives the individual insight into the risks and possibilities of the solution before implementing it (Aydın, 2022).

Imagination is one of the key skills that distinguishes scientists from others. When coming up with new theories, scientists use the ability to imagine and visualize physical phenomena and then 'play' with possible outcomes. Kim et al. (2009) claimed that scientific imagination greatly influences thinking, especially intuitive thinking in science. Scientific imagination helps scientists to look at nature beyond the existing framework, brings to the fore the reality based on scientific knowledge, and influences the precise goals and topics of the researcher. Curiosity and diverse experiences are the driving force of scientists' imagination (Kaynar, 2018; Kim et al., 2009).

Scientific imagination encompasses scientific knowledge, creativity, creative thinking and productivity. Scientific qualities have a great influence on scientific results and the abilities of scientists. However, since the scientific imagination is part of the general imagination, it bears the characteristics of the general imagination. As a result, scientific imagination is defined as the ability to think creatively to create or solve problems based on an understanding of scientific concepts or phenomena, past experiences and scientific knowledge (Egan, 1992; Kaynar, 2018; Mun et al., 2013; 2015; Warnock, 1977; White, 1990).

Scientific imagination has three characteristics. First of all, it contains the characteristics of the general imagination. Imagination is related to cognitive abilities such as memory and logic (Barrow, 1988; Egan, 1992). Along with these, it affects emotional feelings, it can be aroused under such feelings (Egan, 1992; Warnock, 1977; White, 1990). It is also closely linked to previous experiences (Vygotsky, 2004). Second, scientific imagination is closely linked to creativity. Scientific imagination involves creative reconstruction based on past experiences and scientific knowledge (Warnock, 1977). These features form the basis for new scientific discoveries, as demonstrated by most scientists (Shepard,1988).

Similarly, students who are scientifically imaginative are expected to come up with original and creative ideas. Finally, the scientific imagination is different from fiction in that it has generative properties and is used powerfully when creating something new. In addition, one's sense of reality must be generally consistent with reality based on newly acquired scientific knowledge as a result of scientific imagination (Kaynar, 2018; Mun et al., 2013; 2015).

Creativity

When the research on creativity is examined, it is seen that there are many definitions that look at creativity from different perspectives. The concept of creativity in Western languages is "kreativitaet, creativity". It comes from the Latin word "creare". This word means "to give birth, to create, to bring into being" (San & Güleryüz, 2004).

According to Torrance and Myers (1970), creativity is the ability of a person to adapt to a new situation and create a unique and constructive way to adapt to the new situation. Guilford (1987), who has important studies in this field, considers creativity as a part of cognitive skills and sees it as changing the expanding thought with different options. According to the theory developed by Sternberg and Lubart (1995), creativity consists of 6 elements: intelligence, thinking style, knowledge, motivation, environment and personality. According to San (1985), creativity is defined as creating new products with existing information, obtaining an original product by combining information, making connections that have not been established before, and finding different solutions to problems. According to another explanation, creativity is a compilation of many cognitive processes such as perception, comprehension, fluency, sensitivity, consciousness, openness to innovation, intuition, and flexibility (Atay, 2009). Plucker and Beghetto (2004) define creativity as the interaction between the ability and process of an individual or group to produce a result or product that is both new and useful. Torrance (described creative thinking as a power that increases one's mental functions.

Torrance (1963) described creative thinking as a power that increases one's mental functions. He sees creative thinking as a process of intuition, intuiting gaps and disturbing elements, making hypotheses about them, testing them, comparing the results and finding another hypothesis and testing it again (Argun, 2012). Eckhoff (2011) states that creative thinking is a process that interacts with one's sociocultural environment and thoughts. Üstündağ (2003) defined creative thinking as "the establishment of a relationship between objects or thoughts that have not been related before". Atasoy et al. (2007) consider creative thinking as a part of divergent thinking and imagination. Lew & Cho (2013) consider finding new solutions to everyday problems by coming up with functional ideas as an important component of creative thinking ability. Creativity at the individual level is seen as related to solving problems in daily life. Creativity at the societal level means scientific discoveries, life-enriching humanities or innovations in social programs (Sternberg & Lubart, 1999). According to Vygotsky (2004), creativity exists when a person imagines, combines, changes and creates something new.

Imagination and Creativity

Mellou (1995) states that creativity and imagination are interrelated and that the fundamental relationship between them is that they are both reality-based in providing alternatives and possibilities for innovation and original changes. Rowe (2004) states that imagination is an important part of creativity as a powerful tool that helps to understand and visualize alternatives. Creativity is always said to involve imagination. The ability to imagine is used to separate from the present, to create unfamiliar and new connections, to play with ideas, to internalize perceptions and to explore different possibilities (Duffy, 2006). According to Ogilvie (1998), one becomes creative when the use of imagination increases the production of multiple ideas and thoughts. Imagination capacity is directly related to spatial perception, visual memory, problem solving, divergent thinking and creativity (Pérez-Fabello & Campos, 2007). Imagination is the impulsive force behind creativity and the use of imagination allows children to make unconventional connections (Beetlestone, 1998). Imagination is a necessary part of the human creative process (Williams & Walker, 2003). Based on these, it can be said that the wider the imagination of an individual, the more creative the individual can be (Gündoğan, 2011).

Imagination has been found to be one of the strongest predictors of creativity skills in research (Bolen & Torrance, 1978; Çankaya et al., 2012). With the help of creative imagination, the individual enables ideas with high potential to be realized to be designed and transformed into products. In this context, imagination and creativity are effective in the emergence of many original and need-responsive innovations in the field of design, which aims to ensure the harmony of the individual with life and to make the life of the individual easier (Aydın, 2022; Er Bıyıklı & Gülen, 2018).

An individual's ability to dream and to realize one's dreams is primarily dependent on a rich imagination. According to Vygotsky (2004), the critical period in supporting the development of individuals for a rich imagination is preschool and primary school. The preschool period, when creative potential is at the highest level (Aral et al., 2002), is also the period when imagination is at the highest level (Ayaydın, 2011). Similarly, Gündoğan et al. (2013) found an inverse relationship between the rate of imagination development and the age of the individual. For this reason, it is important to support the development of imagination in children, especially starting from preschool education, by eliminating standardized activities and offering rich experiences with activity-based, enriched play options and playgrounds (Aydın, 2022).

According to Duffy (2006), the need to encourage and value the imagination and creativity of young children is important not only for the future of society but also for the present. By encouraging creativity and imagination, children's ability to understand and explore the world can be enhanced by increasing opportunities to find new meanings and make new connections. Considering that creativity is indispensable for social progress and imagination is the impulsive power of creativity, the earlier efforts to include imagination in education are initiated, the brighter the future of society will be.

Society always needs creative and imaginative people who tackle problems with creative solutions and can imaginatively combine disconnected ideas and skills (Duffy, 2006). Developing the creativity skills of gifted and talented children is also important in terms of contributing to the future of humanity, and in terms of making great discoveries and inventions (Clark, 2013; Bütün, 2017). If we analyze how geniuses and famous scientists made their discoveries, we see that they tried to connect things that were not related (Michalko, 2008). Gifted individuals with creativity skills and imagination contribute to both the society they live in and all countries, in short, to humanity in terms of creating original works with these skills (Bütün, 2017; Çağlar, 2004). It is especially important to develop the creativity of gifted children and to support their imagination. Otherwise, the development of creativity skills of students with high levels of ability cannot be ensured. As a result, while these individuals can contribute to the country and humanity with the developments that they can reveal by using their talents and creativity together, they will not be able to do so and these abilities will atrophy.

The Current Study

The aim of this study was to examine the relationship between the creativity and scientific imagination of gifted children in early childhood and to find out whether they differ from their typically developing peers. In this context, the following five questions were sought to be answered in the research.

- Is there a significant relationship between the creativity potential scores of gifted children and their typically developing peers and their scientific imagination inventory scores?
- Is there a significant difference between the creativity potential scores of gifted children and their typically developing peers?
- Is there a significant difference between the scientific imagination inventory scores of gifted children and their typically developing peers?
- Is there a significant difference in creativity potential scores and scientific imagination inventory scores according to gender?
- What is the effect of the sub-dimensions of the Creativity Potential Test and the sub-dimensions of the Scientific Imagination Inventory on children's likelihood of being gifted?

Method

Research Model

This study was designed in a correlational design, one of the quantitative research types. Correlational research is research in which the relationship between two or more variables is examined without intervening in these variables in any way. This examination may give the researcher an idea that there may be a cause and effect relationship, but it cannot be interpreted as cause and effect (Gall et al., 2007). With this research, the creativity and scientific imagination of gifted children and their typically developing peers will be compared and the relationship between them will be examined.

Participants

The research has two study groups. The first one is the group of gifted children. The second is the group of typically developing peers of these gifted children. Gifted children are children who apply to the Research and Practice Center of a State University in the Marmara Region of Türkiye through their teachers or parents with the idea that they may be gifted and are diagnosed as gifted. Gifted children are diagnosed using the Wechsler Intelligence Scale for Children (WISC-R) or the Stanford Binet Intelligence Test (IQ 130 and above). The typically developing peers of these children were selected from among the children attending a state-affiliated kindergarten in the city center where the highest number of children identified as gifted attend. There were 30 children in each group, totaling 60 children. The homogeneous sampling method was used to include gifted children in the study, and the criterion sampling method was used to select their typically developing peers. In determining the second group, some criteria were set to ensure that they had similar characteristics with gifted children other than diagnosis. These were as follows: not having been diagnosed as gifted before or not referred with the idea that they may receive a diagnosis, being in the same class with a gifted child in the first group, and volunteering to participate in the study. The average age of the children included in the study was 74 months. The youngest child is 71 months old, and the oldest child is 79 months old. The age of the children was similar in both groups. In addition, the gender distribution of children in both groups is equal. There are 30 children in each group, 15 girls and 15 boys in total.

Data Collection Tools

Under this heading, the data collection tools used in the research are given in detail. Data were collected from both gifted children and typically developing children using two instruments. The first of these is the Evaluation of Potential Creativity Test (EPoC), which aims to assess children's creativity potential. The other is the Scientific Imagination Inventory to assess children's scientific imagination.

Evaluation of Potential Creativity (EPoC)

The Test for the Evaluation of Potential Creativity, published by Lubart, Besançon and Barbot in 2011, consists of two parallel forms, form A and form B. Each form consisted of 8 items related to two expression domains: graphic and verbal. These eight items were designed to represent two ways of thinking: Divergent-exploratory and convergent-integrative. The 8 items in each form of the EPoC test are grouped into 4 groups, indicating the 4 sub-dimensions of the test for measuring creativity potential. These are; Graphic Divergent-Exploratory Thinking (DG), Verbal Divergent-Exploratory Thinking (DV), Graphic Convergent-Integrative Thinking (IG) and Verbal Convergent-Integrative Thinking (IV). The scores obtained in each of the 4 sub-dimensions of the test are classified at seven levels: Very high, high, upper normal, average, lower normal, weak and very weak (Lubart et al., 2011).

Convergent- Integrative thinking is the production of the most original and single production possible from many different elements. It is stated that synthesizing feature is also used in this way of thinking. This is stated as the opposite of divergent-exploratory thinking. By evaluating both areas, the multifaceted nature of creativity potential can be reflected (Lubart et al., 2011). These active components of creativity are measured in the EPoC test by engaging the child in a production process. At the same time, the EPoC test asks the child to generate ideas and compositions both verbally and graphically.

The EPoC test can be used in children aged 5-12 years. The standardization study of the test was carried out in France. In addition, translation and standardization studies are being carried out to ensure that EPoC can be used in

different countries (Barbot et al., 2016; Kanlı, 2018). EPoC testing is used in many countries. The test was translated into 5 different languages: French, English, German, Turkish and Arabic. The English version of the test was developed in 2012 by the International Center for Innovation in Education (Lubart et al., 2013). The English version was developed by Taisir Subhi Yamin. A Turkish language translation was made by Ahmet Aksu and a Turkish validity and reliability study was conducted by Dereli (2019). The EPoC test takes approximately 30-60 minutes to administer, depending on the performance of each child.

The validity and reliability study within the scope of the Turkish adaptation of the EPoC was conducted by Dereli (2019), and according to the compatibility indices obtained, it was revealed that the model showed a good fit to the structure (GFI=.90, CFI=.93, TLI=.85, SRMR=.047). The four factor structure of the creativity scale is confirmed. In the reliability study of the EPoC test, the reliability coefficient of the whole scale was found to be 0.70. As a result of these analyses, the scale was found to be valid and reliable (Dereli, 2019). In this study, the reliability value for the whole scale was obtained as 0.740.

Scientific Imagination Inventory

In order to measure scientific imagination in the study, three questions developed by Kaynar (2018) within the scope of his master's thesis titled "Scientific imaginations of gifted and non-gifted students" and the inventory for the evaluation of these questions will be used. Children are asked to draw by asking these questions. These questions are as follows:

- How do you think our world would be without the force of gravity?
- What do you think our world would be like if the sun suddenly disappeared?
- Imagine that you are a person traveling in a spaceship. During this journey you discover a new planet. What do you think this planet is like?

The scientific imagination inventory developed by Kaynar (2018) consists of the sub-dimensions of *Scientific Creativity* (Fluency + Flexibility + Originality), *Scientific Sensitivity* (Emotional Understanding + Imagination Experience) and *Scientific Productivity* (Scientific Reality + Creation + Reproduction). Kaynar (2018) consulted the opinions of two faculty members who are experts in the field for the suitability of the questions within the scope of the inventory to the group level, to measure scientific imagination, and for the reliability and validity of the scoring key. Pearson Correlation analysis was used to determine the correlation value between the evaluations of different raters regarding the reliability of the study. The study was evaluated by raters. The correlation coefficient between Rater 1 (researcher) and Rater 2 was 0.91 ($n=72$, $p<0.001$), and the correlation coefficient between Rater 1 and Rater 3 was 0.86 ($n=72$, $p<0.001$). Since there was a statistically significant relationship between the researcher's scoring and the scores of the other raters, the researcher's scoring was taken as the basis for the analysis of the findings Kaynar (2018). The Scientific Imagination Scoring Table was used to score the drawings Kaynar (2018). Within the scope of this study, each of the drawings obtained from 60 children were scored by three different faculty members within the scope of the Scientific Imagination Scoring Table. The first one is a researcher, the second one is a faculty member working in the department of art and craft education, and the third one is a faculty member working in the department of mathematics and science education.

Inter-rater agreement, which is one of the measures of reliability, is a measure of reliability that is applied in situations where more than one observer, independently of each other, tries to measure the same things. In this type of measurement, a single value is found for each situation by averaging the measurements made by the individual observers. The closer the observation results are to each other, the higher the reliability. In addition, as the number of observers increases, reliability also increases at certain rates (Karasar, 1995). In this study, the data obtained from the Scientific Imagination Inventory were independently evaluated by three raters. A total of 180 drawings made by the children were given to three raters and asked to score them. When the correlations between the scores given by the raters to the drawings were examined, it was seen that there were significant relationships.

Table 1. Scientific imagination inventory scores descriptive statistics

Sub-scales	Mean	Sd	Intraclass Correlation Coefficient
Fluency	14,57	6,04	0,910
Flexibility	4,77	1,61	0,920
Originality	2,13	1,33	0,927
Emotional Understanding	1,83	1,04	0,921
Imagination Experience	1,83	1,47	0,932
Scientific Reality	1,57	1,25	0,938
Creation	0,57	0,74	0,942
Reproduction	0,35	0,55	0,946

The scores for each sub-item of the Scientific Imagination Inventory were scored by three expert raters. Intraclass correlation coefficient was used for the agreement between raters and the agreements between experts were obtained as 0,910 for fluency and 0,946 for reproduction, respectively.

Data Collection Procedure

Within the scope of this study, data were first obtained from the group of gifted children. In the spring semester of the 2022-2023 academic year, data were obtained by applying the EPoC and the Scientific Imagination Inventory tools to children who were identified as gifted at the Research and Practice Center within the university. Then, a group of gifted children and a group of typically developing children were formed, taking into account the fact that they may have similar environmental conditions other than diagnosis. For this purpose, a state kindergarten in the city center, where the highest number of gifted children attended, was selected. In this school, according to the criteria determined within the scope of the research, the children of the parents who volunteered to participate in the study were administered the Evaluation of the Potential Creativity Test (EPoC) and the Scientific Imagination Inventory tools and data were collected. Data collection tools were administered individually to gifted children and their typically developing peers.

Data Analysis

In the data analysis within the scope of this study, the normality of the scale scores was first examined with skewness and kurtosis. If the values obtained are in the ±2 range, it shows that the score distribution is normal (George & Mallery, 2010). The independent sample t test was used to compare the scores of both instruments according to the groups, and the Mann-Whitney U test was used to compare the scores according to gender in each group. The reason for using this non-parametric method is that the number of data is not sufficient in the groups. Tabachnick & Fidell (2013) recommend the use of parametric methods in each group (N>30). For significant differences, the effect size was analyzed with eta square. Eta squared ($\eta 2$) indicates the proportion of the total variance in the dependent variable explained by the independent variable (Büyüköztürk, 2006; Pallant, 2007). Cohen (1988) defined this value as 0.01=small effect, .06=medium effect and .14=large effect. In addition, children in typical development were coded as the reference group (0) and children in the gifted group (1), and logistic regression analysis method was used to determine the probability of being gifted according to the scale dimensions. Finally, Pearson's correlation method was used to determine the significant relationship between the scores of EPoC and the Scientific Imagination Inventory. For statistical analyses, $p<.05$ significance level was compared.

Results

In this section of the study, the findings obtained for the five sub-questions of the research are presented separately. Table 2 shows the normality distributions of the scores obtained from the data collection tools.

Table 2. EPoC and scientific imagination inventory normality statistics

	Gifted Children		Typical Development	
Subscales	Skewness	Kurtosis	Skewness	Kurtosis
Score DG	-0,705	-0,027	0,463	-0,299
Score IG	-0,639	-0,816	0,342	-0,166
Score DV	1,023	1,394	0,746	0,223
Score IV	0,822	0,84	0,174	-0,794
Fluency	0,018	-0,604	0,8	0,308
Flexibility	0,067	-0,476	0,699	-0,286
Originality	-0,173	-0,879	0,266	-0,623
Emotional Understanding	0,152	-0,605	0,449	0,06
Imagination Experience	0,533	0,205	1,056	0,672
Scientific Reality	0,62	-0,334	0,934	0,191
Creation	0,804	-0,465	0,583	-1,784
Reproduction	0,324	-0,115	0,428	-0,236

The skewness and kurtosis values for all of the sub-dimension scores of both the EPoC and the scientific imagination inventory were within the range of ±2 in both gifted and typically developing child groups and showed a normal distribution.

First Sub-question of the Research

Table 3. Pearson correlation values between EPoC scores and scientific imagination scores

		Fluency	Flexibility	Originality	Emo. Und.	Imag. Exp.	Scie. Rea.	Creation	Reproduction
Gifted	DG	0,323	,707**	,793**	,724**	,750**	,620**	,522**	0,233
	IG	,553**	0,18	0,102	0,066	0,213	0,029	0,175	0,251
	DV	0,132	,382*	,473**	0,354	,395*	,396*	0,351	0,041
	IV	0,3	0,05	0,242	0,112	,372*	0,36	,449*	,397*
Typical	DG	,903**	,653**	,864**	0,332	,457*	0,18	,670**	,725**
	IG	0,156	0,215	0,272	0,193	0,002	0,138	0,146	0,021
	DV	0,262	0,079	0,167	-0,201	-0,004	-0,301	0,119	0,187
	IV	-0,021	0,321	0,303	,369*	0,279	0,346	0,223	0,049
All	DG	,801**	,711**	,800**	,511**	,825**	,679**	,571**	,388**
	IG	,582**	,329*	,304*	0,19	,411**	,317*	,266*	0,224
	DV	0,024	0,112	0,187	-0,055	0,017	-0,1	0,141	0,095
	IV	,433**	,276*	,374**	,266*	,507**	,500**	,453**	,322*

***p<.01; *p<.05*

The relationship between both types of scores was analyzed by Pearson correlation method. In gifted children, a positive and significant correlation was found between the scores of the DG and the scores of flexibility, originality, emotional understanding, imagination experience, scientific reality and creation. There is a positive and significant relationship between score IG and only fluency scores. A positive and significant relationship was found between score DV and flexibility, originality, imagination experience and scientific reality. A positive and significant relationship was found between Score IV and imagination experience, creation and reproduction.

In the group of children with typical development, a positive and significant correlation was found between the scores of the DG and the scores of fluency, flexibility, originality, imagination experience, creation and reproduction. In this group, there is no significant relationship between Score IG and Score DV and any sub-dimension of scientific

imagination. A positive and significant relationship was found between Score IV and emotional understanding subscale scores.

In the all group, there is a positive and significant relationship between scores DG and IV and all sub-dimensions of scientific imagination. A positive and significant relationship was found between score IG and fluency, flexibility, originality, imagination experience, scientific reality and creation. There is no significant relationship between score DV and any sub-dimension of scientific imagination.

Second and Third Sub-question of the Research

Table 4. Independent sample t-test statistics between EPoC and scientific imagination subdimension scores between groups

Score	Group	N	Mean	sd	$t_{(58)}$	p	Eta-square
DG	Gifted	30	119,73	13,84	7,77	,000*	0,51
	Typical	30	95,43	10,10			
IG	Gifted	30	100,40	18,60	3,886	,000*	0,21
	Typical	30	84,43	12,67			
DV	Gifted	30	86,83	5,57	-0,784	0,436	
	Typical	30	88,80	12,57			
IV	Gifted	30	87,63	9,95	3,378	0,001*	0,16
	Typical	30	80,37	6,31			
Fluency	Gifted	30	19,50	3,81	11,059	,000*	0,68
	Typical	30	9,63	3,06			
Flexibility	Gifted	30	5,37	1,59	3,091	0,003*	0,14
	Typical	30	4,17	1,42			
Originality	Gifted	30	2,63	1,40	3,11	0,003*	0,14
	Typical	30	1,63	1,07			
Emotional Understanding	Gifted	30	2,03	1,00	1,499	0,139	
	Typical	30	1,63	1,07			
Imagination Experience	Gifted	30	2,87	1,20	7,604	,000*	0,50
	Typical	30	0,80	0,89			
Scientific Reality	Gifted	30	2,30	1,12	5,563	,000*	0,35
	Typical	30	0,83	0,91			
Creation	Gifted	30	0,77	0,90	2,142	0,036*	0,07
	Typical	30	0,37	0,49			
Reproduction	Gifted	30	0,43	0,63	1,184	0,241	
	Typical	30	0,27	0,45			

*p<.05

There was a significant difference between the scores of gifted and typically developing children in the sub-dimensions of the EPoC in terms of their scores in DG, IG and DV (p<.05). Gifted children have higher mean scores in DG, IG and DV than typically developing children. Effect sizes were analyzed with eta squared for significant differences in the groups. 0.51 for Score DG (large effect), 0.68 for Score IG (large effect) and 0.68 for Score DV (large effect).

There was a significant difference between the fluency, flexibility, originality, imagination experience, scientific reality and creation scores of gifted children and typically developing children from the sub-dimensions of the Scientific Imagination Inventory (p<.05). Similarly, the mean scores of gifted children in fluency, flexibility, originality, imagination experience, scientific reality and creation were higher than those of typically developing children. The effect

sizes were 0.68 (large effect) for fluency, 0.14 (large effect) for flexibility, 0.14 (large effect) for originality, 0.50 (large effect) for imagination experience, 0.35 (large effect) for scientific reality and 0.07 (medium effect) for creation.

Fourth Sub-question of the Research

Table 5. Mann-Whitney U test between EPoC and scientific imagination subscale scores by gender in each group

	Gifted				Typical			
	Boy (N=15)	Girl (N=15)	Z	p	Boy (N=15)	Girl (N=15)	Z	p
	Mean Rank	Mean Rank			Mean Rank	Mean Rank		
DG	16,23	14,77	-0,46	0,646	16,07	14,93	-0,355	0,722
IG	17,53	13,47	-1,273	0,203	12,93	18,07	-1,608	0,108
DV	16	15	-0,326	0,745	15,67	15,33	-0,104	0,917
IV	14,9	16,1	-0,384	0,701	14,9	16,1	-0,379	0,705
Fluency	15,57	15,43	-0,042	0,967	16,53	14,47	-0,649	0,516
Flexibility	17,3	13,7	-1,142	0,254	14,2	16,8	-0,837	0,403
Originality	15,37	15,63	-0,085	0,932	15,53	15,47	-0,022	0,983
Emotional Und.	15,37	15,63	-0,087	0,931	15,5	15,5	0	1
Imagination Exp.	15,2	15,8	-0,193	0,847	13,83	17,17	-1,122	0,262
Scientific Reality	14,63	16,37	-0,561	0,574	16,7	14,3	-0,802	0,423
Creation	13,53	17,47	-1,328	0,184	16	15	-0,372	0,71
Reproduction	15,6	15,4	-0,073	0,942	16,5	14,5	-0,812	0,417

*$p<.05$

In each of the groups, the difference between the creativity potential and scientific imagination sub-dimension scores according to gender was compared with the Mann-Whitney U analysis method. The number of boys and girls in each group was not sufficient (N<30). There is no significant difference between the sub-dimensions of the EPoC and scientific imagination inventory sub-dimension scores according to the gender of the children in the gifted group. Similarly, there is no significant difference between the sub-dimensions of the EPoC and the sub-dimension scores of the scientific imagination inventory according to the gender of children in the typical development group.

Fifth Sub-question of the Research

Table 6. Logistic regression statistics

Models	**Variables**	**B**	**SH**	**Wald**	**p**	**Odds Value**
Model 1	DG	0,152	0,041	13,947	,000*	1,164
	IG	0,06	0,034	3,19	0,074	1,062
	DV	-0,128	0,066	3,715	0,054	0,88
	IV	-0,018	0,069	0,07	0,791	0,982
	R^2=0,545(Cox & Snell)	$\chi^2_{(4)}$=47.266				
	R^2=0,727 (Nagelkare	p<.001				
Model 2	Scientific Creativity	0,498	0,137	13,212	,000*	1,645
	Scientific Sensitivity	0,073	0,373	0,038	0,845	1,076
	Scientific Productivity	-0,307	0,418	0,539	0,463	0,736
	R^2=0,568(Cox & Snell)	$\chi^2_{(3)}$=50.411				
	R^2=0,758 (Nagelkare)	p<.001				
Model 3	DG Scores	0,03	0,063	0,22	0,639	1,03
	IG Scores	0,02	0,04	0,26	0,61	1,021
	DV Scores	-0,127	0,083	2,379	0,123	0,88

Score IV	0,057	0,095	0,362	0,548	1,059
Scientific Creativity	0,468	0,193	5,859	**0,015***	1,596
Scientific Sensitivity	0,074	0,45	0,027	0,87	1,076
Scientific Productivity	-0,369	0,421	0,768	0,381	0,691
R^2=0,604(Cox & Snell)	$\chi^2_{(7)}$=55.542				
R^2=0,805 (Nagelkare	p<.001				

**p<.05*

The effect of the instrument sub-dimensions on children's likelihood of being gifted was examined by logistic regression analysis. In this method, the dependent variable (group) is coded as 1 and 0 and is considered as the reference group (0=typical development).

According to Model 1, the logistic regression model for the sub-dimensions of the EPoC in relation to children's giftedness is significant ($\chi^2_{(4)}$=47.266, p<.001). The Cox & Snall R-squared and Nagelkerke R-squared values show the smallest and largest proportions explaining the probabilities of being the dependent variable. Between 54.5% and 72.7% of the variability related to children's giftedness is explained by the sub-dimensions of the EPoC. Score DG (B=0.152, Wald=13.947, p<.05) was found to be a significant predictor of children's likelihood of being gifted, and since the coefficient B was positive, the effect of Score DG was positive. A one-unit increase in the score on the DG scores increased the likelihood of being gifted by 1.164 times compared to children in the typical development group.

According to Model 2, the logistic regression model of the sub-dimensions of the Scientific Imagination Inventory in relation to children's giftedness is significant ($\chi^2_{(3)}$=50.411, p<.001). Between 56.8% and 75.8% of the variability related to children's giftedness is explained by the scientific imagination sub-dimensions. Scientific creativity (B=0.498, Wald=13.212, p<.05) was found to be a significant predictor of children's likelihood of being gifted, and since the coefficient B was positive, the effect of the scientific creativity variable was positive. A 1-unit increase in scientific creativity measures increased the likelihood of being gifted by 1.645 times compared to children in the typical development group.

According to Model 3, the logistic regression model of the sub-dimensions of the EPoC and the Scientific Imagination Inventory on children's giftedness is significant ($\chi^2_{(7)}$=55.542, p<.001). Between 60.4% and 80.5% of the variability in children's giftedness is explained by the sub-dimensions of the EPoC and the Scientific Imagination Inventory. Among both instruments, only scientific creativity (B=0.468, Wald=5.859, p<.05) was found to be a significant predictor of children's likelihood of being gifted, and since the coefficient B was positive, the effect of the scientific creativity variable was positive. A 1-unit increase in scientific creativity measures increased the likelihood of being gifted by 1.596 times compared to children in the typical development group.

Discussion

In this section of the study, the discussions on the five sub-questions of the research are given separately in order.

First Sub-question of the Study

Within the scope of this study, a significant positive correlation was found between the sub-dimensions of the EPoC and the sub-dimensions of the Scientific Imagination Inventory in gifted children. In each of the sub-dimensions of the EPoC test, a positive and significant relationship was obtained with at least one of the sub-dimensions of the Scientific Imagination Inventory. Therefore, there is a significant positive relationship between creativity potential and scientific imagination in gifted children. In preschool children with typical development, 2 of the 4 sub-dimensions of EPoC had a positive and significant relationship with the sub-dimensions of the Scientific Imagination Inventory, whereas no relationship was found in 2 of them. Therefore, we can speak of an existing relationship between creativity potential and scientific imagination in typically developing children. When we look at the scores of the all group, it was concluded that the scores of the DG and IV sub-dimensions of EPoC had a positive and significant relationship with all of the sub-dimensions of the Scientific Imagination Inventory. In the all group, there was a positive and significant relationship

between the IG sub-dimension of EPoC and the 6 sub-dimensions of the Scientific Imagination Inventory. In the all group, no significant relationship was found between the DV sub-dimension of EPoC and any sub-dimension of the Scientific Imagination Inventory. As can be understood from the comparison of all group scores, it can be stated that there is a positive and significant relationship between children's creativity potential and scientific imagination. It is thought that the reason why there is no relationship between the DV sub-dimension of EPoC and scientific imagination may be due to the fact that the DV sub-dimension is closely related to verbal skills. In this sub-dimension, there are situations that are closely related to children's vocabulary and expression skills (Lubart et al., 2011). In the scientific imagination inventory, it can be said that drawing and painting skills are predominant (Kaynar, 2018).

When the literature is examined, it is understood that there are very limited studies examining the relationship between scientific imagination and creativity. Therefore, this may indicate the originality of the study. On the other hand, imagination and creativity were mostly emphasized in the studies and their related fields were examined. In their study, Jankowska & Karwowski (2015) suggested that the concepts of creativity and imagination intersect with each other at many points and emphasized the concept of creative imagination. In the study conducted by Çankaya et al. (2012), it was revealed that imagination had a high level effect in predicting creative thinking skills. Kandemir (2006) argued that imagination exercises have positive effects on creative thinking. Aljarrah (2017) theoretically examined the relationship between play-imagination-creativity and consequently emphasized the interrelationship between play, imagination and creativity. However, he emphasized the importance of realizing this reciprocal relationship in early childhood education. In addition, Torrence's (1974) criteria for scoring the Creative Thinking Test include the determination of the richness and colorfulness of imagination. This may emphasize the relationship between creativity and imagination.

Yolcu (2019) examined the relationship between imagination and creativity in preschool children in the context of the literature. As a result of the research, it was determined that in order to develop children's creativity, activities that will develop their imagination should be included more. Caiman & Lundegard (2018) also found that as the use of imagination increases in preschool children, children produce different and original solutions to problems. In the study conducted by Aydın (2022), it was emphasized that when children's imagination development is supported, their problem solving skills are also improved. Yorgun (2021) also found a significant relationship between problem solving and imagery ability. Er Bıyıklı & Gülen (2018) theoretically examined the effect of the concepts of imagination and creativity on the design process and stated that imagination is an important dynamic that provides motivation in situations that require extraordinary creativity such as artistic activities and design creation processes.

In studies conducted in the field of education, the relationship between imagination and other variables such as creative thinking, decision-making, and problem solving skills were examined (Ağraş & Şeyba, 2017; Çankaya et al., 2012; Er Bıyıklı & Gülen, 2018; Yolcu, 2019). As can be seen from the research, creativity and imagination education are inseparable parts of each other. Those who want to develop creativity need to engage children's imagination. As a result of this research, scientific imagination can be accepted as a functional tool for the development of creativity. Based on this result, it can be interpreted that when children's scientific imagination development is supported in the educational environment, their multidimensional development, especially their creativity, will be supported. As Vygotsky (2004) states, supporting children's multidimensional development enables them to be more productive and innovative in adulthood.

Second Sub-question of the Research

In this study, the EPoC subscale scores of gifted children and the EPoC subscale scores of their typically developing peers were examined. It was concluded that the mean scores of gifted children were higher than their typically developing peers in the DG, IG and DV sub-dimensions of EPoC, which has 4 sub-dimensions in total. When the effect sizes of this significant difference were examined, it was seen that a large effect level could be mentioned.

Kersher & Ledger (1985) found that gifted students were more successful in generating original ideas than their typically developing peers. Therefore, it is seen that it has results that support the findings of this research. Similarly,

Preuss and Dubow (2004) found that gifted children have better problem solving skills than typical children. In addition, the study also reported that gifted students were successful in memory, analytical, speed of perception, production and stress tolerance. Kanevsky (2011) found that students who were identified as gifted preferred learning complex information, making connections between ideas, and choosing their own product formats more than undiagnosed students. When the findings obtained within the scope of the studies are examined in general, the finding of a positive and significant relationship between intelligence and creativity is supported.

The relationship between intelligence and creativity has been the subject of much research for many years (Chamorro-Premuzic, 2009; Dağlıoğlu, 2014). There are also studies that emphasize different results with this research finding. Findings from some studies have revealed that there is no relationship between high scores obtained from creativity tests and high scores obtained from intelligence tests (Kim et al., 2013). It has been emphasized that while a high IQ score can say something about intelligence, it is insufficient to express high creative ability (Barbot et al., 2016). This is because the answers to the intelligence test require the recall of certain information, convergent or non-convergent thinking. This is because the answers to the intelligence test require the recall of certain information, convergent or non-creative thinking. Therefore, a child who scores high on an intelligence test may be less creative than other children of average intelligence (Chamorro-Premuzic, 2009; Neihart, 2007). According to Torrance (1963), if we identify gifted children based solely on intelligence tests, we ignore 70% of children with high levels of creativity (Chamorro-Premuzic, 2009; Fox & Schirrmacher, 2012). In summary, it is also seen that there are studies indicating that there is no direct relationship between creativity and intelligence. In other words, it is said that an intelligent individual may not have the same degree of high creativity (Barbot et al., 2016; Dağlıoğlu, 2014; Kim et al., 2013). Creativity may require a certain level of intelligence. However, it is stated that a high IQ level does not necessarily mean high creativity. Similarly, average intelligence does not necessarily imply average creativity. Intelligence is seen as only one of the factors affecting creativity. It is stated that children with high levels of intelligence and children with high levels of creativity do not have the same profiles. Similarly, it is stated that the profiles of children with low intelligence and children with low creativity levels may not be similar (Fox & Schirrmacher, 2012).

Third Sub-question of the Research

In this study, the scores of gifted children on the sub-dimensions of the Scientific Imagination Inventory and the scores of their typically developing peers on the sub-dimensions of the Scientific Imagination Inventory were examined. It was concluded that the mean scores of gifted children in 6 sub-dimensions of the Scientific Imagination Inventory, which has 8 sub-dimensions, fluency, flexibility, originality, imagination experience, scientific reality and creation were higher than their typically developing peers. When the effect sizes of this significant difference were examined, it was seen that there was a large effect in 5 sub-dimensions and a medium effect in 1 sub-dimension.

Kaynar (2018) found results that support the findings of this study. In his study, all sub-dimensions of the main dimension of "Scientific Imagination"; scientific creativity (fluency, flexibility, originality), scientific sensitivity (emotional understanding, imagination experience) and scientific productivity (scientific reality, creation, reproduction) were examined. It was concluded that gifted students were more successful in all sub-dimensions of the main dimension of "Scientific Imagination" than students who were not diagnosed as gifted. Miller (2000) found that gifted students scored unexpectedly low on tests related to spatial ability, which may be related to scientific imagination, and scored lower on novel analysis tests that involve relationships such as perception and inference. These results have findings that differ from the results of this study. However, the same study also found that gifted students performed well on logical tests that require good memory.

Piechowski & Miller (1995) evaluated the developmental potential of gifted children and found that children aged 12-14 scored higher on emotional, intellectual and imaginative measures than children aged 9-11. Both the results of this study and the findings of other studies indicate that the levels of scientific imagination of gifted children differ more positively than their undiagnosed peers. Therefore, these areas of gifted children need to be supported from early

childhood. As a result of this support, both an opportunity for the development of existing potential can be created and a need of the gifted can be met.

Fourth Sub-question of the Research

Within the scope of this research, it was examined whether there was a difference in both creativity potential scores and scientific imagination scores according to gender. It was concluded that there was no significant difference between the sub-dimensions of creativity potential and scientific imagination inventory sub-dimension scores according to the gender of the children in the gifted group. Similarly, there is no significant difference between the sub-dimensions of creativity potential and scientific imagination sub-dimension scores of typically developing children according to their gender.

It is understood that there are very limited studies examining the difference of scientific imagination in the context of gender variable. In this context, there are studies that found that female students use imagination more than male students (Gündoğan, 2011). Pearson et al. (2001) investigated the relationship between having imaginary friends and gender in children aged 5-12 years. The study revealed that girls had more imaginary friends than boys. Forisha (1978) found a relationship between creative ability and keep alive image in women, whereas he found a relationship between creative ability and creative production in men.

Similar to this research finding, Baer & Kaufman (2008) emphasized that there is no evidence to support that there is a clear gender difference in creativity test results when the test results to measure creativity are evaluated in terms of gender differences. Similarly, Naderi et al. (2009), Wu (2010), Rudowicz et al. (1995) and Urban (2005) found that there is no gender difference in creativity. In some studies, there is no gender difference in creative product, in some studies girls outperform boys in some tasks, and in some studies boys outperform girls (Baer & Kaufman, 2008).

Stephens et al. (2001) reported that girls scored higher than boys in all subtests of the creativity test. Ai (1999) examined the effect of gender difference on the relationship between creativity and academic achievement and found that girls scored higher on fluency measures in natural sciences and mathematics than boys, which may be due to the gender role expectations of most societies for girls to imagine objects. DeMoss et al. (1993) state that women score higher than men in verbal creativity tests. Kershner & Ledger (1985) reported that both average and gifted girls scored higher in verbal and formal fluency than boys. Milgram et al. (1978), in their research on the quality and quantity of creative thinking in children and adolescents, state that older girls generate more ideas, but these ideas are not of high quality.
When the findings of the studies are examined in general, it will not be sufficient to explain the effect of gender alone on creativity and scientific imagination. There can be many individual, societal and cultural influences on both creativity and scientific imagination. Therefore, within the framework of the findings obtained in this study, it is not possible for the gender variable to predict creativity and scientific imagination alone.

Fifth Sub-question of the Research

In this study, the effects of EPoC sub-dimensions and Scientific Imagination Inventory sub-dimensions on children's likelihood of being gifted were examined. It was concluded that the DG sub-dimension of EPoC was a significant predictor of children's likelihood of being gifted. It is understood that the Scientific Creativity (fluency+flexibility+originality) sub-dimension of the Scientific Imagination Inventory is a significant predictor of children's likelihood of being gifted.

Gifted people are defined as people who have been determined by experts to be superior to their peers in cognitive abilities (Ataman, 2004; Sak, 2014). In other words, individuals who have a high level of performance or potential compared to their peers in terms of their mental abilities or intelligence, have a strong creative side, and are highly motivated to finish what they start (Clark, 2013). Some of the characteristics of gifted children are flexible thinking (VanTassel-Baska, 1994; 2005), have a vivid imagination (Freeman, 2003), creativity (Renzulli, 2005), excellent problem solving skills (Sak & Maker, 2005). In the literature, the characteristics of gifted children, such as high-level creativity, high imagination, being a good observer, having very interesting ideas, being extremely curious, asking a lot of questions and being able to solve complex problems, are closely related to creativity and scientific imagination. The findings

obtained within the scope of this study also support the characteristics of gifted students having creativity potential and scientific creativity. Therefore, it is thought that it may be important to support these skills in gifted children from an early stage.

Implications

Within the scope of this study, a positive and significant relationship between creativity potential and scientific imagination was determined. Therefore, designs (training program, activity, any content etc.) can be designed and implemented to develop and support these skills in children. In addition, variables that may affect creativity potential and scientific imagination can be examined. At the same time, the reasons for the differences in the creativity potential and scientific imagination of gifted children compared to their typically developing peers can be investigated. This study revealed that creativity potential and scientific creativity are characteristics of gifted children. Therefore, when identifying gifted individuals, multiple diagnoses can be made, such as tools that assess not only intelligence tests but also creativity potential and scientific creativity.

Limitations

One of the limitations of this study is that gifted children were diagnosed as gifted using only intelligence tests. Another limitation is that no intelligence test was applied to the group of undiagnosed peers of gifted children. Therefore, there may be children in this group who can be diagnosed as gifted. However, considering the prevalence of giftedness in the society, it is thought that the number of children who may be diagnosed may be quite low.

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Research Article

Algorithm-based mathematics from the perspective of gifted students: A case study [1]

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Abstract

An algorithm in mathematics is the design of a simple, clear, and specific order of the way to solve a problem. Designing an algorithm in accordance with the rules on the solution of a well-defined sample problem will enable students to consciously manage their own learning processes in solving the problem. The study aims to prepare algorithmic activities in accordance with the learning outcomes of the 4th-grade mathematics curriculum and to obtain the opinions of gifted students about these activities. The research was conducted using a case study design, one of the qualitative research designs. The study group consisted of 17 students studying at the 4th grade level of Science and Art Centre (SAC) in Afyonkarahisar province located in the west of Turkiye. The algorithmic activities were prepared with Lucidchart, a Web 2.0 tool that can prepare algorithms in a digital environment. In order to obtain the students' opinions about the activities carried out, a semi-structured interview form was prepared. The students were interviewed before and after the implementation of the activities. In the interview form, students' knowledge levels about algorithms were analyzed with Wilcoxon Signed Rank test. Students' algorithmic thinking awareness and their views on algorithm-based mathematics activities were analyzed by content analysis. As a result of the data analysis, while the students' knowledge level of the algorithm was low before the application, it increased to a high level after the application and revealed a significant difference. Accordingly, students were able to explain algorithmic thinking skills by producing many codes (rhythmic counting, calculating each path, Lego, experiment, artificial intelligence, instruction, etc.). The use of algorithms in mathematical activities was found to be fun, instructive, facilitating, interesting, revealing of prior knowledge, endearing, and a guide to mathematics. On the other hand, the use of algorithms was found to be tiring and boring due to its limitations in terms of step-by-step progress and immediate achievement of the result. The use of algorithms in mathematics teaching can improve students' algorithmic thinking skills and contribute to the development of their mathematical skills. In addition, it is suggested that these activities should be disseminated through the use of Web 2.0 tools.

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Introduction

Learning mathematics is a fundamental life skill. Like literacy, mathematical skills are involved in every aspect of our lives. Today, when technology is at the center of our lives, students need to use several skills effectively, such as structuring, modifying, communicating or integrating new information in different ways. Solving new problems and

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approaching new situations from a mathematical perspective should be as natural as using literacy to understand facts, insights, or information. In some cases, acquiring the mental tools to understand mathematics in as-yet-unknown mathematical applications is crucial for interpreting our environment and surviving successfully (Van de Walle, Karp, & Bay-Williams, 2021).

In today's education system, instead of filling students' minds with information that they may never use in their lives and will forget after some time (Umay, 2003; Yildirim, 2018), it is necessary to engage students' minds with skills such as problem-solving, establishing relationships, reasoning, and expressing their thoughts. Individuals should be made aware that mathematics is part of life, not operations and rules, and every learning opportunity should be used to develop mathematical thinking (Ministry of National Education [MoNE], 2018).

In mathematics lessons, some procedures and shortcuts that do not encourage students' thinking are directly given, and students are asked to memorize this information. However, students should be given opportunities (The Scientific and Technical Research Council of Turkiye [STRCT], 2022) to think about the subject, talk about it, create models, and give meaning to mathematics. The inclusion of activities in which students can easily express their own thinking and reasoning processes and see the shortcomings or gaps in others' mathematical reasoning processes will enable them to consciously manage their learning processes (MoNE, 2018). Thanks to these activities, mathematics becomes meaningful for students, and they will not have to memorize mathematical procedures.

Mathematics is based on concepts and operations with a certain order and a logical sequence. One of the basic elements of meaningful mathematics for students is to discover this order. It is very important to prepare environments that will allow students to see and create meaningful mathematical relationships (Karakus & Baki, 2020). One of the applications that will be used for the creation of these environments is algorithm-based applications. For the majority of people, the word algorithm is known to be something that is related to computer science (Hubalovsky & Korinek, 2015; Mayer, 1981). However, in computer science and in all areas of life, algorithms are used as a set of rules that govern a decision-making process (Bundy, 2007). For example, when you are preparing a meal, the steps in the recipe for that meal are, in fact, an algorithm (Atabay, 2019). Algorithm-based actions at every stage of our lives develop our systematic thinking skills and our algorithmic thinking skills. Algorithmic thinking is understanding, applying, producing, and evaluating algorithms (Brown, 2015). Algorithmic thinking is an important skill that should be emphasized because it is the basis of many actions, such as problem-solving, system design, and program development, from everyday skills such as describing places, understanding human behavior, and serving people (Copur, 2020). Therefore, considering that algorithms surround us, it can be concluded that the development of algorithmic thinking skills in individuals is an important achievement (Korkmaz et al., 2015).

Algorithmic thinking is not just a way of thinking related to computers. Algorithmic thinking is considered to be a way of thinking that is related to problem-solving (Aho, 2012; Wing, 2006). Algorithmic thinking refers to the systematic understanding of problem situations and the finding of generalizable solutions for problem-solving (Guler, 2021). In the current era of information and communication technologies, algorithmic thinking skills are considered an important prerequisite for the development of effective problem-solving skills and the use of information and communication technologies (Galezer et al., 1995). Teachers' beliefs, perceptions, and attitudes toward algorithmic thinking have an impact on both their algorithmic thinking practices and teaching approaches (Kordaki, 2013). Therefore, teachers should both have algorithmic thinking skills and should guide students in the development of algorithmic thinking skills (Guler, 2021). In addition, the inclusion of algorithmic thinking education in curricula at all levels of education is important (Papadakis & Kalogiannakis, 2019).

An algorithm in mathematics is the design of a simple, clear, and specific sequence of operations for the solution of a problem. For example, you must first perform the operation (3+5) and then the operation "result/2" if you want to find the average of the numbers 3 and 5. In an algorithm, where the steps in a logical sequence are designed to solve a particular problem, each step must be designed very carefully and must be terminated after a certain number of steps have been completed. The designed algorithms can be visualized, explained, and applied to the computer with the help

of a programming language (STRCT, 2022) by transferring them to the flowchart if desired. In the flowchart, different geometric shapes are used. The ellipse shows the place where the algorithm starts and ends. The parallelogram shows the data input from outside. The rectangle shows the operations, and the diamond shows the place where the decision or comparison is made (Guven, 2018). These shapes are universal. They make the algorithm more objective and understandable. Since students with visual intelligence express their thoughts more easily with shapes and symbols, they understand the logic of the algorithm better with the flowchart (Talu, 1999). Designing an algorithm to solve a well-defined sample problem according to the rules, considering all possibilities, and showing the designed algorithm with sequential logical steps with a flowchart enables students to consciously manage their own learning processes in solving the problem (MoNE, 2018; STRCT, 2022). Therefore, preparing algorithmic activities in solving mathematical activities will contribute to the development of students' algorithmic thinking skills and problem-solving skills.

In reviewing the studies conducted in the literature, it was found that there is a significant relationship between algorithm success and problem-solving skills (Demir & Cevahir, 2020). It was found that students were more successful in problem-solving on the basis of a standard algorithm than in problem-solving on the basis of a non-standard algorithm (Topal, 2015). The application of activity-based algorithms supports the problem-solving skills of children aged 5-6 years (Kucukkara, 2019). It was found that sixth-grade students were successful in developing fractional algorithms (Yildirim, 2019). It was found that developing and playing games at the pre-school, primary, and secondary school levels, as well as coding training with Scratch, positively influenced students' algorithmic thinking skills (Atabay, 2019; Dogan & Kert, 2016; Hsu & Wang, 2018; Oluk et al., 2018; Yildiz, 2020; Yunkul et al., 2017). A study with pre-service teachers concluded that the level of logical and mathematical intelligence of students has a positive effect on their algorithm development skills (Korkmaz, 2012). It has been observed that programming instruction in the context of mathematics is effective on students' mathematics self-efficacy (Psycharis & Kallia, 2017). An elective course called algorithmic thinking has been designed for prospective teachers of computer science, and it has been found to be effective and useful (Guler, 2021). As can be understood, it can be seen that algorithmic studies are included in different educational levels, from the pre-school education level to the higher education level. However, no study was found in which gifted students were included in the study group. Gifted students are special individuals with higher mental, social, and creative abilities than their peers (Ataman, 2000). Students who are gifted in mathematics stand out as individuals who can make analogies and develop independent, original, and creative solutions to mathematical problems by reasoning (Polya, 1962). Miller (1990) states that these individuals have an unusual curiosity for mathematical knowledge and can bring different, flexible, and creative solutions to problems other than the learned ones. Krutetskii (1976) stated that people with special abilities in mathematics can use the reasoning process by comprehending the complex structures of problems and simplifying complex processing systems. Gardner (2011) mentions that people with this area of intelligence can focus on structures that can develop generalizations rather than performing numerical operations and have developed the ability to form rules for significant concepts. According to Sriraman (2005), individuals gifted in mathematics have highly developed skills in organizing data, logical thinking, analytical and holistic thinking, problem-solving and construction skills, the ability to form problems and relationships in their minds, and the ability to think repeatedly. Therefore, the use of algorithms in creating and solving a mathematical problem will focus on the analytical and holistic thinking skills of gifted individuals and allow them to look from a broad perspective. Because creating the algorithm steps of the solution steps of a mathematical problem in students' minds, writing them down without skipping the steps, and checking whether this process works or not, will contribute to supporting them by improving their ability to organize data and information. Therefore, the superior characteristics of these individuals should be revealed and supported (Fernández et al., 2017; Navas-Sánchez et al., 2016; Pfeifer, 2012; Renzulli, 2012). In Turkiye, in order to support gifted students, enriched and differentiated educational content is provided through science and arts centers (SAC). In these centers, gifted students receive education under the guidance of expert teachers at certain times of the day so as not to interrupt their education at

school to recognize and develop their interests and talents. Students in 1st, 2nd, and 3rd grade are entitled to enroll in SACs when they succeed in art, music, and general mental ability exams. In these centers, Adaptation, Support Education, Individual Talents Awareness (ITA), Special Talents Development (SAD), and Project Production/Management programs are carried out, respectively. The Support Education Program is the education program that primary school students identified in the field of general intellectual ability continue after the Adaptation Program. This program aims to improve communication, cooperation, group work, learning to learn, problem-solving, scientific research, entrepreneurship, critical and creative thinking, effective decision-making, technology literacy, social responsibility, and effective use of resources. Classroom teachers, the implementers of the Support Education Program, carry out activities with different sub-themes in four modules each year and transition students to the next program. In addition, the educational situation dimension of the SAC curriculum states that teachers and students can establish content-rich learning experiences (MoNE, 2021). In the development of these students' mathematical skills, it was stated that teaching should be carried out with teaching methods and strategies that can provide them with positive learning experiences (Ozlu-Unlu et al., 2022).

Problem of Study

In this study, the aim was to integrate algorithms into gifted students' mathematical activities to provide them with a different learning experience. In this context, the opinions of the students of the 4-grade who attend the Science and Art Centre on algorithms and algorithm-based mathematics activities were investigated. The aim of this study is to prepare algorithm-based mathematics activities in accordance with the acquisitions in the 4th-grade mathematics curriculum and to obtain the opinions of 4th-grade SAC students about these activities. The questions of the research were formed as follows: For 4th-grade SAC students;

- What is their level of knowledge about the algorithm?
- What is their awareness of algorithmic thinking?
- What are their opinions on algorithm-based mathematics activities?

Method

Research Model

A case study, one of the qualitative research designs, was used to conduct the research. According to Creswell (2007), a case study is a research approach that analyses one or more situations in depth using data collection tools such as observations, interviews, reports, and related themes. A case study is a design that deeply investigates one or more events, environments, programs, social groups, or other related systems (McMillan, 2000). This study was an in-depth analysis of students' opinions about algorithms and algorithmic mathematics activities. In this context, interviews were conducted with 17 4th grade SAC students before and after the activities.

Study Group

The research was carried out with 17 students who are studying at the level of 4th grade in the field of general ability in a science and art center in the province of Afyonkarahisar in the 2021-2022 academic year. The study group the research was formed according to the convenience sampling method. Convenience sampling is one of the purposive sampling methods (Yildirim & Simsek, 2006). In convenience sampling, situations, where the researcher has easy access to the study group are preferred (McMillan & Schumacher, 2014). In this context, the researcher, who was a classroom teacher at SAC at the time, included 17 students who were taking the course as part of remedial education in the study group. Information about the students in the study group is presented in Table 1.

Table 1. Structures of participants and codes

No	Grade	Program	Gender	Age	Code
1	4th	Support Training	Female	9	S1-F-9
2	4th	Support Training	Male	9	S2-M-9
3	4th	Support Training	Male	9	S3-M-9
4	4th	Support Training	Female	9	S4-F-9
5	4th	Support Training	Male	9	S5-M-9
6	4th	Support Training	Female	9	S6-F-9
7	4th	Support Training	Female	9	S7-F-9
8	4th	Support Training	Female	9	S8-F-9
9	4th	Support Training	Male	9	S9-M-9
10	4th	Support Training	Female	9	S10-F-9
11	4th	Support Training	Male	9	S11-M-9
12	4th	Support Training	Male	9	S12-M-9
13	4th	Support Training	Female	9	S13-F-9
14	4th	Support Training	Female	9	S14-F-9
15	4th	Support Training	Female	9	S15-F-9
16	4th	Support Training	Female	9	S16-F-9
17	4th	Support Training	Female	9	S17-F-9

Table 1 shows that all 17 students who participated in the study were enrolled in the support program at the 4th-grade level and were in the same age group (9 years old). Six students were female (35.3%), and eleven were male (64.7%). The students were coded as participant number, gender, and age (S1-F-9).

Data Collection

The students who participated in the study were interviewed both before and after the application process. The interview is a mutual and interactive data collection process based on the asking and answering of questions for a predetermined and serious purpose (Yildirim & Simsek, 2006). For the interviews, a semi-structured interview form was prepared, which included three questions. During the interview, the students were asked to give an example of mathematical activity and to explain in detail their opinion about the activity. It took the students 15-20 minutes to answer the questions in the form in the pre-interview and 25-30 minutes in the post-interview. In preparing the interview form, the expert opinion of a faculty member of the teaching staff working in the field was sought. The following questions were included in the form.

1. About the algorithm;

( ) I have no knowledge.

( ) I have a low level of knowledge.

( ) I have a medium level of knowledge.

( ) I have quite a lot of knowledge.

( ) I have a high level of knowledge.

2. Write what comes to your mind when you think of algorithmic thinking skills.

3. What are your opinions about the use of algorithmic content in mathematics lessons?

Implementation process

The study was completed in 4 weeks within the scope of Support Education. In the first week, the researcher applied the interview form before the activities to get the opinions of the students. The third question in the form was asked only in the last interview after the students gained knowledge and experience about algorithms and prepared mathematical activities using flowcharts. After the students answered the first two questions in the interview form, a video was shown to them so they could comprehend what an algorithm meant (Kodla & Oyna, 2022). Then, the

students were told what the stages of the algorithm are, what the flowchart and the shapes to be used in the diagram mean, and examples from daily life were presented. Information about the shapes used in the flowchart is presented in Figure 1.

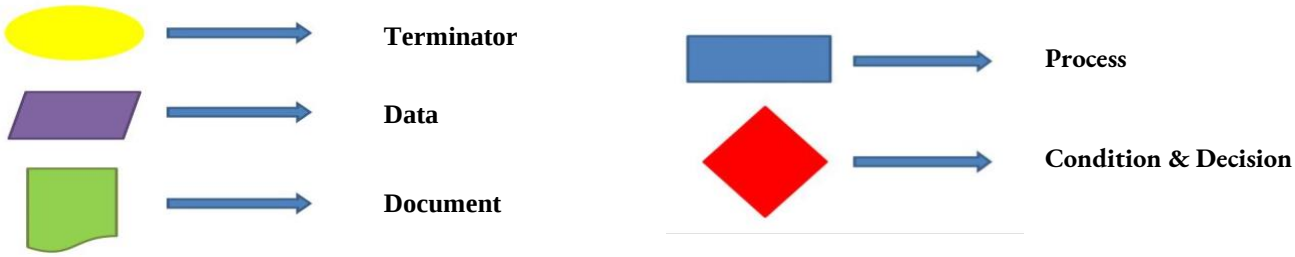
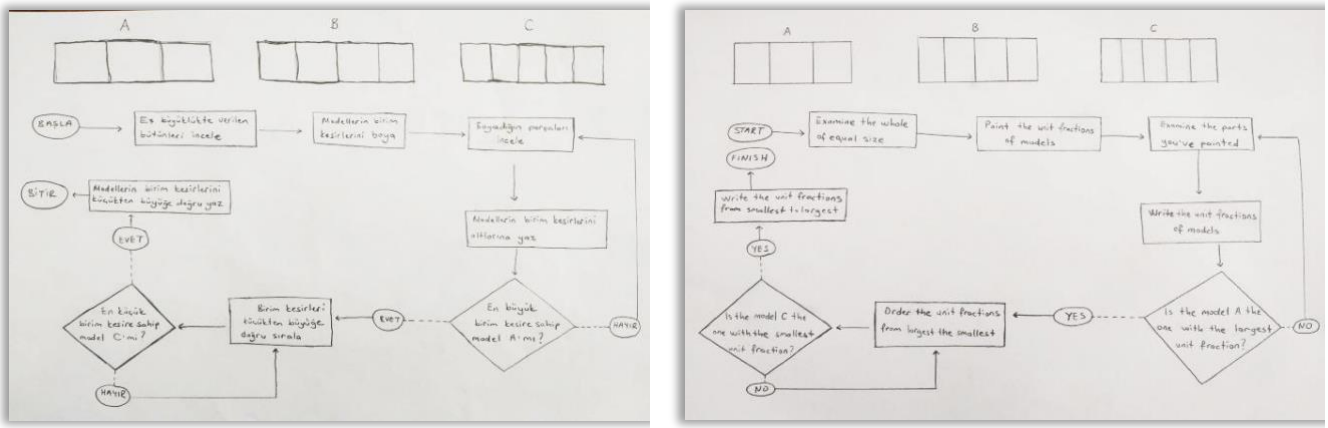


Figure 1. Figures Used in the Flowchart and Their Meanings

Figure 1 shows the shapes used in the flowchart while preparing the algorithm and what these shapes mean. In the flowchart, the ellipse starts and ends the algorithm. Parallelogram is used when a variable is entered from outside, a rectangle is used for calculation, and a rhombus is used for decision-making or comparison. Document shape is used for output. After these explanations, an algorithmic activity was prepared on the smart board with the students as an example.

In the second week, how to prepare an algorithmic activity suitable for the mathematics outcome was explained, and an example was presented (Figure 2). The students were also asked to prepare an algorithmic activity using the mathematics outcome on paper and then make a presentation. During the presentation, it was checked whether the flowchart was started correctly, whether the figures were used in accordance with their meanings, whether they fully guided the mathematical operations, and whether the result was reached. The following week, each student was given different mathematical outcomes to prepare and present algorithmic activities on paper. The students presented the activities they prepared one week later and evaluated them by considering the flowchart features and the mathematical outcomes.



Turkish English

Figure 2. A sample algorithmic activity prepared in accordance with the mathematics outcome

In the third week, Lucidchart, one of the Web 2.0 tools that can be used to create flowcharts, was introduced to the students. Lucidchart is a Web 2.0 tool that can easily create fun flowcharts. Algorithms can be created by logging into this Web 2.0 tool free of charge with an e-mail account. How to log in to Lucidchart Web 2.0 tool and how to prepare algorithmic activities were shown step by step on the smart board. After completing this task, a sample digital algorithmic activity was prepared, and students were asked to prepare and present algorithmic activities with this Web 2.0 tool. The students prepared their own algorithmic activities in the digital environment at home and made their presentations one week later (Figure 3). The other students also evaluated the presentations according to the features of the flowchart and their suitability to the mathematics objectives. In this way, the activities were completed with a total

of 28 mathematics objectives in 4 weeks. These objectives cover the learning areas of Natural Numbers (6 objectives), Addition with Natural Numbers (4 objectives), Subtraction with Natural Numbers (4 objectives), Multiplication with Natural Numbers (6 objectives), and Division with Natural Numbers (8 objectives). After the implementation, the interview form was filled in again, and the process was completed.

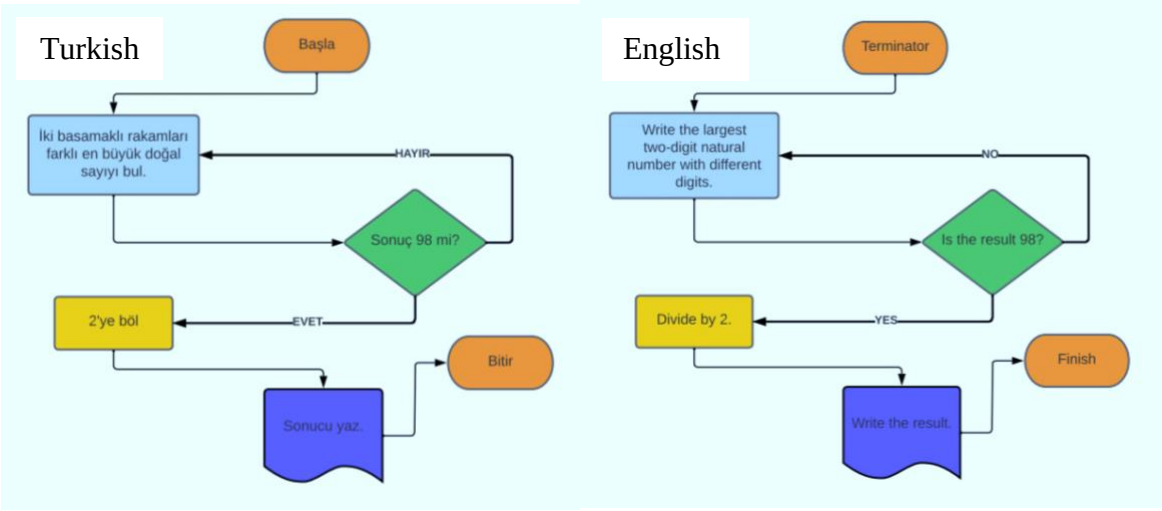


Figure 3. Sample Algorithmic Activities Prepared with Lucidchart

Data Analysis

In analyzing the first question in the interview form, the student's scores were first calculated using the criteria in Table 2 to determine the student's knowledge levels.

Table 2. Scores and information levels

Score	Scale Limits	Description
5	4.51-5.00	Highest
4	3.51-4.50	High
3	2.51-3.50	Moderate
2	1.51-2.50	Low
1	1.00-1.50	Lowest

According to Table 2, student's level of knowledge about algorithms was scored from 1 to 5. Before the application, 12 students scored 1 point, 3 scored 2 points, and 2 scored 3 points. After the application, 9 students received 3 points, 5 received 4 points, and 3 received 5 points. According to this score distribution, 12 students had the lowest level, 3 students had a low level, and 2 students had a medium level of knowledge about the algorithm before the application. After the application, 9 students reached the medium level, 5 reached the high level, and 3 reached the highest level of knowledge. Using these scoring criteria, the minimum and maximum values, averages, standard deviations, and Shapiro-Wilk test results of the scores obtained by the students before and after the application was calculated. The results of the descriptive statistics values obtained are shown in Table 3.

Table 3. Results of descriptive statistics

Application	n	Min	Max	*M*	sd	Shapiro-Wilk		
						Statistic	df	Sig.
Pre-application	17	1.00	3.00	1.41	0.71	0.62	17	0.00
Post-application	17	3.00	5.00	3.64	0.78	0.75	17	0.00

p>.05

In Table 3, the lowest score of the students before the application was 1 and the maximum score was 3. After the application, the lowest score was 3, and the highest score was 5. The average score before the application was 1.41, and the average score after the application was 3.64. According to the average score before the application, the student's level of knowledge about the algorithm was at the lowest level. In contrast, their level of knowledge increased to a high

level after the application. Wilcoxon Signed Ranks test was used to determine whether this differentiation was significant. The results of the Shapiro-Wilk test calculated for the pre-and post-application data were analyzed using this test. According to these results, significance values less than 0.05 indicate that the data do not meet the normality condition (Can, 2019). Therefore, it was assumed that the data were not normally distributed, and the Wilcoxon Signed Ranks test, one of the nonparametric tests, was used.

The qualitative data of the second and third questions were analyzed by content analysis. Content analysis is used to reduce qualitative data and to make logical inferences from qualitative data. In content analysis, the basic meanings of the data are tried to be determined (Patton, 2002; Yildirim & Simsek, 2006). The answers to the second and third questions were collected under categories and presented in tables so the reader could understand better.

Ethical Approval

Ethical approval was obtained from Afyon Kocatepe University Social and Human Sciences Scientific Research and Publication Ethics Committee (Decision Date: 13.05.2022, Decision Number: 2022/161).

Procedure

The application was carried out in the spring semester of the 2021-2022 academic year by the researcher, a classroom teacher at SAC. Before starting the application, the activity plans to be used in the activities were ready, and the researcher applied the interview form. The purpose and instructions of the form were explained to the students before the application. It was stated that the form was not an exam, but the results would be used for a scientific study. After completing the form, the activities were started. Information about the activities implemented is presented in Table 4.

Table 4. Information about the applied activities

Activity Name	Duration	Outcomes	Explanations
Getting to Know the Algorithm	4 class hours	- Creates an algorithm in accordance with the sequence of events in the text he/she listens to/watches. - Understands the logic of the algorithm. - Gives examples suitable for the definition of the algorithm.	It is explained what an algorithm is. Flowcharts and figures are introduced. Examples from daily life are presented.
Algorithm of a Problem	4 class hours	- Understands the logic of the algorithm. - Creates an algorithm for solving a problem. - Applies the algorithm steps according to the given instruction.	An algorithm for solving a mathematical problem is prepared and shown in a flowchart. Prepared algorithms are presented.
Digital Algorithm	4 class hours	- Creates an algorithm for solving a problem. - Applies appropriate instructions to the algorithm.	Digital algorithm preparation tools are introduced. Algorithms are prepared in the digital environment to solve mathematical problems. Prepared algorithms are presented.
My Digital Algorithm	4 class hours	- Creates an algorithm for solving a problem. - Performs commands according to the given algorithm.	Digital algorithms are prepared for solving a mathematical problem. Prepared algorithms are presented.

Table 4 shows information about the four different activities applied. The activities were applied to the support education program students in accordance with the learning outcomes determined in four class hours each week.

Visuals of these activities are given below. A sample activity plan is given in Appendix 1.

Figure 4. Algorithm Studies suitable for mathematics outcomes

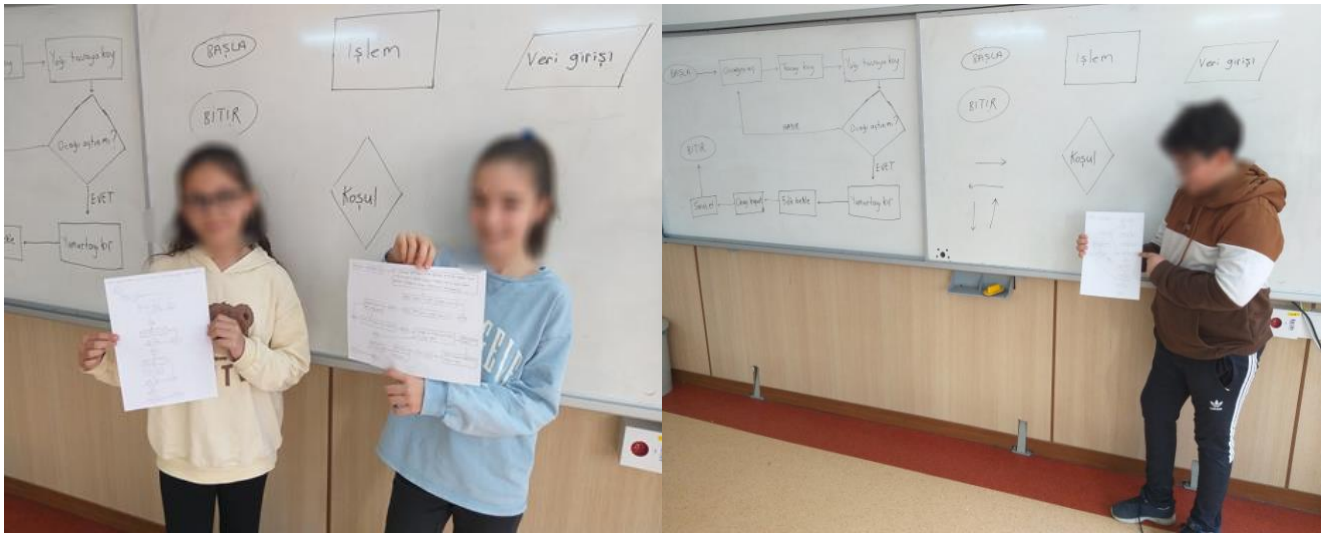


Figure 5. Presentations of algorithm activities prepared in accordance with mathematics outcomes

Results

This section presents the results of the Wilcoxon Signed Ranks test and content analysis obtained from gifted students.

Findings Related to Algorithm Knowledge Levels of Gifted Students

The first sub-problem of the research is to determine whether the knowledge levels of 4th-grade SAC students about algorithms differ significantly. In order to find an answer to this sub-problem, the Wilcoxon Signed Ranks test results conducted to analyze the students' scores before and after the application are presented in Table 5.

Table 5. Analysis of students' algorithm knowledge level scores before and after the application

Pre-application - Post-application	n	Mean rank	Sum of ranks	*z*	*p*
Negative	0[a]	0.00	0.00		
Positive	17[b]	9	153	-3.714	0.000*
Equal	0[c]				

p<.05

Table 5 shows a significant difference between students' scores before and after the application (z=-3.714, p<0.05). This finding shows that the activities increased the students' level of knowledge about algorithms. This increase was from the lowest level before the application (M=1.41) to the highest level after the application (M=3.64).

Findings Related to Algorithmic Thinking Awareness of Gifted Students

The second sub-problem of the research is to determine the awareness of 4th grade SAC students about algorithmic thinking. In order to answer this sub-problem, the data obtained before the application are presented in Table 6, and the data obtained after the application are presented in Table 7.

Table 6. Content analysis of students' awareness of algorithmic thinking before the application

Category	Code	f
Lowest	Organized thinking, thinking, visualization, imagination, organizing things, maps, science	7
Low	Higher level thinking, thinking in order, brain, robotic coding, arduino	5
Moderate	To plan, to think of all the ways to do things in order	3
High	-	-
Highest	-	-

In Table 6, in the category of "Lowest" students produced 7 codes (Organized thinking, thinking, visualization, imagination, organizing things, maps, science). In the "Low" category, students produced 5 codes (higher level thinking, thinking in order, brain, robotic coding, Arduino). In the category of "Moderate", students produced 3 codes (To plan, to think of all the ways, and to do things in order). This finding shows that students have limited knowledge about what algorithmic thinking skill is and where it is used.

Table 7. Content analysis of students' awareness of algorithmic thinking after the application

Category	Code	f
Lowest	-	-
Low	-	-
Moderate	How the computer works, what we do in daily life, work done in sequence, puzzle (2), Action done in sequence (3), telling in rhythmic order, doing step by step (3), rhythmic counting (2), calculating every path, Lego, experiment, spicy Turkish omelet, problem-solving, instruction, coding, software, robots, games	25
High	Command, robot (2), being able to do a job, detailed concepts, program, puzzle (2), Artificial intelligence, performing operations in order, rhythmic counting, step-by-step, Orientation, form	14
Highest	Algorithm steps, doing regular and planned work (2), computer programming	4

In Table 7, students produced 25 codes (rhythmic counting, calculating every path, Lego, experiment, spicy Turkish omelet, problem-solving, coding, etc.) in the category of "Moderate," 14 codes (command, robot, artificial intelligence performing operations in order, etc.) in the category of "High" and 4 codes (algorithm steps, doing regular and planned work, computer programming) in the category of "Highest" The increase in the variety and number of codes produced in the last interview data show that the student's awareness of algorithmic thinking has been formed due to the activities carried out and that they understand what it is used for.

Findings Regarding the Opinions of Gifted Students on Algorithm-Based Mathematics Activities

The third sub-problem of the research is to determine the opinions of 4th-grade SAC students about algorithm-based mathematics activities. In order to find an answer to this sub-problem, the findings of the answers given by the students to the last question in the interview form are presented in Table 4.

Table 8. Content analysis of students' opinions on algorithm-based mathematics activities after the application

Category	Code	f
Lowest	-	-
Low	-	-
Moderate	Fun (4) Instructive (3) Made it easier for us to do operations (3) My interest in the lesson increased (3) Revealed our previous knowledge Tiring Boring (2)	17
High	Fun (3) Instructive (3) Made it easy for us to do operations Made us love the math class Tiring Boring (3)	12
Highest	Fun (3) Orientation (2) It made it easier for us to make transactions	6

In Table 8, students with a moderate level of knowledge put forward 17 different views under 7 different codes and found the algorithmic activities fun, instructive, facilitating interesting and revealing preliminary knowledge. However, there are also students who say that these activities are tiring and boring. In this category, the student expressions that reveal the opinion that is entertaining, instructive, facilitating, interesting, and revealing preliminary information are presented below:

*S4-F-9: I think it is very **fun**. Normal maths lessons are very boring. I was bored at first, but as the activities progressed step by step and I solved the questions, I had a lot of fun.*

*S1-F-9: The algorithm helps me understand the operations more clearly. We are used to solving normal tests. This activity was a new **experience**.*

*S6-F-9: Performing operations with an algorithm **makes it easier** to solve the problem.*

*S9-M-9: I was very surprised, and it was very **interesting** that the algorithm used in every stage of life was also used in the mathematics lesson.*

*S16-F-9: It was different and beautiful. We solved the question using our **previous knowledge.***

Students with high level of knowledge reported 12 different opinions under 6 different codes and found algorithmic activities fun, instructive, facilitating, and endearing. There were also students who found these activities tiring and boring. In this category, the statements of the students who found the mathematics lesson endearing, tiring, and boring are presented below:

*S13-F-9: Since it is a different activity, it can be the favorite lesson in the class. If I had this course at school, it would be **my favorite** course.*

*S10-F-9: It would be useful, but some algorithms are very **tiring**. It never ends. When you can't do it, you start over again.*

*S12-M-9: The algorithm suits mathematics, but going step by step was a bit **boring**. You want to reach the result immediately, but you can't.*

Students with a highest level of knowledge expressed 6 different opinions under 3 different codes and explained that algorithmic activities are fun, guiding, and facilitating. In this category, student expressions reveal the opinions of fun, orientation, and facilitating are presented below:

*S9-M-9: Mathematics does not give us activities, but we learn in a **fun** way with algorithms.*

*S17-F-9: Solving questions like this is both practical and easy as it **orients** us.*

*S5-M-9: It makes the operations more understandable and **helps** me solve problems I had difficulty solving before.*

Conclusion and Discussion

The students' knowledge levels of algorithms significantly differentiated from the lowest level before the application to the highest level after the application. This result shows that most of the students did not know algorithms before. However, with the activities carried out after the application, the student's knowledge of the algorithm increased. We can say that the preparation and presentation of algorithms first on paper and then in a computer environment with the Lucidchart Web 2.0 tool in accordance with the mathematics achievements were effective in this result. While preparing these activities, the figures' meanings in the flowchart were considered; algorithm steps were applied to solve mathematical expressions and problems. In this way, students both gained knowledge about algorithms and different experiences in developing mathematical skills. Different learning experiences in developing mathematical skills and integrating today's technology into mathematics lessons are considered important in supporting the development of gifted students (Karakus & Baki, 2020; Komarudin et al., 2020). Similarly, the results that STEM activities contribute to the creative thinking skills (Kucuk Demir & Duzen Karatepe, 2022) and problem-posing skills (Yurtbakan & Aydogdu-Iskenderoglu, 2023) of gifted students show the need for different learning experiences in supporting gifted students. In addition, differentiated instructional design for value education increased the value development of gifted students; students were happy both to learn values and to create technology-supported products (Avcu & Yaman, 2022). In parallel with the results of these studies, providing differentiated learning experiences and integrating technology into learning activities can be considered an important result in terms of supporting gifted students. In the 21st century, the use of technology in education is considered important to make learning activities motivating, fun, and interesting (Hamdaoui et al., 2015; Yi & Mogilski, 2015). In this study, the preparation of algorithms with the Lucidchart Web 2.0 tool and the fact that the figures used in these algorithms were objective and understandable (Talu, 1999) made the mathematical activities more understandable. In addition, Çopur (2020) concluded that using Web 2.0 tools (Edmodo, LearningApps.org, Kahoot) effectively teaches algorithms, which shows the importance of supporting our research with digital content.

Students' awareness of algorithmic thinking before the application was explained with a total of 15 codes, 7 codes at the lowest level, 5 codes at the low level, and 3 codes at the medium level. After the application, their awareness was explained with 43 codes, including 25 codes at the medium level, 14 at the high level, and 4 at the highest level. Parallel to the increase in students' knowledge levels, the number of codes produced increased from 15 to 43, and there was a noticeable increase in the variety of codes. With the increase in the number and variety of codes produced, it is understood that students comprehend the logic and usage areas of algorithmic thinking. Guler (2021) obtained results that the algorithmic thinking course provides academic and life-related thinking skills, which supports the results of our study. The diversity of algorithm-based studies in different disciplines and subject areas shows that this result is predictable (Atabay, 2019; Galezer et al., 1995; Korkmaz et al., 2015; Papadakis & Kalogiannakis, 2019). Pre-service teachers found the algorithmic thinking course useful because it improved their algorithmic thinking skills; they reported that it was effective and useful (Guler, 2021). In addition, Yıldırım (2019) determined that activities involving algorithms contribute to students' knowledge-creation processes, which coincides with the results of our study.

Students' opinions on the use of algorithmic content in mathematics lessons after the application was explained with 35 codes, 17 codes at the medium level, 12 at the high level, and 6 at the highest level. Of these codes, 28 contain a positive perspective, and 7 contain a negative perspective. From the positive perspective, the logic of using algorithms in mathematics lessons was understood, and the activities were found to be fun and instructive, facilitating interesting and revealing prior knowledge. It has been determined that activity-based algorithm applications support children's problem-solving skills and that students enjoy and love these activities (Kucukkara, 2019; Yildiz, 2020). The results of these studies support the results of our research. It has been determined that applications such as games, Scratch, and Kodu Game Lab increase students' problem-solving skills (Alkan, 2019). In addition, it has been determined that these applications positively affect students' perspectives toward mathematics courses and their attitude scores (Sonmez, 2018; Yildiz, 2020). The fact that the algorithm is effective in solving a problem based on a standard algorithm (Topal, 2015), in creating algorithms about fractions (Yildirim, 2019), on mathematics self-efficacy (Psycharis & Kallia, 2017) shows the importance of this research supported by student opinions.

From the negative perspective, the students found these activities tiring and boring because they were limited in progressing step by step and reaching the result immediately. The fact that gifted students are individuals with fast thinking, problem-solving, and technology utilization skills may have been effective in this result. Although doing algorithmic activities can be tiring and boring, algorithmic thinking is an important skill for the development of skills such as analytical and systematic thinking (Hromkovič, 2006; Saeli et al., 2011), planned work, understanding problem situations and producing appropriate solutions (Coufal et al., 2017; Dasso et al., 2005; Saeli et al., 2011), and using technology effectively (Yi & Mogilski, 2015). This study contributed to developing skills such as communication, learning to learn, problem-solving, and technology literacy, which will be developed in support education program students.

Recommendations

The study was conducted with gifted students studying at the 4th-grade primary school level. Students with normal development can be included in the study with gifted students, and comparisons can be made. Research can be conducted to examine the effect of algorithm-based mathematics activities on gifted students' problem-solving skills, attitudes toward mathematics, or attitudes toward computational thinking skills. The study was obtained from the questions in the students' semi-structured interview form. In future studies, the research results can be interpreted from a broader perspective by including study groups, including primary, secondary, and high school students.

Limitations of Study

This research is limited to the qualitative research method, and the case study design carried out with this method. It is limited to 17 primary school 4th-grade students studying at the Science and Art Center in Afyonkarahisar province in the 2021-2022 academic year. The data obtained are limited to the interview form containing three questions created for this study. The research is limited to activities carried out for four weeks and four hours a week.

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Annex 1. Activity Plan Sample

Activity Plan

Activity Name: My Digital Algorithm
Suggested Duration: 40′+40′+40′+40′
Activity Outcomes: Outcome 1. Understands the logic of the algorithm. Outcome 2. Creates an algorithm for solving a problem. Outcome 3. Performs commands according to the given algorithm.
Interdisciplinary Cooperation: Mathematics
Learning-Teaching Methods and Technques: Lecture, question-answer, demonstration
Explanations: ➢ The mathematics outcome for the activity is determined. ➢ A problem addressing this outcome is written. ➢ The solution steps of this problem are determined. ➢ An algorithm is prepared by placing these steps in a flowchart. ➢ It is checked whether the algorithm works or not. ➢ The prepared algorithm is transferred to the Web 2 tool. ➢ Students apply the algorithm steps. ➢ Presentation of the algorithm is realized. ➢ Student presentations are evaluated.
Educational Technologies And Equipment Used: Teacher: Interactive board, Lucidchart Web 2 tool Student: Paper, pencil, eraser, crayons

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Research Article

Effectiveness of preservice training program for mathematic teacher candidates[1]

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Abstract

It is very important to identify and train gifted individuals who lead the development of societies. It is observed that teachers have a great importance in the identification and education of gifted students. At this point, teacher candidates field knowledge, attitudes and self-efficacy towards gifted students gain importance. This study aims to examine the effects of the Mathematics Teaching for Gifted Students course given in the faculties of education and the education provided by the Science and Art Center on the self-efficacy beliefs and attitudes of mathematics teacher candidate towards teaching the gifted mathematics course. The research model is a descriptive survey model. The research was designed as a single-group pretest-posttest experimental design. The data collection tools of the research are the Attitude Scale for the Education of the Gifted, adapted by Tortop (2014), and the mathematics lesson adaptation was used by making use of the scale developed by Girgin (2021) to determine the self-efficacy of mathematics teacher candidates regarding the education of gifted students. 86 teacher candidates who were studying in the department of primary education mathematics teaching at a state university in the Marmara Region and took the course of teaching mathematics to gifted students were included in the study with appropriate case sampling. The data obtained from the attitude and self-efficacy scales about the education of gifted students, which were applied to the mathematics teacher candidates at the beginning and end of the term, were analyzed with the SPSS 27 program using descriptive analysis, t-test, variance and correlation analysis. As a result of the research, it was concluded that the training provided caused a statistically significant difference in the self-efficacy beliefs and attitudes of the mathematics teacher candidates regarding the teaching of the gifted mathematics lesson. As a result of the research, no difference is observed in the self-efficacy and attitudes of teacher candidates related to the education of gifted students in terms of gender factor.

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Introduction

Education of gifted individuals is of great importance for the future of countries. Gifted individuals are candidates for taking many responsibilities for the rise of societies and humanity with their innate characteristics (Hökelekli & Gündüz, 2007). These individuals need special education due to their individual differences. Failure to provide this and not meeting the educational needs of gifted students will be a significant loss for countries. It has been found that societies that tolerate individual and cultural differences and pre-service teachers who shape those societies have a

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positive view of gifted education. It is very important for the future of gifted education to train teachers who can look at society with the concept of multiculturalism and look at the classroom, which is a mini society through individual differences (Tortop, 2014).

It is very important that these high-potential, gifted individuals, whom we can see as scientist candidates, are recognized and diagnosed and that they receive appropriate training. One of the main problems in the education of gifted students is the qualifications of the teachers who will teach them. In this context, teachers play an important role in the success of gifted education (Summak & Çelik-Şahin, 2014; Plunkett, 2000). Gifted students' teachers should be more talented and more imaginative than others (Lewis, 1982). To make a healthy diagnosis of gifted students, it is very important for teachers to have a positive attitude as well as having sufficient knowledge about the education of gifted students (Tortop & Kunt, 2012).

It is seen that gifted students learn most of the achievements in the program more quickly before the grade level (Tomlison & Alan, 2000). Differentiated instructional opportunities for gifted students should be provided. When the studies on gifted students are examined, it is frequently stated that these students are different from other students who attend formal education and they need to be supported by different teaching programs (Horn, 2002). In order to provide an appropriate education to gifted individuals, the programs should be suitable for the characteristics of these students and at the same time, the teachers who implement the program should receive special training and recognize the characteristics of these students.

When the literature is examined, many studies have shown that teachers' attitudes to gifted education and their self-efficacy beliefs about teaching these individuals are not at an adequate level (Gallagher, 1996; Gross, 1994; Sak, 2011; McCoach & Siegel, 2007; Lassig, 2003; McCoach, 2007, Tortop & Ersoy, 2015). The reason why the attitude to the education of the gifted is still being focused on may be factors such as the lack of knowledge of the educators in this area and the inability to provide adequate education on the education of the gifted (Lewis & Milton, 2005; Gallagher, 2007). In recent studies in Turkey, it is important to emphasize that teachers' attitudes towards gifted education are slightly above the undecided and that they are not very aware of institutions such as SAC (Tortop & Kunt, 2012; Kunt, 2012).

There is a 2-hour theoretical elective course called "Teaching Mathematics to Gifted Students" in the undergraduate education mathematics teaching program of education faculties. A 2-hour theoretical course given to some teacher candidates and not taken by all teacher candidates may not contribute much to the proficiency levels related to the education of gifted students. In this respect, it is necessary to include more courses to improve teacher efficacy regarding the education of gifted students. There are findings related to the fact that in-service training for existing teachers increase teachers' self-efficacy regarding gifted education (Tortop, 2014; Lassig, 2009; Plunkett, 2000). In this respect, it is important to increase the number of in-service training that can be done with SAC.

The importance of teaching mathematics for facilitating our lives is indisputable. This is even more important when it comes to gifted students. Because it makes it necessary for the programs to be prepared for them to differentiate further in mathematics (Sophian, 2004). In this context, mathematics teachers and candidates have more duties than other branches. It is really important to use new assessment and evaluation approaches in order to identify gifted students in the field of mathematics and to start teaching earlier, that is, the attitude and competence of the teacher. It is necessary to offer interesting activities that will ensure the participation of gifted students and encourage them to develop their mathematical abilities (Sheffield, 1994).

It is very important to identify and train gifted individuals who lead the development of societies. It is observed that teachers have great importance in the identification, training and education of gifted students. Professional competencies and personal characteristics of teacher candidates are very important in the development of their students. At this point, pre-service teachers' field knowledge, attitudes and self-efficacy toward gifted students gain importance.

When the studies conducted in our country on the education of gifted students are examined, it is seen that the

number of studies examining teachers' attitudes and self-efficacy is limited (Kaya, 2019; Sarar, 2018; Daştan, 2016; Akar, 2015; Güneş, 2015; Tortop, 2014; Dağlıoğlu, 2010). It has been observed that there is no study comparing their attitudes or self-efficacy. The main goal of the study is to examine the effects of the Mathematics Teaching for Gifted Students course given in the faculties of education and the education provided by the Science and Art Center on the self-efficacy beliefs and attitudes of pre-service mathematics teachers towards teaching the gifted mathematics course. In this context, answers to the following questions were in demand:

- What are the self-efficacy belief levels of mathematics teacher candidates related to the education of the gifted and do these levels change after the education received?
- What are the attitudes of mathematics teacher candidates to the education of the gifted and do these attitudes change after the education received?
- According to the gender variable do mathematics teacher candidates' self-efficacy and attitudes to the education of gifted students differ?
- Is there a significant relationship between mathematics teacher candidates' self-efficacy and attitudes toward gifted education?

Method

Research Model

In this research, within the scope of the descriptive survey model; Q1→X→Q2 single-group pre-test and post-test experimental design method was used. Here, a group is first administered a pretest, then an experimental procedure and a posttest at the end of the process (Creswell, 2013). The above-mentioned (Q1) mathematics teacher candidates' attitudes and self-efficacy levels to the education of gifted students were determined by pre-test before the applications, (X) Mathematics Teaching for Gifted Students course and SAC training process that continued with the participants for 14 weeks, (Q2) after the trainings. It shows the post-test that will examine the effect of teacher candidates on the attitudes and self-efficacy levels to the education of gifted students.

Study Group

86 teacher candidates, 61 female and 25 male, who were studying in the department of primary education mathematics teaching at a state university in the Marmara Region and took the course of teaching mathematics to gifted students, were included in the study with appropriate case sampling.

Data Collection Tools

As data collection tools, Mathematics Education of the Gifted for Self-Efficacy Scale developed by Girgin (2021), Gifted Education Towards Attitude Scale developed by Tortop (2014) were used.

Mathematics Education of the Gifted for Self-Efficacy Scale

Mathematics lesson adaptation was used by making use of the scale developed by Girgin (2021) to determine the self-efficacy of mathematics teacher candidates regarding the education of gifted students. They were asked to give a score between 0-5 (0 = not at all appropriate, 5 = completely appropriate) for the evaluation of the items of the scale. Cronbach's Alpha coefficient was calculated to determine the reliability of the 12 statements that make up the scale. The internal consistency coefficient of this study was determined as 0,929.

Gifted Education Towards Attitude Scale

It was developed by Gagne (1991) to determine the attitudes of teacher candidates to gifted education and its Turkish adaptation study was carried out by Tortop (2014a). As a result of the adaptation work of the scale, 14 items remained. As such, the scale consists of three dimensions: Needs and Support of the Gifted, Opposition to Special Services for the Gifted, and Creating Special Talent Classes. The internal consistency coefficient of this study was determined as 0.767. If the attitude scores obtained from the scale are above 4.00, it indicates a very positive attitude, if it is lower than 2.00, it indicates a very negative attitude, and between 2.75 and 3.25 indicates a state of neutral (Gagné, 1991).

Data Analysis

The data collected from the participants were analyzed with descriptive and inferential statistical methods. While calculating statistics such as mean and standard deviation as descriptive statistics, descriptive statistical methods were used to calculate skewness and kurtosis values for normality analyses. Field (2009) states that examining skewness and kurtosis coefficients in determining normality in social science studies will give more reliable results than Kolmogorov-Smirnov and Shapiro-Wilk tests. Mean, standard deviation, and paired samples t-test and correlation analysis were used in the analysis of the data determined to be normally distributed. All analyzes were performed using the SPSS 27 statistical software program. The ranges used when interpreting the mean score obtained from the scale as a result of the analysis are 0.00-1.80 "Very low", 1.81-2.60 "Low", 2.61-3.40 "Medium", 3.41-4.20 "High", 4.21-5.00 "Very high".

Procedure

The collection of data with the applications and measurement tools used during the research process was carried out with pre-service teachers for 14 weeks between March 2023 and June 2023. The calendar for the implementation processes of the research is given in the Table.

Table 1. Application schedule of the study

Date	Application
01.03.2023-08.03.2023 (1 week)	Application of Scales (Pre-test)
09.03.2023-.15.06.2023 (12 weeks)	Mathematics Teaching Course for Gifted Students
06.04.2023-06.04.2023 (3hours)	Kocaeli SAC Education(online)
05.05.2023-05.05.2023 (3 hours)	Kocaeli SAC Education(online)
16.06.2023- 23.06.2020 (1 week)	Application of Scales (Post-test)

A one-week period was allocated for the pre-test applications of the scales. After the pre-test applications, the course was taught for 12 weeks within the scope of Teaching Mathematics to Gifted Students. In the process, 3-hour training were given to teacher candidates online twice by Kocaeli SAC Education. At the end of the semester, the post-test scale applications were made and the data collection process of the research was completed. To teacher candidates; identification of gifted students in mathematics, advantages and disadvantages of labeling; characteristics of gifted students, development of gifted students in mathematics, program preferences for gifted students, differentiation, enrichment, acceleration for gifted students, supporting gifted students in the classroom, social relations with gifted students; Individualized education programs were provided for gifted students.

Results

Descriptive Statistics for the Variables of the Research

In order to determine whether the variables have a normal distribution, skewness and kurtosis values, mean and standard deviation values were calculated.

Table 2. Definitional statistics of scores from scales

Variable					Skewness		Kurtosis	
		N	$\bar{X}$	Ss	Value	Std.	Value	Std.
Attitude	Pre-test	86	3,62	0,570	,083	,281	-,326	,555
	Post-test	86	3,85	0,383	-,155	,281	-,409	,555
Self-Efficacy	Pre-test	86	3,39	0,774	-,719	,281	,306	,555
	Post-test	86	3,98	0,496	-,567	,281	-,273	,555

Table 2 when examined, it is seen that the skewness values of the variables are between -0.719 and 0.083, and the kurtosis values are between -0.409 and 0.306. For the variables to have a normal distribution, the skewness and flatness values must be between +2 and -2 (George & Mallery, 2010). It was observed that the calculated values were included in the specified range, and the assumption of normal distribution was met.

Self-efficacy of Mathematics Teacher Candidates towards Gifted Education

The first research question of the study, " What are the self-efficacy belief levels of mathematics teacher candidates related to the education of the gifted and do these levels change after the education received?". The findings regarding the sub-problem are given in Tables 3 and Table 4.

Table 3. The results of the analysis of the self-efficacy scores of the teacher candidates related to the education of the gifted before and after the trainings

Items		$\bar{X}$	Level	S.D
I can recognize my gifted student in my class in math class.	Pre-test	3,47	High	1,139
	Post-test	4,07	High	0,647
I can apply the Individual Education Program (IEP) that I have prepared for my gifted student.	Pre-test	3,13	Medium	1,117
	Post-test	3,78	High	0,786
I can make my gifted student value learning mathematics.	Pre-test	3,86	High	0,944
	Post-test	4,16	High	0,533
I can prepare a differentiated teaching plan compatible with the general curriculum for my gifted student.	Pre-test	3,22	Medium	1,172
	Post-test	3,66	High	0,776
I can communicate effectively with the family of my gifted student to support their mathematics education.	Pre-test	4,16	High	0,923
	Post-test	4,50	Very High	0,764
I can prevent the negative behaviors of my gifted student in my class that disrupt the positive classroom atmosphere in the mathematics lesson.	Pre-test	3,58	High	1,958
	Post-test	4,08	High	1,330
I can eliminate the situations that cause my gifted student to not be in harmony with his classmates in math class.	Pre-test	3,39	Medium	0,880
	Post-test	3,91	High	0,701
I can differentiate the forms of assessment for my gifted student in mathematics class.	Pre-test	3,08	Medium	1,145
	Post-test	3,87	High	0,692
I can prepare an Individual Education Program (IEP) for my gifted student.	Pre-test	2,92	Medium	1,157
	Post-test	3,80	High	0,570
I can prepare lesson activities that can be used in the education of my gifted student.	Pre-test	3,38	Medium	0,956
	Post-test	4,10	High	0,729
I can develop teaching materials for my gifted student in mathematics class.	Pre-test	3,26	Medium	0,975
	Post-test	3,66	High	0,570
I can apply instructional activities related to the education of gifted students.	Pre-test	3,23	Medium	0,940
	Post-test	3,84	High	0,772
Total	Pre-test	3,39	Medium	0,774
	Post-test	3,98	High	0,496

When Table 3 is examined, the highest average in the pre-test and post-test results is "I can communicate effectively with my gifted student's family to support their mathematics education." and the item "I can prepare an Individual Education Program (IEP) for my gifted student." has the lowest average. It was determined that there was an increase in the averages after the training in all items. When the total scores were examined, it was seen that the attitudes scores, which were medium level ($\bar{X} = 3{,}39$) before the trainings, increased to the high level $\bar{X} = 3{,}98$) after the training.

Table 4. Paired t-test analysis of pre-test and post-test results of mathematics teacher candidates' self-efficacy scores related to gifted education

		$\bar{X}$	S.D	Item pairs		t	p	η^2
				$\bar{X}_f$	S.D			
Self-efficacy	Pre- Test	3,39	0,774	-1,170	1,894	-5,280	0,000*	0,41
	Post- Test	3,98	0,496					

When the total score averages in Table 4 are examined, a statistically significant difference was found between the pre-test and post-test results of mathematics teacher candidates' self-efficacy scores related to the education of the

gifted (p=0.000<0.05). In other words, it can be said that the trainings provided increase the self-efficacy of the teacher candidates due to the education of the gifted.

Attitudes of Mathematics Teacher Candidates towards Gifted Education

The second research question of the study, " What are the attitudes of mathematics teacher candidates towards the education of the gifted and do these attitudes change after the education received?". The findings due to the sub-problem are given in Tables 5 and Table 6

Table 5. The results of the analysis of the attitudes scores of the teacher candidates regarding the education of the gifted before and after the training

Items		$\bar{X}$	Level	S.D
The best way to meet the educational needs of gifted students is to put them in special classes.	Pre-test	3,20	Neutral	1,345
	Post-test	3,50	Positive	0,672
Special programs for gifted students are inconvenient as they will create elitism.	Pre-test	3,55	Positive	1,225
	Post-test	3,77	Positive	0,913
Special education services for gifted students are a sign of discrimination.	Pre-test	4,10	Positive^{+}	1,256
	Post-test	4,11	Positive^{+}	0,978
Creating special classes for gifted students makes other students feel worthless.	Pre-test	2,73	Negative	1,330
	Post-test	3,30	Positive	1,132
Gifted children are often bored at school because their educational needs are not adequately met.	Pre-test	4,09	Positive^{+}	0,944
	Post-test	4,40	Positive^{+}	0,844
Gifted students waste their time in regular classrooms because their educational needs are not adequately met.	Pre-test	3,05	Neutral	1,195
	Post-test	3,74	Positive	0,968
Special education needs of gifted students are often neglected in our schools.	Pre-test	3,60	Positive	0,957
	Post-test	3,68	Positive	0,752
Gifted individuals need special attention and support to fully develop their abilities.	Pre-test	4,39	Positive^{+}	0,812
	Post-test	4,87	Positive^{+}	0,691
Our schools are already sufficient to meet the special education needs of gifted students.	Pre-test	4,24	Positive^{+}	0,858
	Post-test	3,61	Positive	1,149
Gifted students should be provided with education in regular classes, because gifted students act as an intellectual stimulant for other students.	Pre-test	3,07	Neutral	1,243
	Post-test	3,10	Neutral	0,765
If we divide students into gifted and others, we increase many more labels, such as strong-weak, sufficient-inadequate.	Pre-test	2,72	Negative	1,253
	Post-test	2,46	Negative	1,146
If gifted children are given special support and attention, they may become arrogant or selfish.	Pre-test	3,50	Positive	1,174
	Post-test	3,46	Positive	1,053
We should make the same investments for gifted students as were made for students with learning disabilities.	Pre-test	4,45	Positive^{+}	1,106
	Post-test	4,86	Positive^{+}	0,647
The normal programs of schools quench the intellectual curiosity of gifted students.	Pre-test	3,61	Positive	1,283
	Post-test	4,25	Positive^{+}	1,286
Total	Pre-test	3,62	Positive	0,570
	Post-test	3,85	Positive	0,343

When Table 5 is examined, the highest average in the pre-test and post-test results is " Gifted individuals need special attention and support to fully develop their abilities." and the item " If we divide students into gifted and others, we increase many more labels, such as strong-weak, sufficient-inadequate." has the lowest average. It was determined that there was an increase in the averages after the training in all items. When the total scores were examined, it was seen that the attitude scores that were high $\bar{X}$=3.62 before the trainings increased after $\bar{X}$=3.83 the trainings.

Table 6. Paired t-test analysis of pre-test and post-test results of mathematics teacher candidates' attitudes scores related to gifted education

		$\bar{X}$	S.D	Item pairs		t	p	η^2
				$\bar{X}_f$	S.D			
Attitudes	Pre- Test	3,62	0,570	-0,447	1,211	-3,152	0,002*	0,22
	Post- Test	3,85	0,343					

When the total score averages in Table 6 are examined, a statistically significant difference was found between the pre-test and post-test results of mathematics teacher candidates' attitude scores regarding the education of the gifted (p=0.002<0.05). In other words, it can be said that the trainings provided increase the attitudes of the teacher candidates regarding the education of the gifted.

Gender Factor

The third research question of the study, " According to the gender variable do mathematics teacher candidates' self-efficacy and attitudes to the education of gifted students differ? ". The findings regarding the sub-problem are given in Table 7 and Table 8.

Table 7. Independent samples t-test analysis of the gender variable of the self-efficacy scores of mathematics teacher candidates regarding the education of the gifted

		$\bar{X}$	S.D	t	p
Pre- test	Female	3,39	0,773	-0,83	0 ,934
	Male	3,41	0,811		
Post- test					
	Female	3,93	0,514	-1,454	0 ,155
	Male	4,11	0,431		

*p<0,05

When the total score averages were examined, it was seen that there was no statistically significant difference between the pre-test and post-test results of the pre-service teachers' self-efficacy scores due to the education of the gifted and the gender variable (pre-p=0,934>0,05/ post-p=0,155>0,05).

Table 8. Independent samples t-test analysis of the gender variable of the attitudes scores of mathematics teacher candidates regarding the education of the gifted

		$\bar{X}$	S.D	t	p
Pre-test	Female	3,63	0,513	0,08	0 ,993
	Male	3,61	0,731		
Post-test					
	Female	3,83	0,683	0,416	0 ,679
	Male	3,80	0,722		

*p<0,05

When the total score averages were examined, it was seen that there was no statistically significant difference between the pre-test and post-test results of the pre-service teachers' self-attitudes towards the education of the gifted and the gender variable (pre-p=0,993>0,05/ post-p=0,679>0,05).

Relationship of Self-efficacy between Attitudes towards Gifted Education

The fourth research question of the study, " Is there a significant relationship between mathematics teacher candidates' self-efficacy and attitudes towards gifted education?". The findings regarding the sub-problem are given in Tables 9 and Table 10.

Table 9. Correlation results between teacher candidates' attitudes to the education of gifted students and their self-efficacy before the training

Before the training		**AGE**	**SGST**
AGE	r	1	-0,051
	p	-	0,666
SGST	r	-0,051	1
	p	0,666	-

p < 0,01 **AGE: Attitude towards Gifted Education **SGST**: Selfefficacy of Gifted Students' Teachers

As can be seen in Table 9, no relationship was found between the self-efficacy score averages and attitude scores regarding the education of gifted students in the pre-test results.

Table 10. Correlation results between teacher candidates' attitudes towards the education of gifted students and their self-efficacy after the training

After the training		**AGE**	**SGST**
AGE	r	1	0,404**
	p	-	0,000
SGST	r	0,404**	1
	p	0,000	-

p < 0,01 **AGE: Attitude towards Gifted Education **SGST**: Selfefficacy of Gifted Students' Teachers

According to the post-test results in Table 10, it has been determined that there is a moderately positive relationship between the self-efficacy score averages about the education of the gifted and their attitude scores. In other words, as the self-efficacy scores about the education of the gifted increase, their attitudes towards the education of the gifted also increase positively.

Conclusion and Discussion

In this study, which attempts to determine the attitudes and self-efficacy of mathematics teacher candidates to the education of gifted students; It was found that the effects of the "Teaching Mathematics for the Gifted" course given in the education faculties and the "training given by the Science and Art Center" on the self-efficacy beliefs and attitudes of the pre-service mathematics teachers towards teaching the gifted mathematics course were found to be statistically significant. In the study, pre-test attitude scores of mathematics teacher candidates regarding the education of gifted students were found to be positive ($\bar{X}$=3.62). A positive attitude average was also obtained in studies in which the attitudes of teachers and teacher candidates to the education of gifted students were determined (Tortop & Kunt, 2012; Tortop, 2014; Güneş, 2015; Yıldırım & Öz, 2018). These results show parallelism with the findings of our study. Contrary to these studies, McCoach and Siegle (2007), in their study examining the attitudes of special education teachers towards gifted students, determined that they exhibited more negative attitudes than others. After the trainings, it was observed that there was an increase in the post-test attitude scores related to the education of the gifted and approached the "very positive" level by increasing ($\bar{X}$=3.85).

In the study, pre-test self-efficacy scores of pre-test mathematics teacher candidates regarding the education of gifted students were at the level ($\bar{X}$=3.39). Güneş (2015), Girgin and Şahin (2019) determined teachers' self-efficacy for gifted students. It was determined that he was at a slightly above average level in the studies he examined. After the trainings, it was observed that the post-test self-efficacy scores related to the education of the gifted increased ($\bar{X}$=3.98) and reached the "high" level. In the study conducted by Tortop (2014) to determine the self-efficacy of teachers or teacher candidates about the education of gifted students, a training was prepared for teachers on the education of gifted individuals, and as a result of the training, there was a significant difference in teachers' self-efficacy perceptions related to the education of gifted individuals. It has been observed that self-efficacy perceptions related to gifted education have increased. This result shows that our study supports the higher self-efficacy perception of teacher candidates who attend a seminar or training on the education of gifted students. It is seen in studies that providing

teachers with training on gifted students and their characteristics causes an increase in teachers' self-efficacy related to the education of gifted students (Hansen & Feldhusen, 1994; Goodnough, 2001; Gross, 1994; McCoach & Siegle, 2007; Lassig, 2009; Tortop, 2014b). It is also very important to increase the attitudes and self-efficacy of teacher candidates towards gifted education in the educational process (Tortop, 2014c).

The outcome of our research is that there is no significant difference when the attitudes and self-efficacy of mathematics teacher candidates to the education of the gifted are examined due to the gender variable. Yıldırım and Öz (2018), Demirhan, Kaya, Canan and Gür (2016), Tortop and Kunt (2013), Güneş (2015) and Troxclair (2013) reported in their studies that the attitudes of teachers and teacher candidates to the education of gifted students do not change according to the gender variable they have done. Contrary to these studies, Gencel and Satmaz (2017) and Metin, Şenol and İnce (2017) determined that there was a significant difference in favor of female teacher candidates. When the literature is examined, it was seen that the self-efficacy of teacher candidates regarding the education of gifted students did not change due to the gender variable in the studies of Girgin and Şahin (2019), Güneş (2015) and Tortop and Ersoy (2015).

It has been determined that there is no significant relationship between the pre-test scores of mathematics teacher candidates' self-efficacy regarding the education of the gifted and their attitude to the education of the gifted, and there is a moderate positive relationship after the training given. In the study of Güneş (2015), a weak relationship was determined between classroom teachers' self-efficacy regarding the education of gifted students and their attitude scores. Tortop (2014b) stated that gifted students should have positive views and attitudes and a perception of self-efficacy for differentiated teaching practices related to education. In this context, it can be thought that an increase in the self-efficacy levels of teachers and teacher uncles related to the education of gifted students may also correspond to an increase in their attitudes towards gifted education.

In line with the findings of this study, suggestions can be made that:

- The number and hours of lectures for the education of gifted students in all branches in education faculties should be increased.
- During undergraduate education, teacher candidates in different branches should be given trainings to increase their self-efficacy and attitudes towards gifted education.
- In addition to quantitative studies, qualitative research can be conducted on the gifted education of teacher candidates and teachers in different branches during or after undergraduate education.
- It has been observed that the education conducted within the scope of the research increased the self-efficacy and awareness levels of the teacher candidates regarding the education of gifted individuals.

In this context, it should be ensured that gifted individuals make observations and practices in the Science and Art Centers where they are educated, within the scope of the teaching practice course or with different approaches.

Limitations of Study

The research was carried out with a limited sample of 86 teacher candidates at Kocaeli University Faculty of Education. Repeating this study with a higher number of participants and examining different variables will increase generalizability. The study was carried out using purely quantitative data.

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Research Article

Determining the trend of science education topics in gifted education research with R studio program

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Abstract

The aim of the study is to examine the trends and results of studies on giftedness in science education by making bibliometric analyzes through the R program. For this purpose, 443 scientific studies published between 2000 and 2022 were accessed from Web of Science (WoS). The data were analyzed under the headings of numerical distribution by year, keyword, active scientific study, active researcher, active journal, active institution and most collaborating country. Result show that the most published scientific study on giftedness in science education was in 2016 and the highest citation rate was in 2003. The most common and central keywords related to giftedness in science education were "learning", "creativity" and "development". In addition, the most influential scientific study was "Tracking exceptional human capital over two decades", the most prolific author was "VanTassel-Baska, J.", the most influential journal with the highest co-citation network was "Gifted Child Quarterly", the most influential institution was "National Taiwan Normal University", and the most collaborative country was "USA". This study provides a perspective for future studies by revealing the gaps and emerging trends of giftedness in science education.

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Introduction

Human beings have been to influence and make sense of the environment and the world since the day they came into existence. In this endeavor, individuals whose mental potential, problem-solving skills, creativity and leadership qualities are superior to others, i.e. gifted individuals, emerge more prominently (Tarhan & Kılıç, 2014). It is difficult to define a gifted individual because of his/her complex structure. However, in general, gifted individuals have higher levels of intelligence, talents, expertise, creativity and motivation compared to individuals with normal development. A gifted individual is a person who transfers these characteristics to fields such as science, technology, leadership, creativity, art, aesthetics, music and shows high performance in these fields (Feldhussen, 1986; Kaya, 2022). Considering these gifted students need to be educated. Because although gifted individuals have some innate talents, it is difficult for gifted individuals to reveal their true potential without a good education. Therefore, gifted individuals, who make up approximately 2% of every society and are seen as an above-ground treasure for countries, should receive a good education designed for them (Tanık Önal & Büyük, 2020). It is important for a society to recognize and identify gifted individuals from an early age and provide them with appropriate education. This is because it is believed that gifted

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individuals who are well educated from an early age will produce science, technology, aesthetics, art and practical benefits and thus accelerate the development of society (Betts, 1986; Tortop & Kunt, 2013). In this sense, the education that society provides to gifted individuals is of vital importance in every step of the process of developing their talents. Society should strive for a good education for gifted individuals and gifted individuals should take charge of their own development and growth. Finally, the ultimate goal of gifted individuals in education should be prestige and high achievement (Subotnik, Olszewski-Kubilius & Worrell, 2011).

Research on academically giftedness or giftedness in science

The importance of science and technology in understanding and interpreting the world is undeniable. It is a fact that gifted individuals play a key role in the development of fields such as science, technology and arts. Countries care about gifted people and their education in order to raise the living standards of the society, to increase their power in science, technology and industry, and to make economic gains. In this respect, giftedness has been an important area of research in recent years. Gifted individuals have above-average creativity and scientific research skills. They show strong engagement, interest and motivation in science. Therefore, gifted individuals tend to choose science and technology related courses and show high motivation in those courses. One of the most important courses to provide this service to gifted students is science (Han & Shim, 2019; Kaya, 2022). Science lessons support students' scientific development and develop their sense of curiosity. Thanks to science course, gifted students can create new products and take these skills beyond school. For example, gifted students can design experiments, create personal laboratories and actively participate in scientific journals and books. Therefore, science education for gifted students is necessary (Kunt & Tortop, 2017).

In science, students construct new knowledge through research, reading and discussion. Through these lessons, students also learn how to predict the consequences of their actions. Such achievements reveal the importance of science courses (Tekbıyık & Akdeniz, 2008). Science education is the pathway through which individuals develop their creativity, develop scientific understanding and foresight, and apply scientific literacies to daily life. In addition, the intelligence, aptitudes, talents, expertise, motivation and creativity characteristics of gifted individuals are likely to become more evident of science. Therefore, the field of giftedness in science education has become a priority for countries and states due to these characteristics of gifted individuals and their support for the development of their countries (Demir & Çelik, 2020; Feldhusen, 1986; 1994; Sumida, 2013).

Bibliometric studies and importance

Content analysis and bibliometric analysis are used to map scientific studies. Content analysis examines abstracts of full texts and explores thematic organization, the use of methods and paradigms in a particular field. Content analysis is time-consuming and laborious. It is also limited in terms of analyzing many scientific studies. Another limitation of content analysis is that it is performed subjectively by an author or group (Kuzhabekova, Hendel & Chapman, 2015). Bibliometrics is a quantitative and systematic method that allows an objective evaluation of the literature (Garfield, 1979; Mourao & Martinho, 2020). Bibliometric studies examine coded information about the publication such as the name of the author, the institution to which the author is affiliated, the country where the author lives, keywords, etc. without examining the content of scientific studies. The aim here is to identify and evaluate the status of authors, journals, institutions and countries. It also supports the discovery of patterns of ranking and collaboration in terms of productivity related to the publication. This is achieved through special software that can analyze the bibliographic record (Hernández-Torrano & Kuzhabekova, 2019). Although the use of bibliometric methods is not new (Kessler, 1963), its use is increasing thanks to databases such as WOS, SCI and SSCI, which are easily accessible online. The validity of research articles also largely depends on the representation of the scientific topic being researched in the database (Mongeon & Paul-Hus, 2016). One of the databases that can provide this validity is Web of Science (WoS) (Bicakci & Baloglu, 2021).

Bibliometric analysis provides researchers with insight, enabling them to progress in their work, such as citations of research areas, authors' subject areas, methodologies, and values of other authors' work (Ertz & Leblanc-Proulx, 2018; Zupic & Čater, 2015). Bibliometric studies are significant as to determining the current situation in the field in a holistic

manner and guiding researchers (Demir & Çelik, 2020). When the literature is examined, bibliometric studies on giftedness are found (Gürlen, Özdiyar & Şen, 2019; Hernández-Torrano & Kuzhabekova, 2019; Sierra et al., 2015). Although these studies add a lot of value to the field of giftedness, there are no studies that have conducted bibliometric analyses on giftedness in science education. In addition, it is thought that the study will make significant supports the field because it covers a 52-year period between 1970 and 2022, includes 433 articles, and bibliometric analysis and citation network analysis, thematic analysis, etc. are done with a different analysis program than others by using only R Studio program.

Research aim and problem

The aim of this study is to determine the bibliometric characteristics and common citation network structure of the studies on giftedness in science education and to determine the trends in the field and the effective documents, researchers, sources and countries. This study will provide a solid basis for future studies through bibliometric analysis of giftedness in science education. In addition, it is hoped that this study will shed light on the under-studied topics related to giftedness in science education and the basic resources that guide the field. In this context, answers to the following problems were sought in the study:

- What is the numerical distribution of scientific studies published on giftedness in science education and their citations by years?
- What is the keywords network for giftedness in science education?
- Which are the most effective studies published on giftedness in science education?
- Who are the most prolific authors on giftedness in science education and who are the authors with the most common citation network?
- Which is the most influential scientific journal on giftedness in science education and which journal has the most common citation network?
- Which institutions are effective in scientific studies published on giftedness in science education?
- Which countries cooperate the most in scientific studies published on giftedness in science education?

Method

Research Model

In this study, a bibliometric analysis of studies on giftedness in science education was conducted. Bibliometrics is based on statistical and mathematical methods used to identify studies in a particular field according to certain parameters (Pritchard, 1969). The flow chart used for the bibliometric method in this research is shown in Figure 1. In this regard, a 5-step procedure was carried out for mapping in management and organization (Zupic & Čater, 2015).

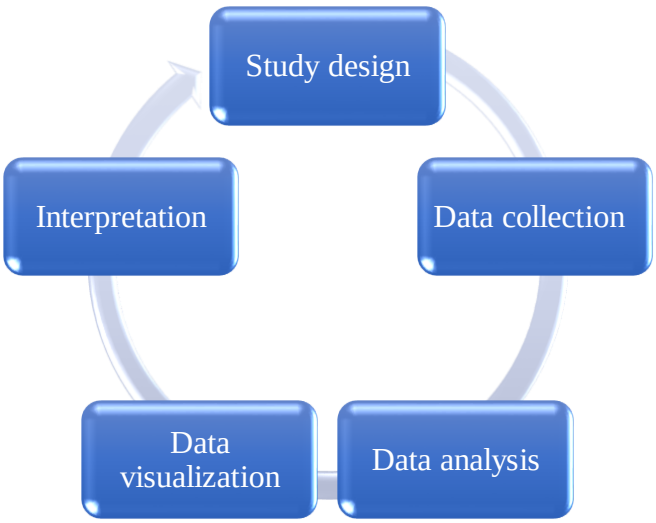

Figure 1. Workflow implementation steps in bibliometric analysis

In the first step of the research, questions are defined and a bibliometric method appropriate to the answer to the questions is selected. In the data collection step, databases such as WoS, Scopus and SSCI are selected and the data are exported by filtering and scanning according to the research questions. In this step, the researcher creates his/her own data. In the data analysis step, the data is analyzed using a bibliometric software. In the data visualization step, programs such as R, Citespace and vosviewer that can be used to visualize the results obtained in the analysis step are decided and appropriate software is used for visualization. Finally, in the data interpretation step, the results are interpreted and explained.

Data Collection Techniques

In order for bibliometric analyses to take place, it is necessary to collect data appropriate to the design of the research. Databases likes WoS, Scopus, and Microsoft Academic are used for data collection in bibliometric analysis. In this study, the Web of Science database was preferred because it has multiple databases, contains citation data, and covers different formats such as abstracts, proceedings, and technical articles (Moral-Muñoz, Herrera-Viedma, Santisteban-Espejo & Cobo, 2020). Web of Science Core Collection Advanced Search database 1970- Between 2022, the "Topic" field was selected and “"gifted education" or "gifted student" or "gifted child" or "gifted" or "giftedness" or "giftedness" or "talented education" or "talented student" or "talented child" or "talent" or "talentless"” and “"science education" or "science teaching" or "science learning" or "science instruction" or "science content" or "science concepts" or "science facts" or "science activities" or "science curriculum" or "science class" or "science classes" or "science teachers" or "science material" or "science achievement" or "science program" or "science vocabulary" or "science laboratory" or "science text" or "science text" or "science textbooks" or "science performance" or "science centre" or "science unit" or "science study" or "science standard" or "science passages" or "science course" or "science inquiry" or "science for students" or "interest in science" or "teaching science" or "learning in science" or "education in science" or "inclusive science"”. As a result of the search, 449 scientific studies were reached (Access Date: 25 Jully 2023). It has been left out as the year 2023 continues. There may be the same and incorrect index documents that may arise from this and the first study published on giftedness in science education was in 1970, the search was limited between 1982-2022 and the number decreased to 433. Regarding the document type of scientific studies, the most common types were articles (n=278, 64.2%), proceedings paper (n=118, 27.3%) and other (review, editorial material, etc.) (n=37, 8.5%).

Data Analysis

The changes in research data such as organization, region, source, research method, number of citations were determined through the Office 2021 program and the data were uploaded to the R Studio program. R studio is a statistical package used for bibliometric and visualization of data obtained from Bibliometrix, WoS and Scopus databases. Bibliometix is a bibliometric analysis package written in R. R program consists of open libraries, open algorithm and open graphical software. This allows for statistical algorithms, mathematical operations and visualization. This makes it a good candidate for bibliometric analysis (Derviş, 2019). Through R studio, the numerical distribution of scientific studies of giftedness in science education, keyword analysis, the most effective scientific studies, the most effective authors, the most effective sources, the most effective institutions and the countries that cooperate were analyzed. Visuals were also included as a result of the analysis.

Results

In this study, the annual number of publications and citations, word analysis, influential researchers, influential journals, influential institutions and influential countries of scientific studies on giftedness in science education were examined and findings were reached.

The distribution of citations and publications of 433 scientific studies on giftedness in science education, which were obtained as a result of the search, is presented in Figure 2.

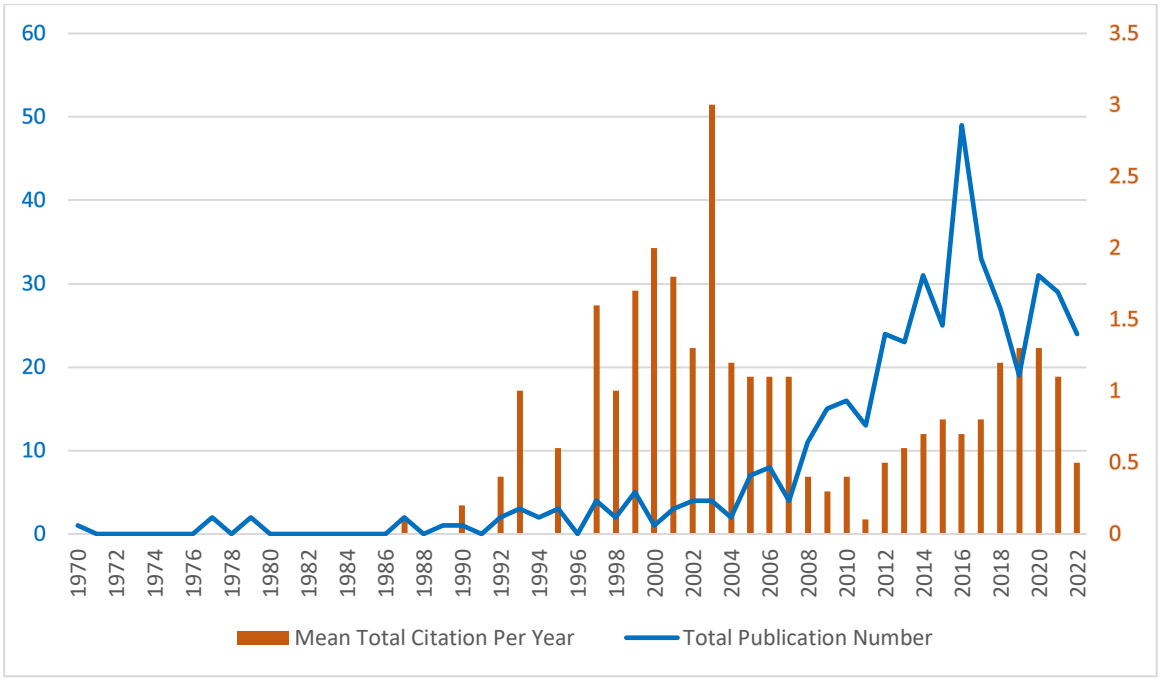

Figure 2. Number of citations and publications of scientific studies on giftedness in science education

Figure 2 shows that the upward trend studies on the field started in 2008 and reached its maximum level in 2016. Looking at the annual total citation averages, it is seen that the upward trend started in 1997 and reached its maximum level in 2003. From 2008 to 2022, the ratio of publications to total publications is 85.5%, and from 1997 to 2022, the ratio of citations to total citations is 90.1%.

The thematic analysis of keywords related to scientific studies on giftedness in science education is presented in Figure 3.

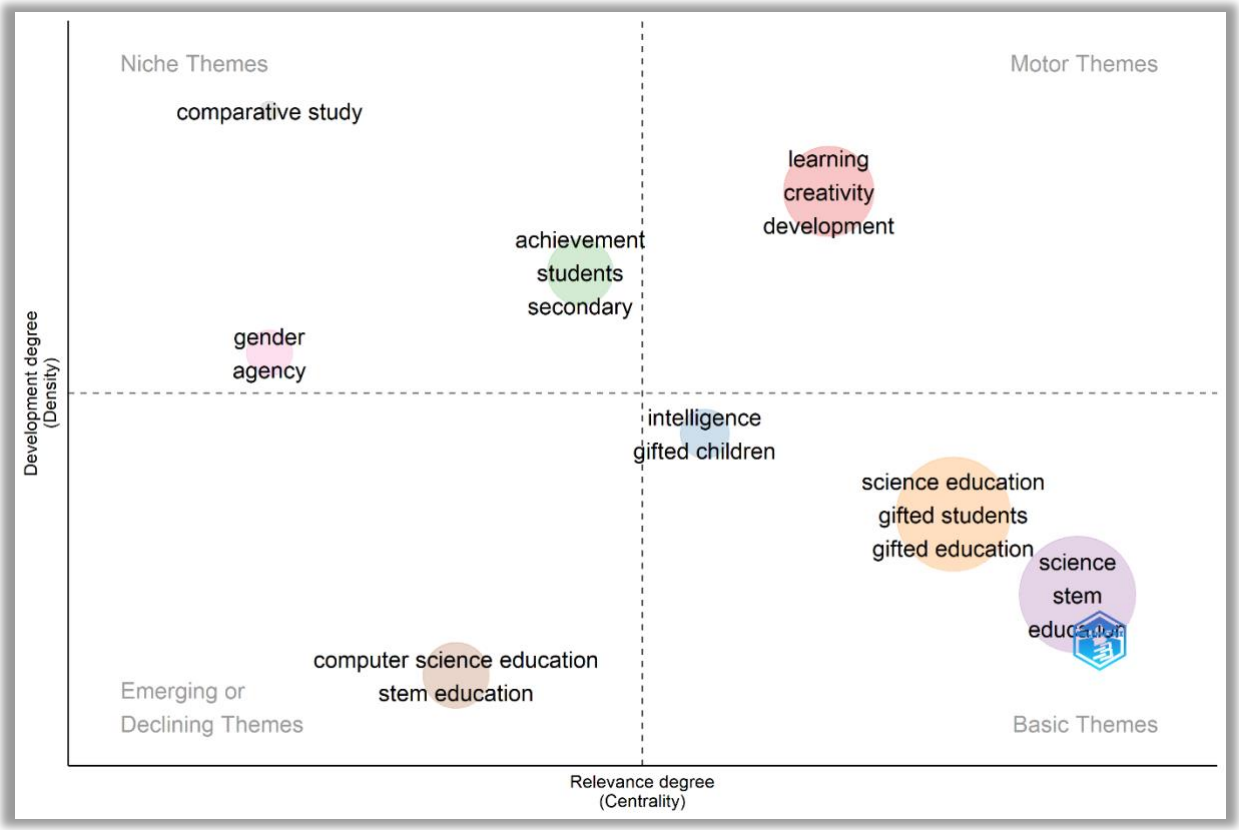

Figure 3. Thematic analysis of keywords related to scientific studies on giftedness in science education

A total of 1563 keywords, including 1176 different types of keywords, were identified for studies on giftedness in science education. When the graph is analyzed, it is seen that the words "science education", "stem", "gifted student" and

"gifted education" are in centrality. The words with both centrality and density in the related field are "learning", "creativity" and "development". In other words, the keywords "learning", "creativity" and "development" were determined as the most robust keywords in the literature. In addition, it is seen that "intelligence" and "gifted children" have a centrality above the medium level and a density slightly below the medium level. In addition, "computer science education" and "stem education" are considered as disappearing or emerging keywords, while "comparative study" is considered to be decentralized but widespread. The top 10 most cited scientific studies on giftedness in science education are presented in Table 1.

Table 1. The top 10 most effective scientific studies on giftedness in science education according to the level of citation

Name of article	Authour(s)	Year	Journal	LC	GC
Tracking exceptional human capital over two decades	Lubinski, D., Benbow, C. P., Webb, R. M., & Bleske-Rechek, A.	2006	Psychological Science	5	118
The effects of a science-focused STEM intervention on gifted elementary students' science knowledge and skills	Robinson, A., Dailey, D., Hughes, G., & Cotabish, A.	2014	Journal of Advanced Academics	5	39
Identifying twice-exceptional children and three gifted styles in the Japanese primary science classroom	Sumida, M"	2010	International Journal of Science Education	4	7
Science enrichment programs for gifted high school girls and boys: Predictors of program impact on science confidence and motivation	Stake, J. E., & Mares, K. R"	2001	Journal of Research in Science Teaching	3	104
Self-regulated science learning with highly gifted students: The role of cognitive, motivational, epistemological, and environmental variables	Neber, H., & Schommer-Aikins, M.	2002	High Ability Studies	3	104
The translation of teachers' understanding of gifted students into instructional strategies for teaching science	Park, S., & Oliver, J. S".	2009	Journal of Science Teacher Education	3	17
Project Clarion: Three years of science instruction in Title I schools among K-third grade students	Kim, K. H., VanTassel-Baska, J., Bracken, B. A., Feng, A., Stambaugh, T., & Bland, L.	2012	Research in Science Education	3	17
Encouraging talented girls in math and science: Effects of a guidance intervention	Kerr, B., & Robinson Kurpius, S. E.	2004	High Ability Studies	2	47
Gendered practices in the education of gifted girls and boys	Kerr, B. A., Vuyk, M. A., & Rea, C.	2012	Psychology in the Schools	2	13
Visual–spatial ability: Important in STEM, ignored in gifted education	Andersen, L.	2014	Roeper Review	2	36

LC: Local Citation **GC**: Global Citation

Table 1 shows that the most cited is "Tracking exceptional human capital over two decades". This study was published in 2006 in the journal "Psychological Science" by the authors "Lubinski, D., Benbow, C. P., Webb, R. M., & Bleske-Rechek, A.". It was found that the study was cited 5 locally and 118 globally. This study is followed by the article titled "The effects of a science-focused STEM intervention on gifted elementary students' science knowledge and skills". It was determined that the study was cited at 5 local and 39 global levels. The third most cited study on giftedness in science education is the article titled "Identifying twice-exceptional children and three gifted styles in the Japanese primary science classroom". This study was cited 5 at local level and 7 at global level.

The productivity of the authors publishing on giftedness in science education by years and the co-citation network of the authors are presented in Figures 4 and 5, respectively.

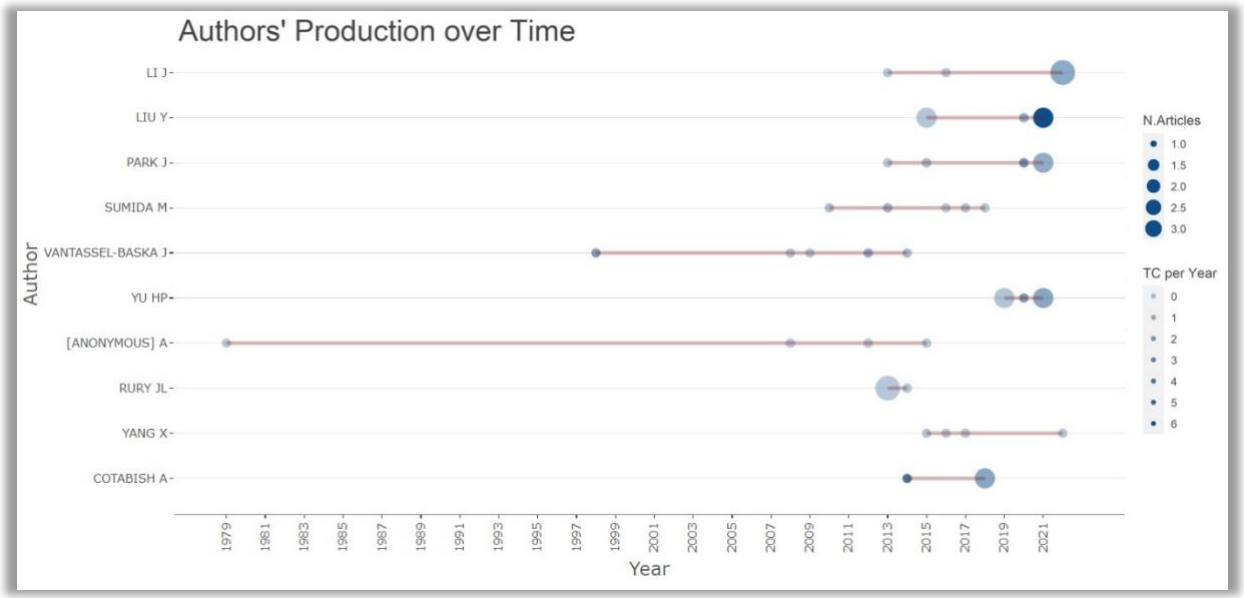

Figure 4. Productivity of authors publishing on giftedness in science education by years

When the productivity of the authors related to giftedness in science education was analyzed, it was determined that VanTassel-Baska, J. had 5 publications and 80 citations between 1198-2014, Liu, Y. had 5 publications and 25 citations between 2015-2021, Sumida, M. had 5 publications and 20 citations between 2010-2018, Park, J. had 5 publications and 19 citations between 2013-2021, and Yu, H. P. had 5 publications and 15 citations between 2019-2021.

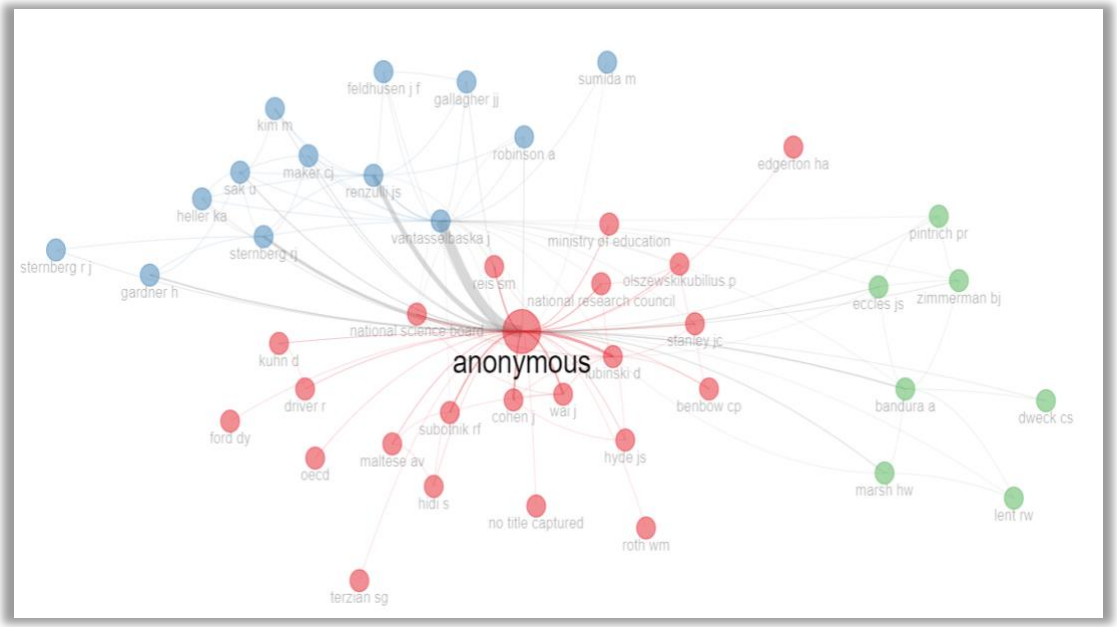

Figure 5. Co-citation network analysis of authors publishing on giftedness in science education

In the analysis of the most common citation network in scientific studies on giftedness in science education, it was determined that the authors were "Anonymous (betweenness; 1377,5)", "Renzulli, J. S. (betweenness; 62,144)", "Robinson, A. (betweenness; 55,6)", "Subotnik, R. F. (betweenness; 53,435)" and "VanTassel-Baska, J. (betweenness; 45,4)" respectively.

The top 10 most effective references on giftedness in science education are presented in Table 2 and the co-citation network of the references is presented in Figure 6.

Table 2. Top 10 most influential references on giftedness in science education

Journals	h-i	g-i	m-i	TC	NP	PYS
Gifted Child Quarterly	9	15	0,167	226	17	1970
Journal for the Education of the Gifted	8	10	0,258	175	10	1993
Journal of Advanced Academics	7	10	0,368	142	10	2005
International Journal of Science Education	6	8	0,24	153	8	1999
Journal of Research in Science Teaching	5	6	0,147	199	6	1990
High Ability Studies	4	5	0,182	195	5	2002
Roeper Review-a Journal on Gifted Education	4	5	0,286	64	5	2010
Science Education	4	5	0,125	324	5	1992
Academic Medicine	3	3	0,12	61	3	1999
Journal of Biological Education	3	4	0,13	16	4	2001

h-i:h-index, g-i:g-index, m-i:m-index, TC:Total citation, NP: Number of publication, PYS: publication year start

When the journals related to giftedness in science education are analyzed, it is seen that "Gifted Child Quarterly", "Journal for the Education of the Gifted" and "Journal of Advanced Academics" are the most effective journals.

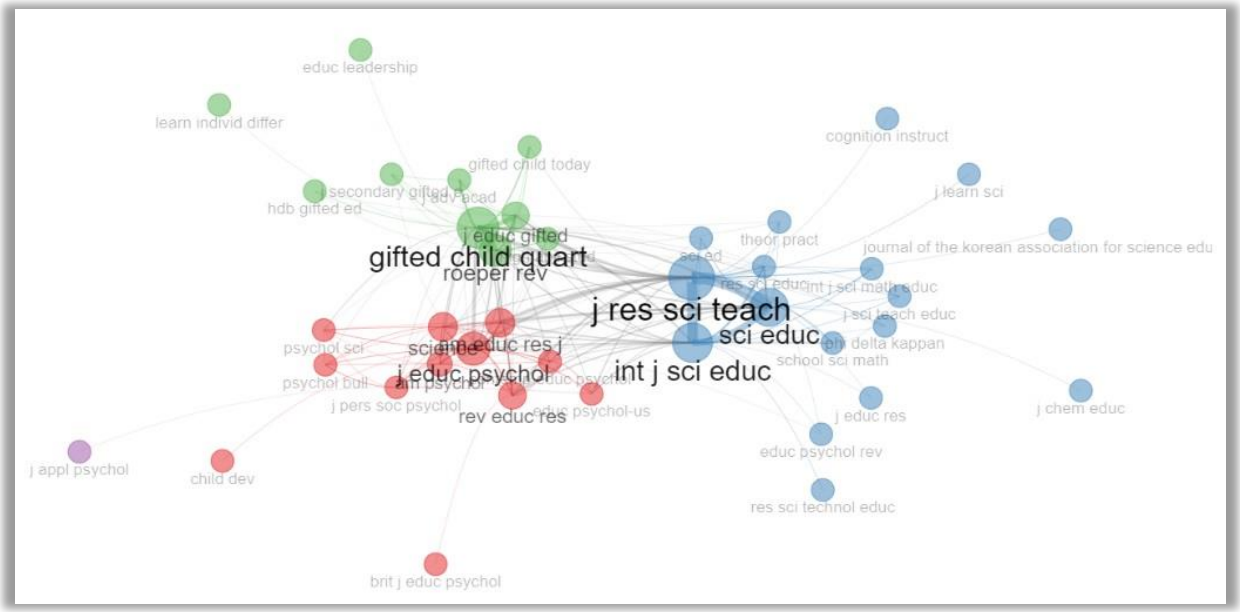

Figure 6. Co citation network analysis of journals published within the scope of giftedness in science education

Among the journals with "co-citation network" related to giftedness in science education, the most active ones are "Gifted Child Quarterly (betweenness; 287,3)", "Journal of Research in Science Teaching (betweenness; 229,6)", "Journal of Educational Psychology (betweenness; 125,7)", "International Journal of Science Education (betweenness; 89,8)", and "Science Education (betweenness; 64,4)".

The institutions that are active in scientific studies on giftedness in science education are presented in Figure 7.

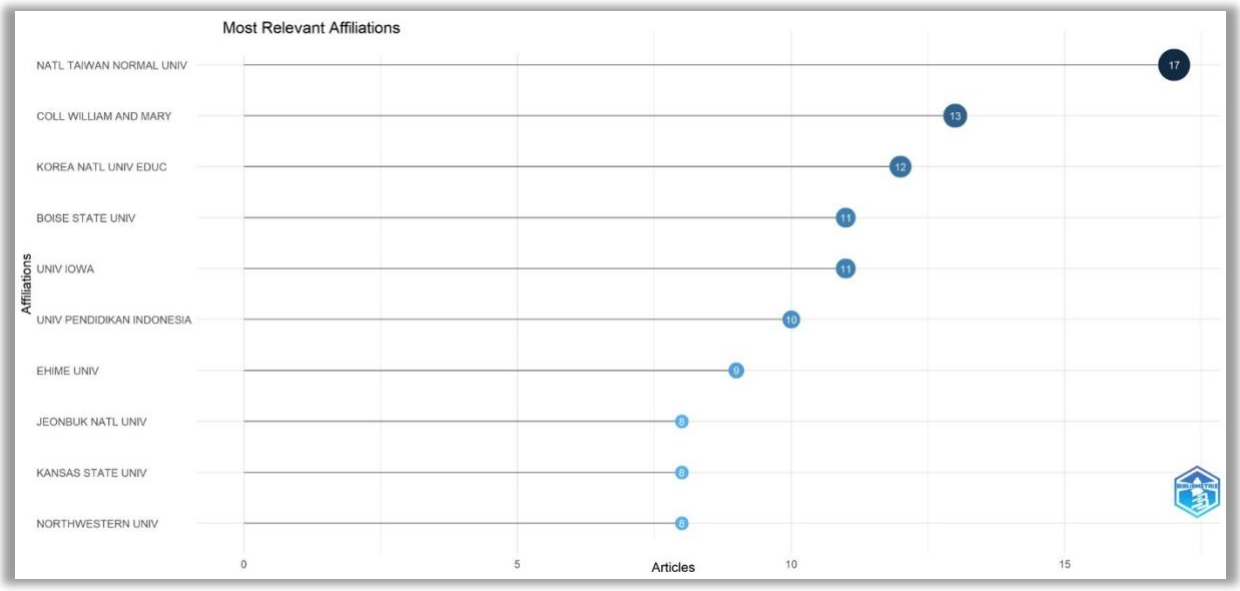

Figure 7. Institutions active in scientific studies on giftedness in science education

Figure 7 shows that the most influential institutions are "National Taiwan Normal University" with 17 scientific studies, "College of William and Mary" with 13 scientific studies and "Korea National University of Education" with 12 scientific studies.

Scientific studies published on giftedness in science education were analyzed and the most collaborative and influential countries and the publication network are presented in Figure 8.

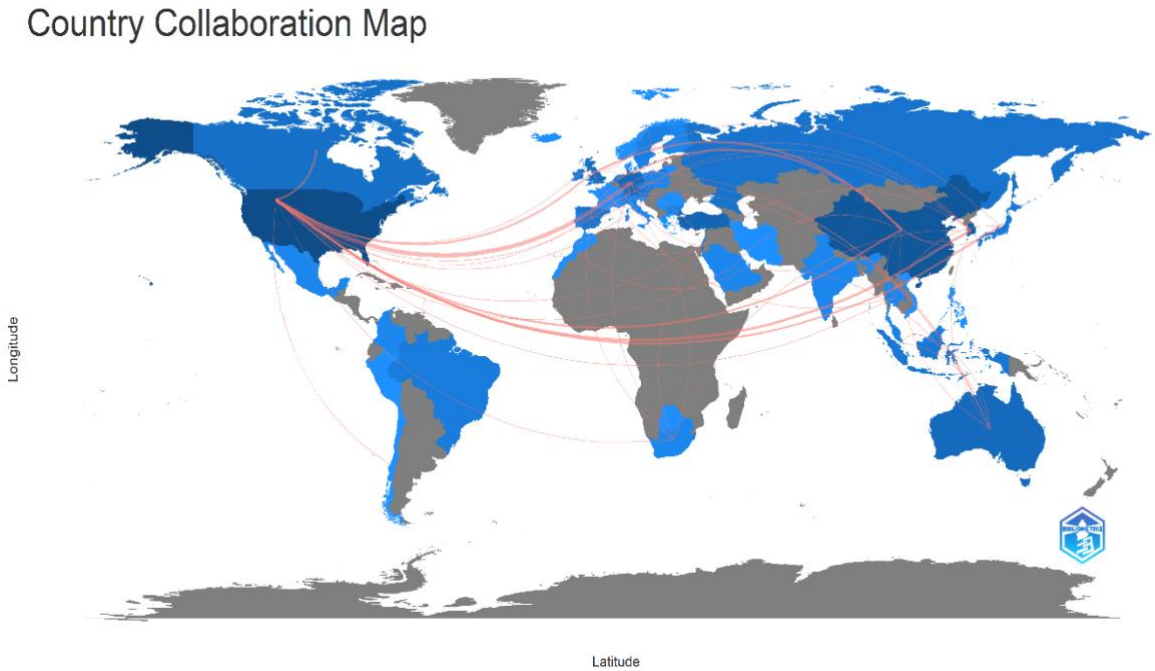

Figure 8. Countries with the highest number of active collaborations on giftedness in science education

Among the countries with the highest number of collaborations in scientific studies on giftedness in science education, it was determined that USA (461 publications, 2285 citations), China (188 publications, 197 citations), Korea (106 publications, 103 citations), Turkey (55 publications, 93 citations), Australia (35 publications, 79 citations), Germany (33 publications, 257 citations), Japan (20 publications, 20 citations), Spain (20 publications, 63), UK (20 publications, 31 citations) and Russia (20 publications, 12 citations), respectively.

Conclusion

In this study, a holistic evaluation of the international literature on giftedness in science education was conducted with bibliometric analysis technique using R software. Bibliometric studies in a certain field provide opportunities for researchers to see the "big picture" (Karagöz & Şeref, 2019). The bibliometric study conducted within the scope of giftedness in science education provides researchers who will work in this field with the opportunity to obtain information about the field, to identify the positive, strong, deficient and weak aspects of scientific publications and to evaluate the performance of publications. The aim of this study is to examine the distribution of scientific studies on giftedness in science education by years, keywords, the most influential scientific studies in this field, the most influential authors, the most influential journals, the most influential institutions and the most collaborating countries.

When the studies conducted in the relevant field are examined in the research, it is determined that the upward trend in the number of studies started in 2008 and reached its maximum level in 2016. There are similar results in the literature. Looking at the bibliometric studies on giftedness, it was determined that the most frequent publications were in 2016 in the study by Gürlen, Özdiyar & Şen (2019) and Baylarova & Baloğlu (2023), 2017 in the study by Bicakci & Baloglu (2021), 2018 in the study by Hernández-Torrano and Ibrayeva (2020), and 2020 in the study by Baccassino & Pinnelli (2023). In addition, in Yurdakul and Bozdoğan's (2022) bibliometric study on science education, it was determined that the most articles were published in 2019 and there was an upward trend after 2005. The ratio of research and citations in the last 10 years to the whole is approximately 85-90%. This shows that studies on giftedness in science education have increased in the last 10 years. Especially after the 2000s, researchers can access libraries in many parts of the world via the internet. The widespread use of online databases may have supported the acceleration of publications related to the field after the 2000s. It was determined that the upward trend of publications has decreased since 2016, albeit partially. This may indicate that the studies on giftedness in science education have reached saturation. In the study, it was determined that the upward trend started in 1997 and reached its maximum level in 2003. In addition, if we divide the studies in the field into beginning, middle and end sections in terms of time, the studies in the first section represent the foundation of the field, the studies in the second section represent the body rising on the foundation, and the last section represents more extreme points. Therefore, more recent studies have been cited less, while earlier studies have been cited more (Bicakci & Baloglu 2021). There are similar results in the literature (Hernández-Torrano & Ibrayeva, 2020). In contrast to this situation, in Baylarova & Baloğlu's (2023) bibliometric analysis study on the social-sensory problems of gifted children, it was determined that citations related to the related field have increased more in recent years.

As a result of the thematic analysis of the keywords, it was determined that "learning", "creativity" and "development" were found in the engine section, that is, in both the common and basic/central sections. These were identified as the most robust and prominent keywords related to gifted students in science education. On the other hand, "science education", "stem", "gifted student" and "gifted education" were identified as core/center words, and "intelligence" and "gifted children" were identified as medium level publications and core words. In addition, "computer science education" and "stem education" are considered as vanishing or emerging keywords, while "comparative study" is in the niche theme, that is, it is located far from the center. It was also determined that "gifted" and "science" were generally used as keywords in studies on giftedness in science education. Similarly, it was determined that the words "gifted", "giftedness", "gifted student", "students", "gifted education", "education" "children" were frequently used in studies on giftedness (Baccassino & Pinnelli, 2023; Baylarova & Baloğlu, 2023; Gürlen, Özdiyar & Şen, 2019). In the studies conducted within the scope of bibliometric analysis in science education, it was determined that the keywords "science education", "science", "science teaching", "education", "student" "professional development", and "science" were used most frequently (Demir & Çelik, 2020; Yurdakul & Bozdoğan, 2022). It is recommended to use the keywords in Figure 3 in future studies on giftedness in science education.

When the studies on giftedness in science education were examined, it was determined that the study titled “Tracking exceptional human capital over two decades” published in the journal “Psychological Science” in 2006 received the highest citation at the local and global level. Perhaps what makes this study special and pioneering in the field is the fact that gifted students were identified before the age of 13, followed for 20 years and compared with other top achievers in

terms of creativity, professional and life achievements. The second study that received the highest citation in the field was “The effects of a science-focused STEM intervention on gifted elementary students' science knowledge and skills” published in the “Journal of Advanced Academics” in 2014. This study is an experimental study conducted with gifted students and the experimental process in the study lasted 2 years. The most prolific authors on giftedness in science education were VanTassel-Baska, J., Liu, Y., Sumida, M., Park, J., and Yu, H.P., respectively. However, when the co-citation network of the authors is taken into consideration, it is determined that the most active authors are "Anonymous", "Renzulli, J. S.", "Robinson, A.", "Subotnik, R. F." and "VanTassel-Baska, J.", respectively. Similarly, in the study conducted by Gürlen, Özdiyar & Şen (2019) with gifted students, "Renzulli J. S." and "VanTassel-Baska, J." come to the forefront in studies on giftedness. Similarly, "VanTassel-Baska, J." stands out in the study conducted by Baccassino & Pinnelli (2023) with gifted students.

When the most effective journals related to giftedness in science education were examined, it was found that the most effective journals were “Gifted Child Quarterly”, “Journal for the Education of the Gifted”, “Journal of Advanced Academics”, “International Journal of Science Education” and “Journal of Research in Science Teaching”, respectively; and the most effective journals among the journals with “co citation network” were “Gifted Child Quarterly”, “Journal of Research in Science Teaching”, “Journal of Educational Psychology”, “International Journal of Science Education” and “Science Education”, respectively. When the most active journals related to giftedness in science education are analyzed, it is seen that journals generally publish studies related to giftedness and/or science education. Similarly, when the studies on giftedness are examined, “Gifted Child Quarterly”, “Journal for the Education of the Gifted”, “Journal of Advanced Academics” and “Roeper Review: A Journal on Gifted Education” are among the most active journals (Baylarova & Baloğlu 2023; Bicakci & Baloglu, 2021; Gürlen, Özdiyar & Şen, 2019). In addition, in bibliometric analysis studies on science education, it was determined that “International Journal of Science Education”, “Science Education” and “Journal of Research in Science Teaching” journals are among the most active (Demir & Çelik, 2020; Yurdakul & Bozdoğan, 2022).

When the institutions that are active in scientific studies on giftedness in science education are examined, it was determined that the most active institutions are “National Taiwan Normal University”, “College of William and Mary” and “Korea National University of Education”, respectively. In Yurdakul and Bozdoğan's (2022) bibliometric study on science education, “National Taiwan Normal University” was among the top three most active institutions. In Baylarova & Baloğlu's (2023) study on gifted education, University of IOWA was among the top 10 most effective institutions. In this study, University of IOWA is the 5th most effective institution.

It has been determined that the countries with the highest number of collaborations in published scientific studies on giftedness in science education are USA, China, Korea, Turkey, Australia, Germany, Japan, UK and Russia, respectively. It was determined that the USA, which ranked first here, published much more (more than twice as much) than China, the country closest to it, in its studies on giftedness in science education. In a sense, it has been determined that the USA acts as a locomotive in the cooperation between countries for the studies on giftedness in science education. In other words, it plays a key role in the development of inter-country cooperation in studies related to the field. It can be concluded that the USA's high budget allocated to science and mathematics fields and gifted students and the federal government's identification and identification of gifted students and the implementation of differentiated education programs for them according to the Marland report have supported its prominence in this field (Freeman, 2005; Jolly, 2009; Marland, 1972; Mcclain & Pfeiffer, 2012). It can also be explained by the fact that countries have a longer history of academic publishing, institutions related to giftedness and more research resources. It is taken into consideration that population is proportional to the studies conducted.Similarly, there are studies in the literature indicating that the USA is the most effective country in terms of giftedness (Baylarova & Baloğlu, 2023; Bicakci & Baloglu 2021; Demir & Çelik, 2020; Gürlen, Özdiyar & Şen, 2019; Yurdakul & Bozdoğan, 2022).

Recommendations

This study provides a bibliometric analysis of the studies on giftedness in science education, reveals research trends in the field and draws a general framework. Looking at this study before starting future studies on giftedness in science education will provide researchers with a foresight and will support the studies to be conducted to be more qualified. It is recommended that researchers who will conduct studies in this field should use keywords in the literature review, search and examine effective documents, resources, journals and authors in the field.

Limitations of Study

This study is limited to a bibliometric analysis of giftedness in science education. The findings provide a more holistic view of more general characteristics. It is recommended that more detailed studies should be conducted to reach in-depth information. Although the WoS used in the research is an accepted database in many fields, it does not show that it contains all the studies on giftedness in science education. This is another limitation of the study. The study is limited to the period between 1970 and 2022 and it is recommended that a similar study be conducted in certain periods in the following years.

Biodata of Author

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Research Article

Visual art teachers' perceptions about visual arts lesson: a case study

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Abstract

The research was designed as a case study, which is one of the qualitative research designs, and the visual arts course, which plays an important role in revealing different talents, especially artistic talents, and in the development of different thinking skills, was discussed in the research. In the research, the opinions, metaphorical descriptions and visual images of primary school teachers who provide art education were used as sources to obtain data. The study group of the research consisted of 20 primary school teachers providing art education. Semi-structured interview form, metaphors and artworks created by the participants were used as data collection tools. The data were analyzed through content and document analysis. The visual arts course was characterized by the participants as containing hopelessness, exclusion and insignificance. The reason for this was summarized by the degree of importance given to the course. The fact that there is an exam-based education system in Turkey and the fact that the course is not in a position to affect an exam is shown as one of the factors that cause this. In addition, the weekly hours allocated to the course, the lack of space and facilities, the thoughts of the administration, teachers, parents and students towards the course were among the other reasons that worsened this hopeless perspective. This hopeless atmosphere is a situation that needs to be considered in terms of art education in our country, which can play a critical role in the context of talent and thinking skills.

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Introduction

Considering Gardner's (2004) theory of multiple intelligences, "spatial-visual intelligence" refers to individuals who are artistically talented. Some studies show that the majority of artistically talented children also have high intelligence scores. However, not every talented individual may also have high intelligence (Day & Hurwitz 2012; Tuna, 2013). At the same time, it has been observed that the integration of artistic activities and science has positive effects on the learning process (Abacı & Tüzün, 2022). In this respect, it can be said that art develops various skills in individuals in the context of intelligence-ability relationship (Laney et al, 1996; Vitulli & Santoli, 2013).

In general, when the branches related to visual-spatial intelligence are ranked within the branches of art, it can be said that visual arts come first. In this context, visual arts is an art field that affects thinking skills such as visual literacy (Dake, 1993), generating ideas, thinking critically, symbolizing images, having the capacity to interpret, evaluating what is happening and developing solutions to problems (Akkurt & Boratav, 2018; Kosky & Curtis, 2008; Rabkin & Redmond, 2006; Vitulli & Santoli, 2013). An activity in the field of visual arts, in return, reveals a whole of blocks that include superior virtues such as being able to overcome something, seeing problems, following innovations-adapting to the situation, aiming for high quality, being open to criticism, and at the same time approaching the works of others aesthetically. Because when an individual tends to produce an artistic work, he/she focuses on a subject and uses materials for it. However, in the process, thinking, decision-making, composition, use of tools and materials, as well as

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evaluating one's own work during the process, giving internal feedback and reorganizing accordingly take place. During these process steps, an intense thinking action is carried out by transforming images into symbols using thinking skills (McCourbrey, 1994).

In the education system of our country, there are courses where this act of thinking can be realized. In particular, visual arts education is included in programs for art education in different institutions under various names. In primary and secondary education levels, visual arts are offered as a course. Multidimensional development of students is considered with art education. Art has manifested itself and continues to manifest itself in the thought structures of societies and in every field where it continues to exist. Art education can contribute to the development of individuals, society and humanity. Because societies that degenerate in terms of art are prone to collapse in terms of both material and spiritual cultural values (Akkurt & Boratav, 2018; Tunçel, 2018; Türkmen, 2007).

For this reason, it can be said that the visual arts course is as important as other courses as a discipline. With visual arts education, a development in the affective sense can be achieved by preventing a life based only on academic success. At the same time, it is important for this development that the teachers presenting the course are excited and eager in this sense in order to achieve the purpose of the course. Because education as a whole has a systematic structure. If each unit of education fulfills its duty as a part of the whole, success is more likely to emerge as a result. At the same time, the fact that teachers have this perspective for the visual arts course is also related to how they get results in the face of the problems they face (Çakmak & Türkcan, 2019; Fidan & Fidan, 2016; Gökay & Özdemir, 2009; Güneş, 2016; Orhun, 2005). If the teacher presents the visual arts course in a reluctant, frustrated and hopeless way, the students' originality and the characteristics discussed in the context of the aforementioned talent/thinking skills may not be revealed (Ayaydın, 2009; Lowenfeld & Brittain, 1987; McCoubrey, 1994). Thus, it may be inevitable that talented and intelligent individuals become invisible.

The level of development of nations is related to the extent to which they utilize the intelligence and talents of the individuals within them. For this reason, with the rapid change in opportunities today, the tendency towards qualified individuals has increased. Because individuals with high levels of intelligence and special talents have an important role in the development of nations and the formation of strong states. These individuals, who have been diagnosed by experts, are characterized as individuals with extraordinary potential in the fields of interest of their intelligence and abilities. The evaluation of these individuals is only possible through systematic education. Because if the discovery of existing talent or intelligence is not supported by the educational process, these individuals may become passive. Access to well-equipped and functional educational opportunities is important in this sense (Çelik & Çaydere, 2021; İdin & Kayhan, 2016; Kılıç, 2015; Mönks & Pflüger 2005; Renzulli, 1999; Tortop, 2012). Talent can be defined as a set of actions that require intelligence, such as being able to establish both numerical and verbal logic, having a high level of imagination, thinking spatially, developing strategies to adapt to every action and situation that exists. In general, the capacity to apply this definition to one's own field of interest (such as literature, science, art, management, etc.) is referred to as special talent (Çuhadar, 2017; İlhan, 2020).

When the literature on the visual arts course was examined, limited studies emphasising the negative perception of the course were found. Yazar et al (2014) emphasised that there is a perception that the course is okay even if there is a lesson and Erim & Caferoğlu (2012) emphasised that the course should be reorganised in every sense for individuals with disabilities. Tanrıverdi (2023) emphasised that the problems arising from the school administration negatively affect the course. However, there are many studies on the importance and necessity of the course. Art education is an education that all individuals should receive and it is an important field, etc. (Atmaca, 2008; Baltacı & Eker, 2019; Çağlayan, 2014; Mercin & Alakuş, 2007).

For this reason, the visual arts course can have an important impact in the context of identifying, supporting and guiding individuals in terms of the relationship between intelligence and talent within the educational structure of our country.

Importance of research

In this study, the visual arts course is discussed in the context of visual arts teachers' opinions, metaphorical descriptions and visual images. The main problem of the research is the status of this course, which contributes to the multidimensional development of individuals, within the education system of our country. When the literature was examined within the scope of the research; (Abacı & Tüzün, 2022; Akkurt, & Boratav, 2018; Ayaydın, 2009; Çakmak & Türkcan, 2019; Çelik & Çaydere, 2021; Dake, 1993; Day & Hurwitz, 2012; Fidan & Fidan, 2016; Gökay & Özdemir, 2009; Güneş, 2016; Kılıç, 2015; McCoubrey, 1994; Mönks & Pflüger, 2005; Orhun, 2005) limited studies related to the main problem of the research were found. However, there is no study that analyzes and evaluates the situation in a three-dimensional way (data obtained from interviews, participants' metaphorical descriptions and visual images) especially through teachers. In this sense, it can be said that the study has a unique structure.

Problem and aim of research

In this study, the visual arts course, which has an important role in revealing talents and developing thinking skills, is discussed. The opinions, metaphorical descriptions and visual images of primary school teachers were used as sources to obtain data.

Through the eyes of the participants for the purpose of the research:

- What are the perspectives of students, teachers and parents towards the visual arts course?
- What are the factors that direct the perspectives of students, teachers and parents towards the course?
- In this case, what kind of examples emerge in the visual arts course in the context of ability and thinking skills?
- What can be done to increase the importance and effectiveness of the visual arts course that has an impact on ability and thinking skills?

Method

Research model

This research, which was carried out to determine the views, metaphorical descriptions and visual images of visual arts teachers about the visual arts course in secondary schools, was designed as a case study, which is one of the qualitative research designs. In addition, it can also be seen as a partial phenomenological study since there are opinions in conveying experiences. "While a narrative study reports stories about the experiences of one or a few people, a phenomenological study explores the common meaning of the lived experiences of several people about a phenomenon or concept" (Creswell, 2016, p.79).

Participants

The study group of this research consists of 20 visual arts teachers. Criterion sampling method, one of the purposeful sampling methods, was used to determine the study group. "In this type of sampling, the researcher uses his own judgment about who will be selected and takes those who are most suitable for the purpose of the research" (Balcı, 2018, p. 105).

Table 1. Structures of participants and coding

No	Gender	Age	code
1	Female	25-30	P1-P6-P12-P14
		30-35	P7-P15-P16
		35-40	P5- P11
		40-45	P3-P18
		45-50	P17
2	Male	25-30	P13-P20
		30-35	P9-P10-P19
		35-40	P2-P4
		40-45	P8

When the participant table is analysed, it is seen that there are more women among visual arts teachers. At the same time, it is seen that all participants are 25 years old and above. Although there are participants over 45 years of age among

women, there are no participants over 45 years of age among men. At the same time, the density of participants in both women and men is concentrated between the ages of 25-35. The fact that the age ranges of the participants vary is considered important for the research to be successful in revealing the real problems.

Data collection tools

A semi-structured interview form, data obtained through debriefing, and documents created by the participants (drawings) were used as data collection tools.

Semi-structured Interview Form

semi-structured interview form developed by the researcher was used for data collection. While preparing the form, a literature review was conducted to write the relevant questions. There were limited studies in the literature that were indirectly similar to the study. For this reason, many questions were created by the researcher in order for the participants to express their thoughts about the visual arts course. After these questions were written, one field expert and one measurement and evaluation expert were consulted. The questions were restructured in line with these opinions. The semi-structured interview form was prepared in line with the expert opinions (the fact that the field experts had previous teaching experience was taken into consideration). Since it is considered that the semi-structured interview can be diversified during the interview, it can be said that the questions represent the scope of the study. In the draft form, in order to reach the first, second, third and fourth sub-objectives of the research, it was tried to reveal what the teachers, who are in the kitchen, would suggest as a solution to such a problem situation. Sample question: If you wanted to add innovations to the visual arts curriculum, what would your suggestions be? (See Appendix 1).

Metaphoric Perception Test

In the second stage of the research, in order to determine the participants' metaphorical images about the visual arts course, they were asked to complete the sentence "visual arts is like.... Because..." sentence. Participants were given a blank paper and asked to express their thoughts by completing this sentence. They were asked to focus on only one image metaphorically. Participants were initially informed about metaphor. Necessary conversations were made especially about a definition related to the visual arts course. Participants were given 20 minutes to create metaphorical images. At this stage, it was deemed sufficient to reveal the participants' first thoughts about visual arts.

Documents

Document analysis and debriefing techniques were used (Fraenkel et al, 2012, p.457). The participants were asked to draw their thoughts with a question such as "If you wanted to describe the visual arts course as a symbol, figure or color, how would you describe it?". Among artistic studies, painting can be defined as a process of mental and emotional concentration. While painting, the individual dives into his/her inner world and may involuntarily reveal a situation that exists in his/her subconscious. With the paintings made by the participants, it was aimed to make the existing situation more evident by using the aspect of involuntary expression of subconscious states and thoughts. Thus, it was aimed to increase the validity and reliability of the research and to obtain more realistic results.

The data obtained from these three stages constituted the main data source of the research.

Data analysis

The data obtained were analyzed through content and document analysis. Content analysis is a technique that allows working on determining human behavior and nature in non-direct ways. As with all qualitative research, it requires in-depth and rigorous study (Labuschagne, 2003). "Content analysis is defined as a systematic, repeatable technique in which some words of a text are summarized into smaller content categories by coding based on certain rules" (Büyüköztürk et al., 2014, p. 246).

The process of understanding and conducting metaphor analysis by the researcher includes the following stages: In the first stage, the metaphors expressed by the participants were temporarily sorted in alphabetical order. While doing this sorting, papers that were left blank and contained a certain speech text that did not provide a logical basis instead of writing a metaphor were eliminated. In the second stage, the metaphors sorted in alphabetical order were re-evaluated

and sample metaphor statements that could represent each metaphor were selected. In doing so, it was aimed to contribute to the formation of categories and easier interpretation of the data. After the sample metaphors were revealed, the metaphors were grouped according to their similarities.

Similarly, the pictures made by the participants were also analyzed by document analysis in the form of examining symbols, figures, colors, etc. In particular, by giving the participants another chance with the debriefing technique, it was thought that the analyzes made would match the purposes that the participants wanted to create in the pictures (Fraenkel et al, 2012, p.457). At this stage, a conversation atmosphere was created with the participants who wanted to make a painting study over the paintings after they finished their studies. Thus, it was evaluated what kind of emotions and thoughts and what kind of references the participants made while creating the paintings. These interviews were recorded and used as a source in the research. The documents consisted of texts and pictures that were not only influenced by the researcher but also recorded (Labuschagne, 2003). In this sense, the picture studies obtained were analyzed by the researcher and other experts and common evaluations were revealed. The participants were asked to draw on a voluntary basis. In this sense, the research was conducted on a certain number of drawing studies in order to set an example in terms of its relationship with metaphors. At this stage, the evaluations of field experts were also utilized.

Reliability and validity

In the last stage, the validity and reliability of the research were addressed. In this context, the opinions expressed by the teachers, the metaphors produced, the pictures made and the categories developed by the researcher were given to the experts as a list. At this stage, Miles & Huberman (2016) formula was used to increase reliability. The data, metaphors and documents obtained in the research were given to the experts as a file and the consistency between the coders was taken as a basis for reliability (Baltacı, 2017; Miles & Huberman, 2016). The reliability of the analysis was calculated as 90% in the calculation made with the formula reliability = agreement/agreement + disagreement by criticizing the gathering of the data around similar categories.

The validity of the research can be achieved when the researcher clearly reports all the details of the research stages. In this context, the research data were analyzed by the researcher and all details were reported.

Results

Perceptions towards visual arts course

In this section, the first sub-problem of the research, "How are the perspectives of students, teachers and parents towards the visual arts course?" is presented with the findings obtained from the interviews with the participants.

Table 2. According to the perspectives of visual arts teachers; students', teachers' and parents' opinions about the visual arts course

Themes	Codes	f
Negative perceptions towards visual arts course	100 points	20
	Unnecessary	20
	Time Loss	17
	Cost	10
Positive perceptions towards visual arts course	Break for rest	8
	Hand dexterity development	5

According to the findings that emerged from the analysis of the interviews with the participants; all of the participants (*f*=20) stated that the visual arts course was perceived as an unnecessary course. For this reason, it was also found that all of the participants (*f* =20) approached the course with the idea that the grade of the course should result in 100 points, especially by parents, students and some teachers. P7 and P18 stated the following regarding the question:

"Parents do not care much, it is a lesson that is never discussed in meetings or left to the last. Other lessons are more important for parents and students. Of course, teachers also see it as a very easy and simple lesson. But it is a difficult and laborious lesson; it requires effort" (P7, October 2022).

"I think that the visual arts course is neglected in the curriculum because it is generally seen as an empty lesson by students and many teachers" (P18, September 2022).

In addition, when the data in Table 2 are analyzed, it is seen that the course is perceived as a waste of time by students, parents and teachers because the course is seen as unnecessary (f =17). When the analysis of the data in Table 2 is continued, it is seen that the course is a financial burden in terms of artistic materials due to the fact that it requires activities, and for this reason, the idea of a costly course by students, parents and teachers was among the opinions of half of the participants (f =10). In addition to the negative opinions, a few positive opinions of students, parents and teachers were also expressed by the participants. Among these positive thoughts; the idea that the lesson is a tool for students to rest (f =8) and develop their hand skills (f =5) was expressed by the participants.

When the findings obtained from the statements of the participants are evaluated; it is seen that the visual arts course is perceived negatively by students, parents and teachers, that it is not important and that those who see it positively approach it with a purpose of benefit.

Factors affecting perception

In this section, the second sub-problem of the study, "What are the factors that direct the perspectives of students, teachers and parents towards the course?" is presented with the findings obtained from the interviews with the participants.

Table 3. Content analysis of visual art teachers' views on the factors affecting their perceptions of visual arts course

Theme	Codes	f
Education system	Placement exams	20
	Class hours	20
	Axis course status	18
Non-individual factors	career plan	18
	economic reason	10
	The importance given to art in society	7

When the data in Table 3 are analyzed, the factors that cause the negative opinions of students, parents and teachers about the visual arts course expressed in Table 2 are revealed. When the data obtained from the interviews with the participants are analyzed, it is seen that these negative opinions of students, parents and teachers are related to the system and anxiety. The fact that the visual arts course does not have any effect on placement exams such as high school, higher education, etc. (f =20), that the time allocated to the course is too little (f =20) and that the center courses are more important (f =18) were expressed by the participants as the response of students, parents and teachers that this course is considered unnecessary. According to the answers given by the participants in the interviews and the findings in Table 3; within the scope of the "non-individual factors" theme of the students, parents and teachers, the inability to find a job if they are inclined to this course (f =18), the idea that it is a course that creates a financial burden (f =10) and also cultural influences (f =8) are among the other reasons for the negative view of the course. Some of the participants stated the following about this question:

"I think it is necessary to include it in the exams. Because this is not a unit where problems are solved like a guidance service" (P1, September 2022).

"Students are focused on exams, our course is not included in the exams. Parents want them to make an effort in math, Turkish, etc. The principal doesn't even see us. It is as if drawing a picture will lead to unemployment in the future. Also, culturally, our artistic side is weak anyway, I don't know" (P13, November 2022).

When we look at the findings that emerged from the statements of the participants, it is seen that the anxiety of finding a job, the small number of class hours systematically trivializes the course, and the fact that the course is not included in the exams automatically results in the course being underestimated alongside other branches. In addition, the cultural background has negative consequences for the course.

In this section, the findings obtained from the interviews with the participants regarding the third sub-problem of the research, "In this case, what kind of examples emerge in the visual arts course in the context of ability and thinking skills?" are presented.

Effects of the duration of the visual arts course

Table 4. Content analysis of the visual art teachers' views on the effects of the short duration of the visual arts course in the curriculum

Theme	Codes	f
Negative effects on visual art talent	Time/Course satisfaction	20
	Ignoring multiple intelligences	20
	Loss of skills	17
	Individual training	12
	Choosing the wrong profession	11

When the data in Table 4 are analysed, there are examples arising from the negative situations in Table 2. and Table 3. When the negative examples are analysed; both for the students and the teachers, the fact that the course was one hour long caused problems. All of the participants (f=20) stated that this situation created a disadvantage in terms of course satisfaction, that is, the inability to complete the activities. In addition, it can be seen in the findings obtained from the one-to-one interviews with the participants that the situations arising from the neglect of the course; ignoring multiple intelligence (f =20) and consequently losing talents (f =17), individual differences (f =12), leading to undesirable occupational preferences (f=11).

When the findings obtained by analysing the data are evaluated, the fact that the visual arts course, which can have an important effect in the context of talent, is in this situation may cause the loss of giftedness, talents and multiple intelligence examples. At the same time, the existence of the course in the system may be promising.

Development of visual art talent and thinking skills and visual art course

In this section, the fourth sub-problem of the study, "What can be done to increase the importance and effectiveness of the visual arts course, which has an impact on talent and thinking skills?" is presented with the findings obtained from the interviews with the participants.

Table 5. Content analysis of teachers' views on what can be done to improve visual arts skills and thinking skills in visual arts course

Theme	Codes	f
Curriculum regulation	Increasing course hours	20
	Specialisation in the field	16
	Parity with Axis subjects	15
	Taking part in exams	13
	Positive change of programs	11
System problem	National target	15
	Orientation	13
Space problem	Drawing room	20

Participants gave answers to the question of what can be done to increase the importance and effectiveness of the course, including curriculum regulations, system and space problems. When these responses in Table 5. are examined; as systemic arrangements, there are statements such as increasing the course hours (f=20), directing students in the form of specialization in the field from primary school according to their abilities and thinking skills (f=16), ensuring equality between courses in terms of impact (f=15), including the visual arts course in exams (f=13) and reviewing the programs for all these (f=11). In this context, P9 and P20 stated the following:

> *"First of all, I would like to have a compulsory workshop and all the painting materials in every school. I would like it to be compulsory for at least 3 hours, not 1 hour"* (P9, November 2022).

"First of all, the number of courses should be increased. It should somehow be associated with students' placement exams. Or it should start from primary school or even preschool and students should be guided according to their intelligence and abilities" (P20, November 2022).

In terms of increasing the importance and effectiveness of the course, the participants also associated the infrastructure of the course with system-related and spatial problems. Placing the necessity of art among the national goals of the country (*f* =15) and informing the public about the importance of art education (*f* =13) were among the codes that supported these ideas. As for the spatial aspect, the need to improve painting work environments and to have workshops in every school (*f* =20) were among the opinions of the participants.

When all these findings are evaluated; increasing the importance and effectiveness of the course is not seen as unattainable from the participants' point of view. However, failure to make arrangements in this sense may lead to irreversible losses for our country in terms of both intelligence and talent.

Visual art teachers' metaphorical perceptions about visual art course

In this section, the findings obtained by revealing the participants' metaphorical depictions of the sub-problems of the research in the context of the visual arts course and the reflections of the thoughts about the course on the pictures are given.

Metaphorical test findings

Table 6. Visual arts teachers' metaphorical descriptions of visual arts course

Theme	Codes	f
Visual arts lesson as neglected	Labyrinth	15
	Exclusion	13
	Jewelry	5
	Insignificant	5
	notebook	1
	Wreck	1
	İmpasse	1
Inspiring visual arts lesson	Spirit	1
	Rainbow	1
	Snake game	1

The definitions made on the visual arts course as a metaphor study conducted with the participants have similar characteristics with the data obtained from the interviews, the figures and references used in their paintings. When we look at the metaphors that correspond to the negative thoughts of the participants in Table 6, the participants characterised the course with the "labyrinth" metaphor (*f*=15). P3 describes the reason for this metaphor as follows: "*Visual arts is in an insurmountable situation for me right now*" (P3, September 2022). When Visual 1. is analysed, the situation of being a labyrinth was also included in P3's painting work. The painting works of P5 and P17 are similar to the situation of being restricted and restricted in freedom (Visual 2. and Visual 3.).When the data in the table are examined, it is seen that this situation also gives rise to the metaphor of "exclusion" (*f*=13). In addition, the metaphors of "jewellery of unknown value" (*f*=5) and "insignificant" (*f*=5) seem to summarise the responses expressed in the interviews. The metaphors of soaked notebook, ruin, dead end street were characterised by the same number of participants (*f*=1) in terms of simulating the visual arts course.

"It is snowing, it is raining, my notebook is wet and I am still trying to paint. So my wet notebook is my visual arts. " (P10, October 2022).

It is also seen that the existence of the visual arts course has positive effects. The participants expressed the positive contributions of the course in their mental world with the metaphors of soul, rainbow and snake game (*f*=1).

Picture analysis findings

When we look at the metaphor examples given positively by the participants in Table 6 in terms of describing the visual arts course; visual arts were compared to the symbols of the soul, rainbow and snake game (*f* =1). The rainbow metaphor

was also included in the painting works of P3 and P17 (Visual 1. and Visual 3.). The soul metaphor was included as an image in P20's drawing (Image 6.).

When we look at the drawing works of the participants; in Figure 1, P3 symbolized the visual arts course with the metaphor of a rainbow that contains all colors. In his work, P3 tried to reveal the references of puzzles, labyrinths, unsolvability within the solution with the daily routines of the visual arts course (such as the materials in the course, the work done, etc.). Hope and stuckness are presented together in the work. The messages given by P3 with the conversation held within the scope of the debriefing technique are as follows:

Factors such as limited class hours, inadequate physical facilities in many schools, negative prejudices of parents and students, academic success being more important, expensive materials or departments, etc. symbolize the missing pieces of the puzzle, that is, the visual arts course cannot be taught at the desired quality. If these missing parts are completed, the whole will be completed and the product will emerge (P3, September 2022).

Figure 1. The description of the schema in the participant's mind about the visual arts course. P3, 2022,

Figure 2. Description of the schema in the participant's mind about the visual arts course. P5, 2022

When we look at Figure 2, P5 associated the visual arts lesson with the figure of a white pigeon representing freedom trying to fly. However, there is an example of a pigeon that tries to fly but cannot fly in the living space. According to P5's point of view, the total words in the sense of view of art, environment, time, prejudice, anxiety and grade, which are the blockers of the pigeon, i.e. visual arts, are depicted as the shackles on the feet of the pigeon in the writing and painting work. P5 explained this study as follows during the conversation:

> *"I wanted to explain the reasons that prevent the practice of art with barbed wires tied to the pigeon's feet"* (P5, September 2022).

In Visual 3., similar to Visual 2., there was a bird figure painted colorfully with the colors of visual arts trying to get out of the cage and the restricted situation. The metaphor of visual arts trying to get out of the cage is tried to be made even stronger with the presence of hands reaching out to it, waiting for hope. In this work (Image 3.), P17 depicts the eyes above everything, some of which remain in the dark and some of which can be called well-intentioned, as controllers in a state of surveillance and control. P17 stated the following about her work:

Art is the freedom of feelings and thoughts, the most essential need for a society. Our visual arts class is the gateway to this perspective. Our children reflect themselves with this consciousness as a reflection of our future. The cage in the picture is a reference to the freedom of art. The transition to light is depicted with the bird symbol. The hand figures on the floor describe the society. It reflects the past and the future. The eye symbol is the impression of the system in our lesson. As a result, our children who express themselves artistically form the form of our future (P17, September 2022).

Figure 3., Description of the schema in the participant's mind about the visual arts course. P17, 2022

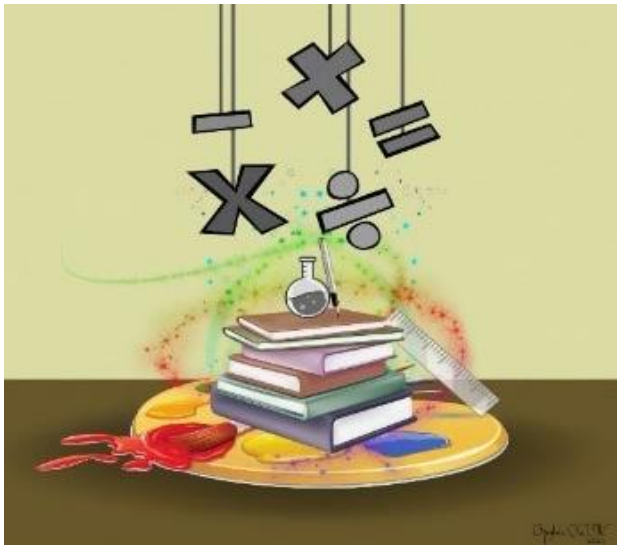

Figure 4. Description of the schema in the participant's mind about the visual arts course. P10, 2022,

When we look at Figure 4, it is seen that P10 represented visual arts in a similar way with the results obtained from the interviews, metaphors and the painting works of other participants. In his study, P10 described visual arts or art by making negative references such as crushed, stuck, etc. under the center courses, exams, grades.

It can be said that the importance of visual arts in the system where exams have a very important place is represented in this way. P10 shared the following about his work:

> *"I described the situation of visual arts as oppression and worthlessness in return for the importance given to other courses"* (P10, October 2022).

Figure 5. Description of the schema in the participant's mind about the visual arts course. P6, 2022,

Figure 6. Description of the schema in the participant's mind about the visual arts course. P20, 2022,

Figure 5 has similar clues with the metaphors produced about visual arts and reflected in the drawings. The dead-end street metaphor in Table 6 was also depicted in P6's drawing. The haphazard and quick description can be characterized as an expression of burnout. While talking about her work, P6 said: *"I think this painting said it all, this is how we are unfortunately"* (P6, October 2022). P20 depicted visual arts from a different perspective in his painting works through images of hope, strength and spirit.

> *"Visual arts class comes to my imagination with the hands of artist people who create wonderful works. I think they move thousands of movements with those hands to attract people's attention"* (P20, October 2022).

Discussion and conclusion

It can be said that art contributes to the development of humanity in the context of the individual and society. It is seen that societies reveal their existing values, talents and intelligence through their art. Art has had an impact both in the transfer of values and in the self-efficacy of individuals and continues to do so. Many human histories in which talents and multiple types of intelligence manifested themselves through artistic expressions have taken their place in historical texts.

In the education system of our country, there are a number of courses aiming at art education in terms of artistic impact. Visual arts course can be shown as a course in which talents and spatial intelligence, one of the multiple intelligence types, are used intensively. In this study, the status of the visual arts course, which can create an impact in the context of talent and thinking skills, in the education system of our country is discussed. The research is considered important in order to contribute to the determination of the extent to which the programs put forward by the country for its ultimate goals have achieved their goals.

The results that emerged within the scope of visual arts teachers' opinions, metaphorical descriptions and visual images; it was seen that the visual arts course created an unnecessary course image in teachers, students, administrators and parents. Many sub-causes of this result were among the results. The most important of these reasons is whether the course serves an interest or not.

This idea was reflected in the results as follows: It was seen that the visual arts course was perceived negatively by students, parents and teachers, that it was ignored, and that those who saw it positively approached it with a purpose of profit. In particular, the anxiety of finding a job, the small number of class hours systematically trivialized the course, and the fact that the course was not included in the exams automatically resulted in the course being underestimated alongside other branches. In this sense, the teachers of the course experienced hopelessness, their power in presenting the course gradually diminished, and accordingly, they could not cope with the feeling of being underestimated. In addition, the cultural background was also found to have negative consequences for the course.

In his study, Koçak (2002) stated that positive professional attitudes increase teachers' motivation. Similarly, Özgen (2004) and Atmaca (2004) found that both physical facilities and attitudes have an impact on teachers' motivation.

Güneş (2016), on the other hand, emphasized the insufficiency of course hours as a negative result in his study, but stated that the majority of secondary school students were satisfied with visual arts education.

When it is examined; negative results such as insufficient course hours, limited workshop facilities, bad perspective due to the course not being included in the exams, etc. have been included in many scientific studies (Adar, 2019; Adıgüzel & Tomsur, 2010; Avşar & Soğancı, 2011; Batur, 2010; Çakmak & Türkcan; Gündal, 2007; Kahraman, 2007; Tarı, 2011; Yazar, et al., 2014). These results also revealed the fact that those who took this course did not know why art was made (Rosalinda, 1995).

The fact that the visual arts course, which can have a significant impact in the context of talent and thinking skills, is in this situation may cause the loss of giftedness and multiple intelligence examples. At the same time, even the existence of the course in the system can be considered as a promising situation. When all these results are evaluated; increasing the importance and effectiveness of the course is not seen as unattainable from the participants' point of view. However, failure to make arrangements in this sense may lead to irreversible losses for our country in terms of both intelligence and talent. In the name of "unification on the road to civilization" (Kaya, 2007), individuals should be handled with their talents and intelligence. In this sense, it is seen that the infrastructure of the visual arts course should be reconstructed (Akkurt & Boratav, 2018).

The results obtained from the analysis of the data obtained from interviews, metaphors, painting studies and conversations show that while the visual arts course is a promising field for visual arts teachers, it has turned into disappointment, hopelessness and burnout. It is thought that the fact that teachers feel themselves insignificant and worthless with the course will have negative consequences for determining the types of talent and intelligence that exist

in students. This situation is worrisome in many aspects from gifted individuals to all students who need individualized education planning.

As a result, these findings are thought-provoking for the visual arts course, which can have very different effects in the context of talent and thinking skills. Addressing these concerns of teachers can be a very important turning point for both the course and the students.

Recommendations

The scope of the study can be expanded to cover the whole country. In addition, the education system of the country can be examined in comparison with the systems of countries that have achieved success in terms of art abroad. The results of the study can be elaborated with the reasons as a new study.

Limitations

The study is limited to visual arts teachers working in Kars central secondary schools.

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Research Article

Thematic analysis of studies on gifted students in the field of mathematics education[1]

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Articles in Turkiye

Abstract

This study aimed to determine the study subjects and methodological tendencies of articles and theses written in Turkey between 2011 and 2023 on gifted students in the field of mathematics education. The Council of Higher Education (YÖK) National Thesis Center catalog and DergiPark and Google Scholar databases were used to collect the data for the study. As a result of the scanning, 71 theses and 60 articles on gifted students in mathematics education were reached. Among the theses and articles conducted on the same data, theses were selected due to their comprehensiveness, and a total of 120 studies, including 71 theses and 49 articles, were examined. Examination of the studies was carried out using the descriptive content analysis method. Six themes were determined, four of which covered the methodological dimension, and the studies were examined in terms of publication year, sample group, research method, and design, data collection method and techniques, study subject, data analysis method and technique. As a result of the examinations, it was concluded that studies on gifted students in mathematics education have increased over the years and that studies adopting qualitative methods have increased in recent years. It was determined that there were specific approaches in the studies regarding research models, data collection tools, and data analysis techniques and that the studies concentrated on specific methods and techniques in these themes. It was concluded that the studies were mainly conducted with secondary school students as the sample group, the number of studies conducted with teacher candidates and parents was quite limited, and no studies were conducted in mathematics education with the preschool student group. It has been determined that cognitive field studies come to the fore as study subjects and that there is an increase in the development, evaluation, and comparison studies of educational programs. Studies on the diagnosis of gifted students and studies on teachers, who have a critical role in the education of gifted students, are minimal. Almost no studies include technology, which is the critical reality of our age. In line with the research results, it can be said that mixed research methods are adopted, and increasing studies for teachers, parents, and preschool students, designing research that allows different analysis techniques and incorporating technology is essential in order to eliminate the deficiencies in the literature.

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Introduction

It is accepted that the individuals who shape history are different from other people and superior in some aspects. Today, these individuals, who differ from others with many characteristics, are considered gifted. Gifted/exceptionally talented individuals are academically successful and high-level individuals who learn faster than their peers. They are at the forefront with characteristics such as creativity and leadership and can understand abstract ideas (MEB, 2018). Gifted individuals are also expressed with the concepts of gifted and special talent. Although intelligence and talent have different meanings, the concepts of giftedness and exceptional talent are generally evaluated together in the

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literature. The characteristics of gifted students, such as above-average talent, outstanding creativity, and success that differentiates them from other students, are also the characteristics that define gifted students (Shavinina, 2013). For this reason, individuals with high academic potential and ability are considered gifted or gifted.

The learning of gifted students is different from that of other students. They can learn complex information much faster (Karaduman, 2010). However, this should not create the perception that gifted people can do everything themselves (Altıntaş, 2009). These individuals need education in line with their interests and abilities. Therefore, the education programs of gifted students should be differentiated by considering their abilities and learning speeds, and the education provided should aim to maximize the potential of this particular student group. Because it is known that gifted students can improve themselves under appropriate conditions, and only in this way can they serve their society at the highest level (Clark, 2002). For this reason, how education for gifted students should be has become an important research topic (Özyaprak, 2016), and in recent years, this issue has started to gain importance in the curriculum of countries.

It is stated that the practices for gifted students in our country have a very long history, and the first studies reached the Enderun schools that were active during the Ottoman period (Birgili & Çalık, 2013; Koç-Koca & Gürbüz, 2022). During the Republican period, training for gifted students remained in the background, and, except for a few practices, no significant steps were taken on this issue for a long time. In the 1990s, some developments began with the opening of private schools where only gifted students could receive education (Ataman, 2012). The number of institutions where gifted students receive education has increased, and science and art centers (SACs)[3] have begun to serve actively in many provinces and districts. SACs are official institutions belonging to the Ministry of National Education, which enable gifted students to receive an education in which they can develop their talents and provide this education at times outside the students' formal education period. Apart from this, gifted students can also receive education in institutions such as Turkish Education Foundation İnanç Türkeş Private High School (TEVİTOL) and Gifted Education Center (ÜYEP) (Sak et al., 2015; Koç Koca, 2022).

SACs institutions provide an excellent advantage for gifted students to receive education with their peers at their level and in line with their abilities. On the other hand, gifted students spend most of their educational lives with typically developing students (Özdemir, 2016). Although this situation is essential in preventing gifted students from being isolated from society, it also has some limitations. It is stated that these students learn faster than other students, causing them to get bored in class more quickly, and their capacities decrease (Gadanidis et al., 2011). In this sense, it is essential to create educational environments that will support students' potential in their regular education processes. Mathematics lessons require much more attention and importance (Özdemir, 2018). They are considering that the IQ score, which is generally an expression of intelligence level, and giftedness are considered equal (Sternberg & Davidson, 2005) and that the IQ score explains mathematics success (Konold & Canivez, 2010), the perception that gifted students are generally successful in mathematics emerges. The concept of giftedness in mathematics is used as a type of giftedness (Singer et al., 2016). Giftedness in mathematics is expressed as the ability to see the world through a mathematical lens (Krutetski, 1976). At the same time, students who are gifted in mathematics stand out as individuals who can solve problems in a different and fast way and associate mathematical structures with real life (Fıçıcı & Siegle, 2008). Therefore, mathematics is among the subjects gifted students can express themselves best in school courses. Because the learning opportunities in these courses play an essential role in developing students' superior abilities (Singer et al., 2016). For this reason, it is essential to research the mathematics education of gifted students.

International research on gifted students in mathematics education was limited in the 2000s, and most studies focused on gifted students in general terms without focusing on specific areas such as mathematics, art, music, or science education (Leikin, 2009). A similar situation exists in the national literature (Nacar, 2015); but today, this number is increasing daily. It is essential to examine the changes in the subject orientations and methodological tendencies of the studies conducted over the years to identify the literature gaps. When we look at the studies on gifted

[3] These institutions provide support education to gifted students in Turkey.

students, curriculum development and evaluation studies stand out (Ayvacı & Bebek, 2019). In addition, in the studies conducted, emphasis is placed on studies addressing the cognitive dimension (Kaya, 2021). In their study, Ayvacı and Bebek (2019) stated that the studies carried out with gifted people concentrated on specific subjects and that studies aimed at improving research-inquiry skills should be increased. Güçin (2014) states that quantitative methods are mainly adopted in the studies. İnan and Uyangör (2022) similarly stated that studies adopting quantitative research methods predominate, and many studies focus on specific patterns in research methods. Kirişçi (2023) examined the theses about gifted students in mathematics education and emphasized that very few studies deal with technology. Güçin and Oruç (2015) stated that academic studies on gifted students mainly consist of papers. It is possible to come across studies examining research on gifted students in mathematics education. In his study, Kaya (2021) limited the theses about gifted students in mathematics education conducted between 2002 and 2020, İnan and Uyangör (2022) limited the theses conducted between 2009 and 2020, and Demirci and Tertemiz (2022) limited the theses conducted between 2002 and 2020 in gifted education journals. It examined and limited mathematics education studies published between 2022 and 2022. In his master's thesis study, Nacar (2015) examined the studies on gifted students in mathematics education in our country and worldwide between 2005 and 2014.

Research Problem

In analyzing studies on gifted students in mathematics education, the focus is generally on one type of study, either articles or theses. For this reason, it is considered critical to present information about the current literature and draw a more general picture of the literature by considering studies conducted in different types of research together. Examining studies conducted in mathematics education can also enable researchers to handle gifted students more effectively and supportively and plan their studies by considering the literature gaps. For this purpose, the study aimed to examine the articles and theses about gifted students in mathematics education between 2011 and 2023, and the problem of the research was "What are the study subjects and methodological tendencies of the studies conducted between 2011 and 2023 about gifted students in mathematics education?" was determined as.

Method

Pattern of the Research

This research is a document review aiming to examine thematically and methodologically the articles and theses published until June 2023 regarding gifted students in mathematics education. Document review is a qualitative research method that involves examining written documents and documents systematically and in detail (Wach & Ward, 2013). This method has several analytical steps, which are based on examining or evaluating materials in both written and electronic media (Bowen, 2009). The main steps of the document review process are collecting documents within the limits appropriate to the research problem, reading the documents in detail by checking their originality, analyzing them according to the created themes and codes, and interpreting and reporting the results (Kıral, 2020). The procedures performed according to these steps will be explained in the research.

Collection of Data

Before determining the articles and theses to be examined in the research, the articles' characteristics were decided to limit the documents. Accordingly, the documents to be examined are;

- It is done only within the scope of mathematics education
- It is aimed at gifted people
- It has been decided that the articles must be published in journals included in the TR Index database and meet the criteria.

After the criteria were determined, a general literature review was conducted to determine the appropriate keywords for the search, and potentially related terms were identified. As a result of the determination, the keywords to be used in scanning,

- Gifted in mathematics education
- Special talented in mathematics education
- Gifted in mathematics education
- Highly talented
- Special talents
- Gifted
- Science and Art Centers
- It was decided to become a Gifted Education Program Model (ÜYEP)

The English equivalents of the keywords were also used in the search, thus aiming to reach more studies. "Dergipark" and "Google Scholar" databases were used to access articles, and the "National Thesis Center" data catalog was used for these. While scanning the studies, the keywords mentioned above were considered one by one every year. The bibliography of the studies included in the scope of the review was also examined, thus aiming to access all relevant studies. As a result of the literature review, 60 articles and 71 theses published between 2011-2023 were reached. In the examinations, it was determined that these were articles produced from theses, and it was decided to examine the thesis due to the comprehensiveness of both studies. In this context, 11 articles determined to be produced from theses were excluded from the review, and 49 articles were evaluated. The list of studies is presented in Appendix 1 and Appendix 2.Data

Analysis, Validity, and Reliability Studies

The descriptive content analysis method, one of the content analysis methods, was used to analyze the articles collected in the research. *Descriptive content analysis* is a systematic review that identifies and describes the trends of independent studies conducted in a particular field with different methods, such as quantitative and qualitative (Çalık & Sözbilir, 2014). The purpose of descriptive content analysis is to reveal the trend of science regarding the determined research topic and to present a general picture that will provide ideas to researchers who want to research this topic in the future (Cohen et al., 2017). Since this research aims to determine the topics and methodological tendencies of studies on gifted students in mathematics education and to reveal the deficiencies, gaps, and accumulations in the literature, descriptive content analysis was deemed appropriate. Since many studies are examined in descriptive content analysis, an in-depth examination is impossible in the studies discussed (Çalık & Sözbilir, 2014). In this research, six themes were determined to analyze the articles, 4 of which covered the methodological dimension. The determined themes are a) publication year, b) study group, c) research method and design, d) data collection method and techniques, e) study subject and f) data analysis method and technique. After the themes were determined, the analysis process began.

In the first stage of the analysis process, which took place in four stages, a study code was assigned to the studies, separate articles, and dissertations. Articles were assigned from 1 to 49 as Group A, and theses were assigned from 1 to 71 as Group B. The studies were handled according to the codes given throughout the analysis and in presenting the findings. The second phase is the preliminary analysis phase of the studies. At this stage, the Excel program was used to enter data for each theme, the articles examined were read in-depth, and article information was entered according to each theme. In the preliminary analysis stage, the primary purpose is to determine the sub-themes of the themes. In the third stage, subthemes for each theme were determined, and all studies were recoded according to the subthemes. At this stage, it was aimed to increase the validity and reliability of the research with in-depth re-readings. The last stage is the reporting part, which is the last step of the document review. At this stage, tables were first created by each theme, and the distributions of the studies placed in the table, together with their study codes, were presented to the reader with graphs, frequencies, and percentage values.

In this study, in which qualitative research methods were adopted, expert opinion and researcher triangulation, which are used in qualitative research, were used for validity and reliability (Cresswell, 2013; Yıldırım & Şimşek, 2013). In the third stage of the analysis, the list of themes and sub-themes determined was shown to a researcher who is an

expert in the field, and his opinion was taken. In the analysis part of the third stage, help was received from another expert researcher, and 20% of the articles (10 articles) were coded separately by both researchers. To calculate the compliance percentage of the codes, Miles and Huberman's (1994) coder reliability formula ([Compatible codes/ (Compatible codes + Incompatible codes)] x100) was applied, and the compliance percentage was determined as 90% (54 compatible codes - 60 total codes). Incompatible codes were evaluated, and consensus was reached. For example, studies examining the factors affecting academic success within the theme of the study were placed into different sub-themes, namely cognitive field studies and affective field studies, by two researchers. The disagreement arising from the fact that academic success is related to the cognitive domain, while the influencing factor is related to the affective domain, was resolved by consensus of the researchers, and it was decided to code the articles into the relevant sub-theme according to the type of factor whose effect on academic success was examined. After consensus was reached on the themes, the researcher continued the analysis process alone. Another way to increase validity and reliability in research is to explain in detail how the results were obtained, present the findings and evidence that reveal the results in a way that the reader can easily access, and convert the data into a numerical form (Cresswell, 2013). For this reason, the research presented the articles with their study codes and digitized them with frequency and percentage values.

Results

In the research where articles about gifted students in mathematics education were analyzed, the articles were discussed under six themes. The findings obtained in each theme will be presented respectively. The first of the themes discussed is the distribution of articles according to the years they were published. Graph 1 presents the distribution of studies according to publication years.

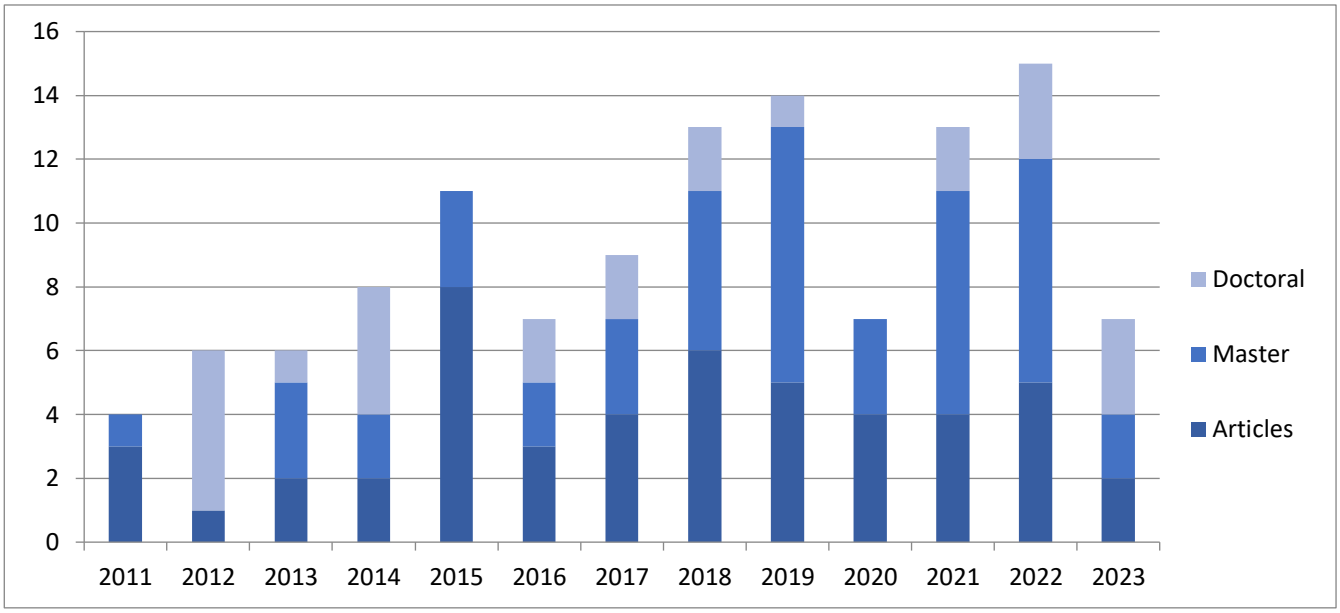

Chart 1. Distribution of studies according to the years they were published

In light of the information in the graph, the total number of studies has increased over the years. Of the total 120 studies, 41% consist of articles 49, 21% consist of a doctoral thesis with 25, and 38% consist of a master's thesis with 46 studies. When the study titles are considered separately, it is seen that there were few studies in the articles between 2011 and 2014, there was a significant increase in the studies conducted as of 2015, and the frequency of studies showed a proportional distribution in the following years. When looking at the thesis studies, it can be stated that doctoral theses were mostly done in 2012, master's theses were mostly done in 2019, doctoral theses showed a proportional distribution over the years, and there has been an increase in master's theses in recent years. The total number of studies generally increased from 2011 to 2019. Although there was a decline in 2020, these were the years when the most work was done, starting from 2019 and including the first half of 2023. The findings obtained from the graph show that studies on gifted students in mathematics education have gained momentum as of 2019, and this momentum continues in the following years.

The second theme addressed in the studies is the sample group. The sample group distribution of the studies is presented below (Table 1). Studies conducted with different sample groups were coded separately for each group.

Table 1. Sample profiles of the studies

				Registered in SACs		SACs unregistered	
	(f) (%)			(f)	Research Codes	(f)	Research Codes
Student	101 %85	36	Primary school -A	10	18*, 20*, 21*, 28, 33, 36*, 37*, 38*,42*, 46	4	10*, 20*, 21*, 36*
			Secondary school-A	27	2*, 3, 4, 7, 8, 11, 12, 17*, 18*, 19, 20*, 22, 23, 24, 25, 26, 29, 30, 37*, 38*, 39*, 41, 42*, 45, 47*, 48, 49*	6	2*, 10*, 17*, 20*, 39*,49*
			High school-A	5	5, 16*, 27, 40, 47*		
		65	Primary school -B	12	1*, 8*, 10, 19, 38, 45*, 47*, 51*, 56, 57*, 65*, 67*	1	47*
			Secondary school -B	49	1*, 3, 4*, 6, 7*, 8*, 12, 14, 15, 16, 17, 18, 20, 21*, 24*, 25, 26*, 27, 30, 31*, 32, 33*, 34, 36*, 37, 39, 40*, 42, 43*, 44, 46, 47*, 49*, 50*, 51*, 52*, 54*, 57*, 58*, 59*, 61*, 62, 63*, 65*, 66, 67*, 69, 70, 71*	16	4*, 7*, 11, 21*, 24*, 33*, 36*, 40*, 47*, 49*, 50*, 54*, 58*, 61*, 63*, 71*
			High school-B	10	2, 26* , 28, 31*, 35, 51*, 52*, 55, 60, 68		
			Unspecified	2	5, 48		
Prospective teacher	1 %1			1	1		
Teacher	15 %12	5	High school-A	3	15, 16*, 35	1	14*
			Secondary school-A			2	9*, 14*
			Primary school-A			1	9*
		10	High school-B	5	9, 13, 43*, 45*, 67*		
			Secondary school-B			5	29, 41, 49*, 58*, 64*
			Primary school-B				64*
Lecturer -B	1 %1					1	67*
Parents -B	1 %1				45*		
Total	119 %100						

** Articles with code A, theses with code B, and studies carried out with different working groups are shown with the symbol "*." Articles with study codes 6, 13, 31, 32, 34, 43, and 44 and theses with study codes 22, 23, and 53 were not included in the scope of the review.

A large portion of the studies on gifted students was conducted with students (85%), and most studies were conducted with secondary school students in the student group. Most sample groups consist of students studying at the science and arts center and working teachers. Studies conducted with teachers constitute 12% of the total studies. In the studies carried out with teachers who do not work in the science and art center, it is seen that the studies were carried out with teacher groups from all three levels. The studies of sample groups of teachers show a balanced distribution in this sense. Likewise, it was determined that studies were conducted with primary and secondary school students who were not diagnosed as gifted but not with high school students. Teacher candidates, faculty members, and parent groups were determined as the sample groups with the lowest percentage (1%). So much so that it was determined that only one article was conducted with teacher candidates and one thesis each conducted with instructors and parents; however, it was determined that no study was conducted with teacher candidates studying in the secondary school mathematics department.

When the studies were considered under subheadings, findings parallel to the general findings were obtained. Secondary school students were the most preferred sample group for both articles and theses. Almost half of all studies (57 studies - 48%) consist of studies conducted with two or more sample groups. While different sample groups are groups of students or teachers at different levels in some studies, some studies include students at the same level who are diagnosed as gifted and those who are not. Articles with study codes 32, 43, and 44, theses with codes 22 and 23 on instructional design and comparison, and 34 articles with code 34 on theoretically addressing giftedness in mathematics. Articles with codes 6, 13, and 31 and theses with code 53 based on the analysis of academic studies were included in the sample group. Accordingly, it was not considered within the scope of the analysis.

The third theme of the research consists of the articles' research methods and research designs. The distribution of articles according to research methods and designs is presented in Table 2.

Table 2. Distribution of studies according to research method and design

Method	(f)	(%)	Research Desing		(f)	Research Codes A	(f)	Research Codes B
Quantitative	46	38	Experimental design		4	7, 41, 48, 49	10	12, 20, 38, 55, 56, 57, 62, 66, 69, 70
			Survey	Descriptive	7	9, 11, 17, 23, 38, 40, 46	5	18, 34, 41, 63*, 65
				Relational	5	8, 24, 25, 26, 28,	9	11, 42, 47 48, 51, 59, 61, 63*, 71
				Causal	1	20	1	64
			Scale development		1	10		
			Meta analysis				1	22
			Unspecified		3	29, 42, 45		
Qualitative	60	50	Case Study		11	2, 3, 5, 12, 16, 21, 27, 30, 33, 35, 39	28	1, 3, 4, 6, 7, 8, 9, 14, 15, 16, 17, 19, 21, 23, 24, 27, 28, 32, 33, 35, 36, 39, 44, 46, 50, 54, 60, 68
			Phenomenology		4	14, 15, 37, 47	3	13, 25, 52
			Descriptive research		1	1	1	5
			Document review		6	6, 13, 31, 36, 43, 44	1	53
			Design based research				1	49
			Action aesearch				1	30
			Unspecified		2	18, 22	1	29
Mixed	12	10	Explanatory design		2	4, 19	3	2, 31, 58
			Parallel design				6	26, 37, 40, 43, 45, 67
			Unspecified					10
Total	118	100			49		71	

*Studies with 32, 34 study subjects were not included in the scope of the review

When the studies are examined in terms of research method, it is seen that 60 studies (50%) adopted the qualitative research method, and 46 studies (38%) adopted the quantitative research method. According to the research results, where quantitative and qualitative methods constitute a large percentage, articles designed in mixed research methods constitute 10 of all studies. When examined in terms of research design, it is seen that in quantitative research, the survey design was the most preferred, with 27 (23%) studies. Among the survey designs, descriptive (10%) and relational survey (12%) designs were preferred. In qualitative research methods, studies were mainly organized according to the case study design (33%). Experimental design (12%), scale development (1%), and meta-analysis study (1%) are other research designs considered in the quantitative method. Other preferred research designs in qualitative research methods were phenomenology (6%), document analysis (6%), descriptive research (2%), and action research (1%). There are studies in quantitative and qualitative research methods where the research design is not specified, and these studies are evaluated under a separate heading. In mixed methods, parallel (5%) and explanatory designs (4%) were the adopted research designs. When the study titles are considered separately, qualitative research designs come to

the fore in articles (49%) and theses (51%); mixed research method is rarely preferred in articles (4%). Case study design is prominent in these (39%). It came to the fore. Finally, 32 articles with study codes on instructional design and 34 articles with study codes on giftedness from a theoretical perspective were excluded from the review.

The distribution of articles according to data collection tools, the fourth theme of the research, is presented in Table 3.

Table 3. Data collection tools of the studies

	(f) (%)	Technic		(f)	Research Codes A	(f)	Research Codes B
Quantitative	133 %59	Test	Achievement	5	11*, 22*, 23*, 26*, 49*	13	4*, 12, 20*, 45*, 47, 48*, 55*, 58*, 60*, 62*, 66*, 69*, 70*
			İntelligence	3	10, 26*, 41	5	16*, 36*, 38*, 63*, 70*
			Problem solving	2	21, 36	10	1*, 3, 6*, 35*, 38*, 51*, 54 * , 56*, 57*, 60*
			Creativity	1	49*	8	11*, 56*, 58*, 59*, 62*, 66*, 69*, 70*
			Critical thinking			2	42*, 48*
			Spatial	1	7	3	48*, 66*, 69*
			Problem posing	1	46	2	21*, 30*
			Other	5	12*, 20, 47	4	11*, 14*, 34, 42*
		Scale	Reflective thinking skills	2	4*, 38		
			Anxiety	4	8*, 17, 24*, 28*	1	71*
			Self efficacy	4	8*, 11*, 24*, 25	6	5*, 26*, 37*, 41*, 57*, 59*
			Student characteristics assessment	1	9	1	64
			Attitude	2	19*, 42*	12	5*, 18*, 20*, 26*, 37*, 41*, 55*, 56*, 57*, 62*, 65*, 70*
			Learning styles	2	29*, 42*	1	61*
			Multiple intelligences	2	29*, 49*	3	7*, 58*, 61*
			Metacognition			3	51*,28*, 59*
			Academic self			2	57*, 62*
			Motivational strategies			2	16*, 63*
			Opinion	1	48	2	43*, 67*
			Self-regulation	1	40*	1	57*
			Other	1	28*	5	2*, 10, 31*, 40, 61*
		Form	Personal data form			8	2*, 18*, 26*, 31*, 38*, 42*, 51*, 65*
			Assessment	1	45	2	45*, 49*
		Survey		1	23*	2	52*, 67*
		Rubric				1	38
Qualitative	93 %41	İnterview	Semi structured	10	3, 4*, 5, 14, 15, 16*, 18, 19*, 30, 35*	24	1*, 2*, 6*, 9, 13, 15*, 17*, 21*, 25, 26*, 28*, 29, 30*, 32*, 36*, 37*, 43*, 46, 49*, 52*, 54*, 60*, 68*, 71*
			Structured	4	1, 22*, 27, 33	3	14*, 35*, 45*
			Unstructured			1	31*
			Focus group	1	37	1	8*
			Clinical interview	3	2*, 12*, 39	5	7*, 24*, 27, 33*, 50*
		Observation		2	4*, 35*	8	7*, 8*, 17*, 30*, 32*, 45*, 49*, 68*
		Document review		9	6, 13, 16*, 31, 32, 34, 35*, 43, 44	4	17*, 22, 23, 53
		Activity- Worksheet-Problem solving sessions		2	2*, 16*	13	4*, 6*, 8*, 15*, 19, 24*, 28*, 30*, 32*, 33*, 44, 50*, 68*
		Journaling				1	30*
		Field notes				2	8*, 24*
Total	226			71		155	

When the distribution of the conducted studies according to data collection tools was examined, it was determined that quantitative data collection tools were mainly used. Since more than one data collection tool was used in the studies, 59% of the 226 data collection tools used were quantitative data collection tools, and 41% were qualitative data collection tools. It was determined that 35% of the articles (17 articles) used more than one data collection tool, and in theses, this figure was 75% with 55 studies, and it was observed that three or more data collection tools were frequently used in theses. When data collection types are examined according to the number of uses, it is seen that tests (27%) and scales (26%) come to the fore among the quantitative data collection types. In contrast, success, problem-solving, intelligence, and creativity tests are more preferred in tests, and attitude and self-efficacy scales are more preferred in scales. Has been determined. Scales and tests used once in research are coded in the other category. The scales coded in the Other category are "Holistic and Analytical Thinking While Solving Problems," "Perfectionism," "Mathematical Modeling Competencies," "Self-Learning with Technology for Children," "Mathematical Thinking," "Number Sense," "Identification of Personality" scales. It is in the form. The research is not concentrated on one type of scale but has a wide range of scales. In the other test categories, there are "Mathematical Literacy," "Number Sense," "Argument Formation," "Mathematical Ability," "Proportional Reasoning Skill," "Proof Skill," and "Mathematical Productivity" tests. Forms, surveys, and rubrics were other types of quantitative data collection used in studies. In the qualitative data collection type, the most used type is interview (23%), and among the interview types, semi-structured interview (15%). Observation (4%) and document review (6%), keeping a diary (1%), and field notes (1%) are other types of qualitative data collection, and after the interview, activity and problem-solving sessions (7%) were mainly used.

The topics covered by the studies are the fifth theme examined. The topic distribution is presented in Table 4.

Table 4. Topics of the study

Study Topıcs			f	%	Research Codes A	Research Codes B
PROBLEM	Cognitive and motivational insights	1	31	18	27	
	Reflective thinking skills	2			4, 38	
	Problem solving strategies	8			21*, 36*, 39*	6*, 24*, 54*, 57*, 60
	Problem solving process	7			12, 19*	6*, 19*, 24*, 33, 35
	Problem solving skills	7				1*, 19*, 21*, 38, 51*, 56*, 57*
	Problem posing	6			30, 46	4, 21*, 30*, 31
COGNITIVE	Mathematical thinking processes	1	54	32	2*	
	Reasoning skills	3			3	3, 34
	The relationship between academic success and IQ	1			26	
	Variables affecting academic success	3			23	48*, 59*
	Computational thinking	1				37*
	Critical thinking skills	3				42, 48*, 51*
	Mathematical literacy skills	1			11*	
	Mathematical reasoning	1				15
	Effect of intervention on academic achievement	8				5*, 10*, 12, 20*, 22, 55, 58*, 66*
	Mathematical modeling competencies	2				2*, 8
	Proving processes-skills	3				1*, 14, 27
	Socio-mathematical norms	1				17
	Mathematical concept information	4			5, 33, 47	52
	Creating mathematical knowledge	2				16, 46
	Learning styles	2			29	61*
	Ability to ask questions	1				32
	Number sense	2			20*	40*
	Metacognitive knowledge-process	3				28, 51*, 59*
	Spatial ability	3			7	48*, 66*
	Creativity	9				11, 30*, 36*, 44, 50*, 56*, 58*, 59*, 66*
AFFECTIVE	Self-efficacy	9	32	19	8, 11*, 24, 25	5*, 26*, 41*, 57*, 59*
	Mathematics perceptions	2			18, 37	
	Teacher perceptions	1				25
	Academic self	1				57*
	Anxiety	3			17*, 28	71*
	Self-regulated learning and motivational belief	4			40	57*, 63, 68
	Attitude	10			19*, 42	18, 20*, 26*, 37*, 41*, 56*, 57*, 65
	Epistemological belief	1				9
	Views on the history of math	1			48	
Educational program development, evaluation or comparison			21	12	16, 22, 32, 35, 41, 43, 44, 45, 49*	13, 21*, 23, 39, 43, 45, 49, 58*, 62, 67, 69, 70
Identifying/identifying gifted people, their knowledge, perceptions and opinions			5	3	1, 9, 14, 34	64
Scale development			1	1	10	
Analysis of research conducted			4	2	6, 13, 31	53
Problems faced by mathematics teachers working at BİLSEM			2	1	15	29
Comparison of students diagnosed as gifted and other students			16	9	2*, 17*, 20*, 21*, 36*, 39*, 49*	7, 24*, 36*, 40*, 47, 50*, 54*, 58*, 71*
Technology interaction and digital software			5	3	16*	5*, 20*, 37*, 55*
Total			171	100		

When looking at the distribution of the research topics of the studies, it can be said that although some topics stand out, the study topics vary and have a wide spread. The studies mainly focus on subjects involving cognitive targets, and 50% of the total (85) consists of cognitive field studies on gifted people. Study titles such as problem-solving strategies, skills and processes, and problem-posing skills are the preferred topics in theses on gifted students, and problem-themed studies constituted 18% (31 studies) of all studies. Studies on creativity in cognitive field studies (8 studies) and studies examining the effect of intervention on academic achievement (8 studies) were other topics on which these focused. When we look at the adequate field studies, it was determined that 32 studies (19%) included targets for this field. Self-efficacy studies are discussed more in articles and theses than other subjects (9 studies), while studies on attitude come to the fore mostly in theses (8 studies). Developing, evaluating, or comparing curricula for gifted students is one of the prominent topics in both articles and theses, and 21 out of 166 studies (12%) dealt with this subject. Five of the studies (3%) examined the identification and identification of gifted students and the opinions or perceptions of pre-service teachers on this subject, and the other 3% included technology in their studies. Scale development, problems faced by students working in science and art centers, and analysis of the studies conducted were other study topics with a 2% and 1% rate. Finally, some studies compared students diagnosed as gifted with other students. In addition to the study topics specified in the table, these studies are also coded under the theme of comparison studies. 10% of the studies (16 studies) consist of studies comparing students who were diagnosed as gifted and those who were not.

The last theme addressed in the research was the data analysis method. The distribution of articles according to data analysis method and technique is presented in Table 5.

Table 5. Data analysis method and technique of the studies

Method	f	%	Analysis technique	f	Research Codes-A	Research Codes-B
QUANTATIVE	148	65	Descriptive	18	4*, 7*, 9*, 19*, 20*, 22, 23*, 38*, 40, 45*, 47	28*, 38*, 41*, 42*, 51*, 60*, 61*
			PREDİCTİVE T-test	29	7*, 11*, 17*, 19*, 20*, 26*, 41, 45*, 50*	10*, 11*, 12*, 20*, 26*, 31*, 34*, 40*, 41*, 42*, 43*, 51*, 55*, 56*, 58*, 59*, 63*, 65*, 67*, 71*
			Variance- (Anova-Manova)	20	11*, 17*, 19* 23*, 38*, 45*	11*, 26*, 31*, 34*, 41*, 42*, 43*, 47*, 51*, 59*, 63*, 64, 65*, 71*
			Covariance- (Ancova)	1		2*
			Mann whitney U	21	7*, 17*, 26*, 42*, 48*, 49*	2*, 18*, 37*, 40*, 45*, 55*, 56*, 58*, 62*, 63*, 65*, 66*, 67*, 69*, 70*
			Kruskal wallis	7	17*, 42*	18*, 40*, 63*, 67*, 71*
			Kolmogorov simirnov	6	19*, 38*	18*, 20*, 56*, 65*
			Wilcoxon	14	48*, 49*	2*, 20*, 37*, 38*, 45*, 56*, 57*, 58*, 62*, 66*, 69*, 70*
			Regresyon	7	8, 24, 25*, 28*	48*, 51*, 59*
			Shapiro Wilk			10*, 12*, 38*, 40*, 57*, 58*
			Pearson korelasyon	11	9*, 25*, 26*, 28*	11*, 26*, 31*, 42*, 47*, 51*, 63*
			Tukey	3		40*, 43*, 48*
			Diğer	7	9*, 10, 26*, 29	43*, 48*, 61*
			Rubric	4		5*, 6*, 8*, 30*
			Meta analysis	1		22
QUALITATIVE	78	35	Descriptive	27	2, 12*, 13, 18*, 30, 31, 43	1*, 6*, 7*, 8*, 10*, 14, 15, 16, 23, 24, 27, 31*, 39, 44, 46, 53, 58*, 60*, 67*, 71*
			Content analysis	39	1, 3, 4*, 5, 6, 12*, 14, 15, 16, 19*, 21, 33, 36, 37, 46	1*, 2*, 3, 4, 7*, 9, 19, 21, 25, 26*, 28*, 29, 30*, 32, 33, 36*, 37*, 43*, 45*, 50, 52, 54*, 67*, 68*
			Constantly comparative	7	18*, 27	6*, 17, 35, 49, 68*
			Discourse analysis	2		36*, 54*
			Phenomenological	1		13
			Unspecified	2	35, 39	
Total	226	100				

*Articles with study codes 32, 34, and 44 were not included in the review.

When we look at the distribution of articles and theses according to data analysis methods, it is seen that specific methods come to the fore among quantitative and qualitative methods. When we look at the quantitative data analysis methods, it is seen that 18 studies, articles, and theses use descriptive statistics techniques. Among the predictive statistical techniques, t-test (29 studies), Mann Whitney-u test (21 studies), and analysis of variance (20 studies) techniques come to the fore. There are four theses in which rubrics are used, which are among the quantitative analysis techniques, and one thesis in which meta-analysis is used. The techniques that came to the fore in qualitative data analysis were content analysis with 39 studies and descriptive analysis with 27 studies. The constant comparative analysis technique, grounded theory analysis, was another qualitative technique used in 7 studies. Phenomenological analysis and discourse analysis are other analysis methods used. When looked at, it constitutes 65% of the quantitative techniques used. Some of the studies dealt with quantitative and qualitative data analysis together. In the analyses made regarding this, 33 of 71 theses studies (46%) were qualitative, 26 studies (37%) were quantitative, and 12 studies (17%) dealt with quantitative and qualitative analysis techniques together. When the articles were examined, it was seen that 22 studies (48%) dealt with qualitative, 21 studies (46%) dealt with quantitative, and three studies (6%) dealt

with quantitative and qualitative analysis techniques together. Although the number of quantitative techniques is high, it has been determined that the studies are mainly carried out with qualitative methods. Of the 120 studies, 55 (46%) adopted qualitative methods, and 47 (39%) adopted quantitative methods. Finally, the articles with study codes 32 and 44 on instructional design and the article with code 34, which deals with giftedness in mathematics theoretically, were evaluated outside the scope of evaluation according to the data analysis method.

Conclusion and Discussion

This study examined the subject orientations and methodological tendencies of articles and postgraduate studies conducted in mathematics education between 2011 and 2023. When looking at the distribution of research types, it was determined that doctoral theses had the lowest percentage. Since master's education and thesis writing takes place in a shorter period of time compared to doctoral education, it is quite normal for the number to be in favor of master's degree. However, considering that doctoral theses contribute more to the world of science, the number of doctoral theses on mathematics education of gifted students can be increased. Ayvacı and Bebek (2019) and Kaya (2021) obtained similar results in their studies. When theses articles were compared, it was seen that most were related to the subject. Surprisingly, theses have a higher percentage than articles, even though they are more comprehensively conducted scientific research. When looking at the distribution of studies by years, it was determined that the articles have increased since 2015; the master's thesis was not done in 2012, and the doctoral thesis was not done in 2011, 2015, and 2020. It can be said that these do not have a balanced distribution over the years, but when we look at the studies in general, there is a regular increase over the years, except for 2020. The worldwide pandemic process in 2020 may have caused scientific studies to slow down in this sense. In general, it is possible to say that the limited number of studies on gifted students in mathematics education (Nacar, 2015) has increased over the years. However, focusing more on doctoral theses and articles is crucial to contribute more to the literature.

The second theme discussed in the study was the sample group. It was determined that in both articles and theses, most students were studied, and among the student groups, most were secondary school students. While some of the studies were conducted with teachers, parents, and instructors were the sample groups in which the least amount of research was conducted. Studies conducted with high school and primary school students constitute one-fifth of all studies in the student group. No studies conducted with preschool students were found.

Additionally, almost one-third of the studies involved students not diagnosed as gifted. İnan and Uyangör (2022), who obtained a similar result, emphasized the importance of equal distribution in sample groups. In general, studies conducted with gifted students, most studies were conducted with secondary school students (Ayvacı & Bebek, 2019; Güçin, 2014; Kirişçi, 2023). It is expected that studies on gifted students will be carried out with groups of students who are diagnosed and educated in science and art centers. Many research topics, such as gifted student characteristics and determining the effect of my education program, are student-centered. Likewise, the lack of studies conducted with preschool children may be because the diagnosis of gifted students is made in the primary school period. However, as stated in the study of Demiroğlu et al. (2013), it is essential to increase the studies carried out at an early age to identify gifted people.

Additionally, the development of gifted students should be considered more than just student-focused. The role of teachers is critical in recognizing and educating gifted students (Şahin & Kargın, 2013). For students to receive a complete education, teachers must be highly aware of giftedness and some competencies (Dağlıoğlu, 2010). In a lesson such as mathematics, where gifted students generally exhibit high performance, the teacher must organize his/her awareness and education according to gifted students (Kanlı, 2011) because one of the ways that these particular students make progress in mathematics is through teacher support (Lynn and Stanley, 1972 as cited in Kanlı, 2011). It is stated that if gifted individuals are not diagnosed in time, their abilities atrophy (Rohrer, 1995). Along with teachers, parents also play a significant role in recognizing gifted individuals' differences, development, and talents (Akar & Akar, 2012). For this reason, the work carried out with teachers, teacher candidates, and parents needs to be increased.

When the studies examined were considered according to research methods, it was determined that qualitative methods were used the most and mixed research methods were used the least. Similar results were obtained when theses and articles were considered separately, and qualitative studies were the most used method in both types of research. In their studies, Ayvacı and Bebek (2019), İnan and Uyangör (2022), Kaya (2021), and Kirişçi (2023) concluded that theses were mainly carried out with quantitative methods, and Demirci and Tertemiz (2022), in articles published in gifted education journals, examined quantitative and qualitative methods. He stated that the methods are used in a balanced manner and that there has been an increase in qualitative approaches in recent years. The same applies to studies conducted in mathematics education. With the increase in qualitative studies in recent years, the intensity of quantitative methods has decreased. However, the number of mixed methods is still not at the desired level. As an effective method to eliminate the deficiencies of quantitative and qualitative methods by handling them together, the mixed research method allows for a detailed and advanced analysis, thus increasing the reliability of the research (Rossman & Wilson, 1994; Tunalı et al., 2016). In this sense, increasing the number of mixed studies will effectively provide richer data to the scientific world. When the research designs adopted in the studies were examined, it was determined that specific designs were accumulated. Survey and experimental research have been the most adopted research designs in quantitative studies, and case studies have been the most adopted research designs in qualitative studies. Researchers may have frequently preferred the case study because it provides in-depth information about the research problem. In addition, ethnographic and theory-building research is less preferred because it requires more time and experience (Cresswell, 2013). Nevertheless, studies that use different research methods are essential in offering different perspectives to the literature. Likewise, it is thought that it is essential to focus on developmental studies to investigate the effect of a developed teaching model and descriptive studies such as survey design in quantitative methods.

Another theme discussed in the study was determined as data collection tools. Among the quantitative data collection tools, tests and scales were the studies' most commonly used data collection tools. While achievement, problem-solving, intelligence, and creativity tests came to the fore in the tests used, attitude and self-efficacy scales were mainly used in the scales. Among the qualitative data collection tools, the interview was used most, and the semi-structured interview method was used most among the interview types. Demirci and Tertemiz (2022) and Kaya (2021) obtained similar results in their studies examining theses. There is a similar accumulation of articles. The fact that gifted people come to the fore regarding academic success and creativity may have affected the data collection tools used to address the dimensions of success, intelligence, and creativity. The interview, a research technique that allows the collection of in-depth data in qualitative research (Yüksel, 2022), is the most used qualitative research technique (Karataş, 2015). In this sense, it can be said that researchers act with a similar idea. When we look at the data analysis methods used in the research, it was determined that quantitative analysis techniques were used more, and descriptive statistics, t-test, analysis of variance, and Mann-Whitney-U test techniques were used more. Content and descriptive analysis were the most used among the qualitative analysis techniques.

In contrast, the continuous comparative analysis technique, which is the analysis of theory development studies, discourse analysis, and phenomenological analysis, could have been used more. Although there are more qualitative studies in research methods, the predominance of quantitative techniques in analysis may be because mixed methods research wants to strengthen the study data with different quantitative data collection tools. Some of the studies used both quantitative and qualitative data collection tools. At the same time, applying more than one test to the same data group in quantitative analysis techniques may be another reason for the greater use of quantitative analysis techniques. Some methods and techniques come to the fore in both data collection tools and analysis techniques. As stated by Kaya (2021), who found similar results in his research, designing studies that allow different analysis techniques is essential to eliminate the literature's deficiencies.

When the studies examined were examined according to research topics, it was determined that cognitive field studies were predominant, while affective field studies covered approximately one-fifth of all studies. Studies on

identifying gifted students, problems encountered by teachers at SACs, and scale development studies were other topics covered in limited numbers. When we look at cognitive field studies, it is possible to say that there is a wide range of topics, but problem-solving and problem posing studies come to the fore. Since the research group is highly talented, it is standard for studies to focus on the cognitive field. Because gifted students exhibit advanced cognitive skills (Gagne, 2005), the predominance of problem posing studies may be due to the idea that giftedness is directly related to problem-solving performance (Maker, 1994). At the same time, one of the skills that students should acquire in mathematics teaching goals is problem-solving. Therefore, some of the research conducted in mathematics education is expected to include problem-solving studies. The fact that creativity is one of the essential characteristics of gifted students (Koçak & İçmenoğlu, 2012) and the direct relationship between problem-solving and creative thinking (Tok, 2008) may be another reason for focusing on problem-solving and problem posing studies. It can be seen that very few studies have been conducted on the creativity of gifted people. Although gifted people generally stand out with their cognitive characteristics, it would not be wrong to say that their affective characteristics affect their performance. Since the mental development of gifted students is more advanced than their emotional development, it is stated that individuals experience fear, anxiety, perfectionism, and some problems with adaptation to peers and school (Preuss & Dubow, 2004; Akarsu & Mutlu, 2017). It is known that students' affective characteristics are an essential factor affecting success, especially in mathematics education (Yenilmez, 2010). Therefore, it is essential to increase research focusing on the affective characteristics of gifted students and to conduct studies to determine the problems and difficulties experienced by these individuals. Studies on the diagnosis of gifted students are still limited in number, in line with the results found in the study of Ayvacı and Bebek (2019). There are almost no studies that include technology. Kirişçi (2023) stated that only two of the theses he examined dealt with technological software.

Similarly, only one study in the articles discussed technology. One of the immutable realities of our age is technology, and education policies and approaches are primarily based on technology (Cloete, 2017). It is a significant deficiency that studies on technology related to gifted people, who are the productive power of the future in the development of society, should be carried out. Technology in mathematics teaching is an effective tool in concretizing knowledge, making learning permanent, and increasing motivation (Bircan, 2023); increasing technology interactive studies is essential. Likewise, studies focusing on teachers are also limited in number. Teachers who teach gifted individuals must have different characteristics, and their competencies are critical (Feldhusen, 1997). For this reason, it is essential to increase studies on teachers working in science and art centers and teachers with gifted students in other formal institutions to identify the problems experienced and to carry out studies to increase the awareness and competence of teachers in order to fill a significant gap in the literature.

In summary, studies on gifted students in mathematics education are generally conducted with secondary school students, mostly on cognitive issues, and qualitative or quantitative methods are at the forefront. Specific approaches, such as case studies, survey studies, and content analysis, are preferred regarding research design and data analysis techniques. Conducting studies that use different research methods and data collection tools, especially those that include technology, for teachers, teacher candidates, parents, and preschool children can be presented within the scope of the research recommendations.

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Appendix 1. Codes of Articles (A)

	Articles
1.	Aytekin, C., Sarıca, R., & Aytekin, T., (2019). İlköğretim matematik öğretmen adaylarının gözünden üstün yetenekli/zekâlı öğrenciler(Opinions of elementary mathematics teacher candidates about gifted students). *Sakarya Üniversitesi Eğitim Fakültesi Dergisi*, *19*(2), 30-54.
2.	Güç, F. A., İsa, Y. A. & Orbay, K., & (2021). Üstün yetenekli tanısı konulmuş ve konulmamış öğrencilerin matematiksel düşünme süreçlerinin karşılaştırılması (Comparison of mathematical thinking processes of students who assigned as gifted and the students who are not assigned as gifted). *Milli Eğitim Dergisi*, *50*(229), 337-362.
3.	Tekerek, B. K., & Argün, Z. (2022). Üstün yetenekli öğrencilerin geometri öğrenme alanında akıl yürütme becerilerinin incelenmesi (Investigation of reasoning skills of gifted students in geometry). *Gazi Eğitim Bilimleri Dergisi*, *8*(2), 306-332.
4.	Kaplan, A., Doruk, M., & Öztürk, M. (2017). Üstün yetenekli öğrencilerin problem çözmeye yönelik yansıtıcı düşünme becerilerinin incelenmesi: Gümüşhane örneği (Examine of reflective thinking skill toward problem solving of talent students: a sample of gümüşhane). *Bayburt Eğitim Fakültesi Dergisi*, *12*(23), 415-435.
5.	Öztürk, M., Akkan, Y., & Kaplan, A. (2017). Üstün yetenekli lise öğrencilerinin ispatla ilgili kavramlara yönelik bilgi ve farkındalıklarının incelenmesi (Examination of gifted high school students' knowledge and awareness of concepts related to proof). *Journal of Gifted Education and Creativity*, *4*(2), 19-35.
6.	İnan, E., Mert Uyangör, S., (2022). Thematic Analysis of Theses Prepared on Mathematics Education with Gifted and Talented Students in Türkiye. *Participatory Educational Research*, *9*(6), 19-40.
7.	Alyeşil Kabakçı, D., & Demirkapı, A. (2016). İzmit bilim ve sanat merkezinde uygulanan "matematik ve sanat" dersi etkinlik uygulamalarının öğrencilerin uzamsal yetenekleri üzerine etkisi (The effect of "mathematics and art" course activity applications on students' spatial talents in izmit science and art center). *Hasan Ali Yücel Eğitim Fakültesi Dergisi*, 11-22.
8.	Yurt, E., & Kurnaz, A. (2015). Özel yetenekli öğrencilerin matematik öz-yeterlik kaynaklarının matematik kaygıları üzerindeki etkilerinin incelenmesi (An investigation of the effects of the mathematics sources of selfefficacy on talented students' mathematics anxiety). *Pegem Eğitim ve Öğretim Dergisi= Pegem Journal of Education and Instruction*, *5*(4), 347-360.
9.	Güçyeter, Ş. (2015). Ortaokul matematik öğretmenleri ve sınıf öğretmenlerinin matematikte üstün zekâlı öğrenci özelliklerine yönelik yargılarının incelenmesi (Investigating middle school math and primary teachers' judgments of the characteristics of mathematically gifted students). *Türk Üstün Zekâ ve Eğitim Dergisi*, *5*(1), 44-66.
10.	Özdemir, D., & IŞIKSAL, M. (2021). Adaptation study of mathematical ability test (tomags) to turkish. *Bartın University Journal of Faculty of Education*, *2021*(1), 200-217.
11.	Albayrak, H. B.,Tarım, K.., & Baypınar, K. (2023). Özel yetenekli öğrencilerin matematik okuryazarliği öz-yeterlik algilari ile matematik okuryazarliği başarilarinin incelenmesi (İnvestigation of mathematical literacy self-efficacy perceptions and mathematical literacy achievement of gifted students). *Trakya Eğitim Dergisi*, *13*(1), 115-127.
12.	Karaduman, B., Arslan, Ç., Broutin, M. S. T., & Ezentaş, R. (2023). Özel yetenekli öğrencilerin resim, müzik ve sayısal yeteneklerine göre matematiksel okuryazarlık problemlerini çözüm süreçlerinin irdelenmesi (Investigation of the mathematical literacy problems of special talented students according to the art, music and numerical talents). *Turkish Journal of Educational Studies*, *10*(2), 193-220.
13.	Demirci, N., & Tertemiz, N. I. (2022). Üstün zekâlılar eğitimi dergilerinde yayınlanan matematik eğitimi çalışmalarına yönelik bir tematik derleme çalışması (A thematic compilation study on mathematics education studies published in gifted education). Journals *Uluslararası Türk Eğitim Bilimleri Dergisi*, *2022*(19), 381-410.
14.	Kırmızı, M., & Tarım, K. (2018). Matematik öğretmenlerinin üstün zekâlılar hakkındaki görüşlerinin incelenmesi: bir metafor çalışması (Investigating mathematics teacher perceptions' of gifted students using metaphors). *Sakarya University Journal of Education*, *8*(4), 337-350.
15.	Çetin, A., & Doğan, A. (2018). Bilim ve sanat merkezlerinde görev yapan matematik öğretmenlerinin karşılaştıkları sorunlar (Problems that mathematics teachers encounter in science and art centers). *Ankara Üniversitesi Eğitim Bilimleri Fakültesi Özel Eğitim Dergisi*, *19*(4), 615-641.
16.	Baltacı, S., Yıldız, A., Kıymaz, Y., & Aytekin, C. (2016). Üstün yetenekli öğrencilere yönelik geogebra destekli etkinlik hazırlamak için yürütülen tasarım tabanlı araştırma sürecinden yansımalar (Reflections from a design based research preparing geogebra supported activities towards gifted students). *Mehmet Akif Ersoy Üniversitesi Eğitim Fakültesi Dergisi*, *1*(39), 70-90.
17.	Gürel, R., & Yetkin-Özdemir, İ. E. (2020). Üstün yetenekli olan ve olmayan ortaokul öğrencilerinin matematik kaygı düzeylerinin incelenmesi (İnvestigation of gifted and non-gifted middle school students' mathematics anxiety levels). *Mehmet Akif Ersoy Üniversitesi Eğitim Fakültesi Dergisi*, (52), 261-286.
18.	Özdemir, D. (2018). Matematikte üstün yetenekli ilköğretim öğrencilerinin okullarındaki matematik derslerine ilişkin algıları(Perceptions of mathematically gifted students about math classes in their own schools). *Kastamonu Eğitim Dergisi*, *26*(1), 153-160.
19.	Çetin, A., & Doğan, A. (2018). Üstün yetenekli öğrencilerin matematik problemi çözme tutumuna ve süreçlerine yönelik algılarının incelenmesi (Investigation of the perceptions of gifted students on the problem solving attitudes and processes). *Cumhuriyet Uluslararası Eğitim Dergisi*, *7*(4), 510-533.
20.	Doğan, A., & Paydar, S., (2020). Üstün yetenekli öğrenciler ile akranlarının sayı hissi alt bileşenlerinin karşılaştırılması (Comparing gifted students and their peers' sub-components of number sense). *Kahramanmaraş Sütçü İmam Üniversitesi Sosyal Bilimler Dergisi*, *17*(1), 21-44.
21.	Koç-Koca, A., & Gürbüz, R. (2019). Üstün yetenekli ve diğer 4. sınıf öğrencilerinin matematik problemlerini çözme stratejileri üzerine bir araştırma (An investigation of the mathematics problem solving strategies developed by the 4th grade gifted and other students). *Yüzüncü Yıl Üniversitesi Eğitim Fakültesi Dergisi*, *16*(1), 1638-1667.

22. İnan, E., (2019). Özel yetenekli öğrenciler için farklılaştırılmış matematik programı etkinlik örneği (An activity sample of differentiated maths programme for the gifted students). *Bilim Armonisi*, *2*(2), 15-23.
23. Mecek, S., & Taşlıdere, E. (2015). Üstün zekâlı/yetenekli öğrencilerin matematik ve fizik akademik başarılarının çeşitli değişkenler açısından incelenmesi (Investigation of gifted students mathematics and physics achievements in terms of different variables). *Pegem Eğitim ve Öğretim Dergisi*, *5*(5), 733-746.
24. Yurt, E., & Kurnaz, A. (2015). Özel yetenekli öğrencilerin matematik öz-yeterlik kaynaklarının matematik kaygıları üzerindeki etkilerinin incelenmesi (An investigation of the effects of the mathematics sources of selfefficacy on talented students' mathematics anxiety). *Pegem Egitim ve Ogretim Dergisi= Pegem Journal of Education and Instruction*, *5*(4), 347.
25. Akgül, S. (2019). Üstün yetenekli öğrencilerin matematik öz-yeterliklerinin matematik başarılarını yordama gücü (Predictive power of mathematical self-efficacy for gifted and talented students' mathematical achievement). *Ekev Akademi Dergisi*, *23*(78), 481-496.
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27. Yazgan-Sağ, G., (2016). Üstün yetenekli öğrencilerin matematiksel problem çözme durumlarındaki motivasyonel öngörüleri (The motivational forethoughts of gifted students in mathematical problem solving situations). *Kastamonu Üniversitesi Kastamonu Eğitim Dergisi*, *24*(3), 1165-1182.
28. Akgül, S., & Nuhoğlu, H. (2020). Üstün yetenekli öğrencilerin matematik kaygısı ve mükemmeliyetçilik düzeylerinin incelenmesi (Examining mathematics anxiety and the level of perfectionism of gifted and talented students). *Yaşadıkça Eğitim*, *34*(2), 299-312.
29. Aksoy, E., & Narlı, S. (2015). Matematik alanında üstün yetenekli öğrencilerin öğrenme stillerinin karar ağaçları kullanılarak incelenmesi (An examination of mathematically gifted students' learning styles by decision trees). *Türk Üstün Zeka ve Eğitim Dergisi*, *5*(2), 147-156.
30. Erdogan, F., & Gül, N. (2020). Özel yetenekli öğrencilerin matematiksel problem kurma becerilerinin incelenmesi (An investigation of mathematical problem posing skills of gifted students). *Pegem Journal of Education and Instruction*, *10*(3), 655-696.
31. Kaya, D. (2021). Türkiye'de matematik eğitimi alanında üstün zekalılar ve özel yetenekliler konusunda yürütülmüş tezlerin tematik ve yöntemsel eğilimleri (A thematic and methodological trends of postgraduate theses conducted on gifted and talented students in the field of mathematics education in turkey). *Uluslararası Bilim ve Eğitim Dergisi*, *4*(3), 157-178.
32. Özyaprak, M. (2016). Üstün zekâlı ve yetenekli öğrenciler için matematik müfredatının farklılaştırılması (Differentiation of math curriculum for gifted students). *Hasan Ali Yücel Eğitim Fakültesi Dergisi*, *13*(2), 115.
33. Kayabaşı, A., & Kayabaşı, N. (2022). Bilim ve sanat merkezleri destek grubu öğrencilerinin üç boyutlu kavram görüntüleri: cisim imgeleri (Three-dimensional concept images of science and art centers support group students: body images). *The Journal of Academic Social Science, 10*(129), 241-253.
34. Yazgan-Sağ, G., (2018). Matematikte üstün yetenekliliğe teorik bir bakış (A theoretical view to mathematical giftedness). *Milli Eğitim Dergisi*, *48*(221), 159-174.
35. Yıldız, A., & Baltacı, S. (2017). Bilim sanat merkezi matematik öğretmenlerinin kurdukları geometrik inşa problemlerine bilişsel seviye düzeyleri açısından ders imecesi çalışmalarının etkisi (The impact of lesson study practices on science art center mathematics teachers' cognitive levels in geometrical construction problems). *Yüzüncü Yıl Üniversitesi Eğitim Fakültesi Dergisi*, *14*(1), 1481-1516.
36. Tertemiz, N. I., Doğan, A., & Karakaş, H. (2017). 4. sınıf üstün yetenekli öğrenciler ile başarılı akranlarının problem çözme stratejilerinin karşılaştırılması (A comparative study on problem solving strategies of gifted 4th grade students and their high-achieving counterparts). *Uluslararası Eğitim Programları ve Öğretim Çalışmaları Dergisi*, *7*(13), 161-188.
37. Öztürk, M., Akkan, Y., & Kaplan, A. (2014). Üstün yetenekli öğrencilerin matematik kavramına yönelik algılarının incelenmesi (Gifted students' perceptions towards the concept of mathematics review). *Journal for the Education of Gifted Young Scientists*, *2*(2), 49-57.
38. Saygılı, G., & Atahan, R. (2014). Üstün zekâlı çocukların problem çözmeye yönelik yansıtıcı düşünme becerilerinin çeşitli değişkenler bakımından incelenmesi (Analyzing reflective thinking skills towards problem solving of gifted children in terms of various variables). *Süleyman Demirel Üniversitesi Fen-Edebiyat Fakültesi Sosyal Bilimler Dergisi*, *2014*(31), 181-192.
39. Yıldız, A., Baltacı, S., Kurak, Y., & Güven, B. (2012). Üstün yetenekli ve üstün yetenekli olmayan 8. Sınıf öğrencilerinin problem çözme stratejilerini kullanma durumlarının incelenmesi (Examining the usage of problem-solving strategies by the eighth grade gifted and non-gifted students). *Uludağ Üniversitesi Eğitim Fakültesi Dergisi*, *25*(1), 123-143.
40. Akkuş-İspir, O., Sonay-Ay, Z., & Saygı, E. (2011). Üstün başarılı öğrencilerin öz-düzenleyici öğrenme stratejileri, matematiğe karşı motivasyonları ve düşünme stilleri (High achiever students' self regulated learning strategies, motivation towards mathematics, and their thinking styles). *Eğitim ve Bilim*, *36*(162), 235-246.
41. Sak, U. (2013). Üstün yetenekliler eğitim programları modeli (üyep) ve üstün yetenekli öğrencilerin matematiksel yaratıcılıkları üzerindeki etkisi (Education programs for talented students model (epts) and its effectiveness on gifted students' mathematical creativity). *Eğitim ve Bilim*, *38*(169), 51-61.
42. Kuloğlu, S., & Uzel, D., (2016). Üstün yetenekli öğrencilerin matematiksel tutumlarının farklı değişkenlere göre incelenmesi: Manisa bilim ve sanat merkezi örneği (The analysis of gifted students' mathematical attitudes according tdifferent variables: manisa science and art center example). *Üstün Yetenekliler Eğitimi ve Araştırmaları Dergisi (UYAD)*, *1*(2), Özel Sayı, 97-107.
43. Koca, A. K., & Gürbüz, R. (2022). Education of gifted and talented individuals in United States, Germany and Turkey: a comparison of education policies and its implementations. *Route Educational & Social Science Journal* , *9*(4), 591-614.
44. Kanlı, E. (2011). Üstün zekalı ve yeteneklilerin alan eğitiminde hızlandırma (Gıfted and talented people acceleratıon ın field educatıon). *HAYEF Journal of Education*, *8*(2), 95-104.
45. Sak, U. (2011). Üstün yetenekliler eğitim programları modeli (ÜYEP) ve sosyal geçerliği (An overview and social validity of the education programs for talented students model (EPTS)). *Eğitim ve Bilim*, *36*(161), 2013-229.
46. Erdoğan, F., & Erben, T. (2018). Özel yetenekli öğrencilerin doğal sayılarla dört işlem gerektiren problem kurma becerilerinin incelenmesi (Investigation of gifted students' problem posing abilities requiring arithmetical operations with natural numbers). *İnönü*

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47. Arslan, M., & Nacaroğlu, O. (2020). Özel yetenekli öğrencilerin öklid'in 5. postulatı ile öklid dışı geometriler hakkındaki farkındalıklarının incelenmesi (Examination of awareness of gifted students on euclidean's 5th postulate and the non-euclidean geometries). *International Journal of Educational Studies in Mathematics*, *7*(1), 14-25.
48. Yıldız, A. (2021). Matematik tarihi etkinlikleri kullanımının özel yetenekli öğrencilerin matematik tarihine ilişkin görüşlerine etkisi (The effect of using mathematics history activities on the opinions of gifted students on history of mathematics). *Fen Matematik Girişimcilik ve Teknoloji Eğitimi Dergisi*, *4*(3), 189-202.
49. Altıntaş, E., & Özdemir, A. Ş. (2015). Geliştirilen farklılaştırma yaklaşımının öğrencilerin yaratıcı düşünme becerileri üzerindeki etkisi (The effect of the developed differentiated approach on creative thinking skills of the students). *Kastamonu Eğitim Dergisi*, *23*(2), 825-842.

Appendix 2. Codes of Theses (B)

		Author	Type	Date
1.	Özel Yetenekli Öğrencilerin Ve Matematikte Başarılı Akranlarının Problem Çözümlerini Dayandırdıkları Kanıt Şemaları: 4. Ve 5. Sınıf Öğrencileri Üzerinde Bir Durum Çalışması Proof Schemes On Which Gifted Students And Their Peers Who Are Successful In Mathematics Base Their Problem Solutions: A Case Study On 4th And 5th	Niymet Demirci	Doctoral	2023
2.	Matematiksel Modelleme Tabanlı Proje Üretimi Ve Yönetimi Programının Özel Yeteneklilerin Proje Üretimi Bağlamında Etkililiği The Effectiveness Of A Mathematical Modeling Based Project Production And Management Program Within The Context Of Project Production Of Gifted Students	Gülnur Özbek	Doctoral	2023
3.	Üstün Yetenekli Ortaokul Öğrencilerinin Geometri Problemleri Yoluyla Akıl Yürütme Becerilerinin İncelenmesi Investigation Of Reasoning Skills Of Gifted Primary Students Through Geometry Problems	Birnaz Tekerek	Doctoral	2023
4.	Üstün Yetenekli Olan Ve Olmayan Öğrencilerin Cebir Öğrenme Alanı Kazanım Edinimleri Ve Problem Kurma Becerileri: Müfredat Sıkıştırmanın Etkisi Gifted And Non-Gifted Students' Acquisition Of Learning Outcomes And Problem Posing Skills In Algebra: The Effect Of Curriculum Compacting	Hüseyin Tatlı	Master	2023
5.	Somut Nesneler Ve Dinamik Geometri Yazılımı Kullanımının Üstün Zekâlı Ve Yetenekli Öğrencilerin Geometri Performanslarına, Tutumlarına Ve Öz Yeterliğine Etkisi The Effect Of Concrete Objects And The Use Of Dynamic Geometry Software On Geometry Performance, Attitudes And Self-Efficiency Of Gifted And Talent Students	Fidan Çalışkan	Master	2023
6.	Özel Yetenekli Öğrencilerin Matematiksel Problem Çözme Süreçleri Ve Kullandıkları Stratejiler The Mathematical Problem Solving Processes Of Gifted Students And The Strategies They Used	Aygen Koç Koca	Doctoral	2022
7.	Üstün Yetenekli Tanısı Konulan Öğrenciler İle Tanı Konulmamış Öğrencilerin Üçlü Zekâ Kuramına Göre Matematiksel Yeteneklerinin İncelenmesi Investigation Of Mathematical Abilities Of Students Diagnosed As Gifted And Undiagnosed According To The Triarchic Intelligence Theory	Yasin Kurak	Doctoral	2022
8.	Üstün Yetenekli İlköğretim Öğrencilerinin Modelleme Yeterliliklerinin Mühendislik Temelli Model Oluşturma Etkinlikleri Yoluyla İncelenmesi An Investigation Of Elementary Gifted Students' Modeling Competencies Through Engineering-Based Model Eliciting Activities	Firdevs İclal Aydın Karataş	Doctoral	2022
9.	Bilsem Matematik Öğretmenlerinin Bilginin Gerekçelendirilmesine Yönelik Epistemolojik İnançları İle Teknoloji Kullanımlarının Değerlendirilmesi The Evaluation Of Bilsem Mathematics Teachers Epistemological Beliefs On The Justification Of Knowledge And Their Use Of Technology	Banu Şimşek	Master	2022
10.	Khan Academy İle 4. Sınıf Bilsem Öğrencilerinin Matematik Eğitimi Mathematics Education Of 4th Grade Bilsem Students With Khan Academy	İmren Çelik	Master	2022
11.	Ortaokul Öğrencilerinin Matematikte Özel Yetenekli Olma Durumları İle Yaratıcılıklarının Karşılaştırılması Comparison Of Mathematical Giftedness And Creavity Of Middle School Students	Berna Mercan	Master	2022
12.	Gerçekçi Matematik Eğitiminin Özel Yetenekli Öğrencilerin Matematik Başarılarına Etkisi The Effect Of Realistic Mathematics Education On Special Talent Students' Success In Mathematics	Zekai Çırak	Master	2022
13.	Bilim Sanat Merkezlerindeki Matematik Öğretmenlerinin Üstün Yetenekli Öğrencilerin Matematiksel Gelişimine Dönük Yaptıkları Uygulamalara İlişkin Deneyimleri Experiences Of Mathematics Teachers İn Science And Art Centers Regarding The Mathematical Development Of Gifted Students	Mustafa Çelik	Master	2022
14.	Üstün Yetenekli 8. Sınıf Öğrencilerinin İspat Yapma Süreçlerinin İncelenmesi Examination Of The Processes Of Processes Of Highly Talent 8th Grade Students	Betül Vatandaş	Master	2022
15.	Üstün Yetenekli Öğrencilerin Matematiksel Muhakeme Becerilerinin İncelenmesi E Investigation Of Mathematical Reasoning Skills Of Gifted Students	Tuğçe Çınargil	Master	2022
16.	Öğrenmede Farklı Güdüsel Stratejilere Sahip Üstün Yetenekli Öğrencilerin Matematiksel Soyutlama Süreçlerinin İncelenmesi The Investigation Of Mathematical Abstraction Processes Of Gifted Students Who Have Different Motivational Strategies For Learning	Mehmet Çağlar Çoşar	Doctoral	2021
17.	Üstün Yetenekli Öğrencilerin Matematik Sınıf Kültürlerinin Sosyo-Matematiksel Normlar Bağlamında İncelenmesi Examination Of Gifted Students' Mathematics Classroom Culture In The Context Of Sociomathematical Norms	Aslı Çakır	Doctoral	2021
18.	Bilsem Ortaokul Öğrencilerinin Matematiğe Yönelik Tutumlarının Çeşitli Değişkenler Açısından İncelenmesi Investigation Of Bilsem Secondary Students' Attitudes To Mathematics In Terms Of Various	Rıdvan Kartal	Master	2021

	Variables			
19.	Matematikte Özel Yetenekli Çocukların Problem Çözme Becerilerinin İncelenmesi A Determination Of Problem Solving Skills Of Mathematically Gifted Children	Sevinç Turkut	Master	2021
20.	Özel Yeteneklilerde Teknoloji Destekli Etkinliklerle Zenginleştirilmiş Matematik Öğretimi Mathematics Teaching Enriched With Technology Supported Activities For Gifted Students	Seçil Çırak	Master	2021
21.	Üstün Zekâlı Öğrencilerin Akranlarına Göre Problem Kurma Becerilerinin Problem Türlerine Göre Karşılaştırılması Problem For Gıfted Students Compared To Theır Peers Installatıon Skılls Accordıng To Problem Types Comparıson	Ahmet Burak Akdemir	Master	2021
22.	Üstün Zekâlı Öğrencilere Yönelik Farklılaştırılmış Matematik Öğretiminin Etkililiği: Bir Meta-Analiz Çalışması A Meta-Analysis On The Effects Of The Differentiated Mathematics Instruction For Gifted Students	Şerife Bilgiç	Master	2021
23.	İlkokul Dönemi Üstün/Özel Yetenekli Bireylere Yönelik Almanya Ve Türkiye'de Uygulanan Matematik-Fen Bilimleri Öğretim Programlarının Karşılaştırılması Comparisons Of Mathematics And Science Teaching Programs Of Gifted/Talented Individuals In Primary School Period In Turkey And Germany	Ulaş Özkahraman	Master	2021
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49.	Beşinci Ve Altıncı Sınıf Matematikte Üstün Yetenekli Öğrencilere Yönelik Farklılaştırılmış Etkinliklerin Tasarlanması Ve Geliştirilmesi Design And Development Of Differentiated Tasks For 5th And 6th Grade Mathematically Gifted Students	Duygu Özdemir	Doctoral	2016
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Interview Article

A cross cultural interview with Julián Betancourt Morejón: CEPAC

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Abstract

Julian Bettencourt is an important scientist known worldwide for his work on creativity. I asked him questions on important issues related to her research field and he answered sincerely. We would like to state that this interview contains important codes for researchers and practitioners study on the field of creativity. In this interview the reader can use Google Translate to see the responses to questions answered by Julián Betancourt Morejón. This is an attempt to be culturally sensitive and reach out to those in both the English speaking and Spanish speaking world.

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Michael Shaughnessy: First of all, can you tell us a bit about yourself, your education, and experience? And you may respond in either Spanish or English –thanks to Google Translate!

En primer lugar, ¿puede contarnos un poco sobre usted, su educación y experiencia? Y puede responder en español o en inglés, ¡gracias al traductor de Google! ¡Puedo publicar esto en ambos idiomas!

Julián Betancourt Morejón: Mi experiencia en el campo de la creatividad comienza en los 90 en la Academia de Ciencias de Cuba con una investigación sobre el fomento de la creatividad en las y los niños de primaria. Luego en México comienzo el trabajo en la creación de atmósferas creativas para la escuela y en el fomento del talento. Uno de los trabajos más significativos fue crear un diplomado en Creatividad e Investigación en la Educación por el que pasaron 15000 maestros de educación básica. La otra área de trabajo ha sido sistematizar toda la experiencia educativa en la creatividad a través de nuestras 25 publicaciones sobre esta temática entre la que destacan: La clase creativa, inteligente,

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motivante y cooperativa de editorial Trillas y Atmósferas creativas 2: rompiendo candados mentales de editorial Manual Moderno. He sido asesor de la secretaria de Educación de México en políticas y programas para la Atención al alumnado de aptitudes sobresalientes. Actualmente mi último trabajo ha sido la creación y coordinación del Centro Educativo para Alumnado de Altas Capacidades de la secretaria de Educación de Jalisco que cuenta con primaria, secundaria y preparatoria. En el año 2017 recibí el Premio Iberoamericano de Innovación Educativa de la Red de Creatividad de Hispanoamérica.

Michael Shaughnessy: You have shared much of your knowledge in You Tube presentations. What were the most important points that you tried to make in the following You Tube presentation?

Julián Betancourt Morejón: Ha compartido gran parte de su conocimiento en presentaciones de YouTube. ¿Cuáles fueron los puntos más importantes que trató de hacer en la siguiente presentación de YouTube? https://www.youtube.com/watch?v=mDJzpYDOxGY
En este video se expone las características cognitivas y socio afectivas del alumnado con altas capacidades presentes en el Centro Educativo para Alumnado de Altas Capacidades (CEPAC). A continuación, se mencionan:

La alta capacidad, es la manifestación del rendimiento que se encontrará claramente en el extremo superior con otras personas de alto nivel de funcionamiento en el dominio. Más aún la alta capacidad puede verse como un proceso de desarrollo en el que en las primeras etapas el **potencial** es la clave variable, en etapas posteriores el **rendimiento** es la medida de talentos completamente desarrollados la **eminencia** es base acreedora a dicha denominación. Las variables intelectuales sociales y emocionales juegan un papel esencial en la manifestación de la alta capacidad.

Intelectuales

- Muy observadores.
- Extremadamente curiosos.
- Intereses específicos.
- Excelente memoria visual y de trabajo.
- Largo período de atención en las cosas que le gustan.
- Excelentes habilidades de razonamiento. Es decir, conceptualización y síntesis bien desarrollados.
- Rápida y fácilmente ve las relaciones en las ideas, objetos o hechos.
- Pensamiento creativo (fluido, flexible, elaborado y original).
- Excelentes habilidades para resolver problemas.
- Aprende rápidamente y con menos práctica y repetición.
- Muy imaginativos.
- Amplio vocabulario.
- Puede leer a temprana edad.
- Lee rápida y ampliamente.

Sociales y Emocionales

- Interesado en temas filosóficos y sociales.
- Preocupado por la justicia y la injusticia. Con niveles avanzados de juicio moral
- Perfeccionista.
- Entusiasta.
- Sentido del humor bien desarrollado, por lo general, motivado intrínsecamente.
- Muy sensible, emocional y hasta físicamente.
- Acumulan gran cantidad de emociones de manera consciente.
- Inusualmente sensibles a los sentimientos y expectativas de los otros.
- Gran conciencia de sí mismo.
- Desarrollo temprano del locus de control interno.

- Intensidad y profundidad emocional inusual.
- Tienen gran necesidad de consistencia entre sus valores.
- Fuertemente motivados para su autorrealización.

Otras características:

- Disfruta de aprender cosas nuevas.
- Disfruta de la actividad intelectual.
- Muestra alegría intelectual.
- Prefiere libros y revistas destinados a niños mayores
- Escéptico.
- Desarrollo asincrónico

También se abordan los antecedentes de CEPAC. La atención a los educandos de altas capacidades en países latinoamericanos como Argentina, Colombia y Chile comienza en la década de los 90, mientras México y Perú lo hicieron formalmente en los años 80, y sólo Brasil, España y Venezuela desde mediados de los 70 incorporaron medidas para la atención de dicho alumnado. En relación a México comenzó en los ochenta con la modalidad del enriquecimiento. A partir del 2008 con la aceleración, en México se aplicó la variante de acreditación, certificación y promoción anticipada y más recientemente el agrupamiento en algunos estados de manera experimental y por decisión de autoridades políticas. El inicio del agrupamiento en México ocurrió en Puebla en los noventa con una escuela pública. Luego apareció la secundaria estatal No 12 "Talentos" en la ciudad de Colima (estado de Colima), en 2014 Jalisco el Centro de Alto Rendimiento Académico CARA en la ciudad de Monterrey (estado de Nuevo León), en 2016 , el Centro de Atención al Talento (CEDAT) en ciudad de México y Jalisco en 2017, el Centro Educativo Integral Para Altas Capacidades (CEIPAC) en la ciudad de Aguascalientes (estado de Aguascalientes) en 2017, la E**scuela de Talentos Guanajuato-Azteca** y las Escuela de Talento Irapuato-Azteca en 2018 **.**Finalmente, en el ciclo escolar 2017-2018 entró en funcionamiento el Centro Educativo Para Altas Capacidades de Jalisco(CEPAC).

En este se abordarán los elementos esenciales de las diferentes respuestas educativas para el estudiante de altas capacidades dentro de las que se enmarca CEPAC. También se podrá apreciar las principales estrategias de intervención para el alumnado de altas capacidades que se llevan a cabo en México y la importancia de la creación de un sistema integral de atención al talento que viene desarrollando la secretaria de Educación del Estado de Jalisco.

Michael Shaughnessy: How do you go about identifying students who might be gifted or talented or creative?

Julián Betancourt Morejón: ¿Cómo identifica a los estudiantes que podrían ser dotados, talentosos o creativos?
Tenemos cuatro momentos claves para visibilizar al alumnado de altas capacidades. El primero es la detención , que es por medio de actividades exploratorias, productos destacados y nominación del profesor; la identificación, que se realiza por medio de un inventario para la identificación del alumnado de altas capacidades , que contestan los profesores de aquellos estudiantes que fueron previamente detectados; (c) la evaluación psicopedagógica, en la que se confirma la presencia de altas capacidades medio de pruebas de inteligencia, de creatividad, y de socialización de aquellos estudiantes que cubren el punto de corte establecido en el inventario y, por último la detección permanente, donde a largo del ciclo escolar se puede detectar, identificar y evaluar.

Michael Shaughnessy: ¿Cuáles son algunas de las características que los maestros y los padres notan para indicar que su hijo podría ser dotado, talentoso o creativo?
What are some characteristics that teachers and parents notice to indicate that their child might be gifted or talented or creative?

Julián Betancourt Morejón: Lo que caracteriza al alumnado de altas capacidades es que tienen alta curiosidad y gran memoria de trabajo y visual, así como alto nivel de pensamiento abstracto, adaptación a situaciones nuevas y flexibilidad cognitiva. Además manejan una gran cantidad de información, mayor velocidad de procesamiento de esta y uso de habilidades metacognitivas lo que los lleva a preferir tareas complejas y retadoras, así como a desenvolverse en entornos

complejos de aprendizaje, donde se profundice en los conocimientos y se atiendan los intereses diversificados que presentan ya que las tareas repetitivas y poco retadoras les llevan al aburrimiento a la falta de motivación y a la necesidad de un programa educativo acorde a sus necesidades. También tiene tienen mayor capacidad de resolución de problemas complejos y capacidad de regulación metacognitiva. Su procesamiento de información es de tipo analógico, muestran una alta capacidad de transferir sus estrategias de solución de problemas a situaciones nuevas, poniéndose de manifiesto las habilidades metacognitivas y la meta-memoria siendo la corteza prefrontal la que entra en juego. Además, predominan estrategias de enseñanza inductivas.

En lo afectivo se encuentra a su alta sensibilidad, y perfeccionismo, lo cual puede llevarlos a presentar miedo al fracaso, ansiedad, sentimientos de impotencia, baja autoestima, agotamiento mental, emocional y depresión. También sus habilidades cognitivas les pueden ayudar a tener un adecuado ajuste en lo socioemocional.

Michael Shaughnessy: ¿Cuál es el papel de "la familia" o la familia en la crianza de estudiantes que muestran muchas potencialidades?
What is the role of " la familia" or the family in the nurturance of students who show many ptentialities?

Julián Betancourt Morejón: Es clave del papel de la familia porque son los catalizadores de todo el talento de sus hijos e hijas. Son los mejores embajadores de su alta dotación y acompañantes constante en cuanto tiempo, recursos humanos y materiales para que el alto potencial deje de ser una promesa sino una realidad a través de los diferentes talentos que puede manifestar su hija e hijo.

Un elemento clave a trabajar con las familias es la creación de redes de apoyo a las altas capacidades en todas las áreas de STEAM + H (ciencia, tecnologías, ingenierías, artes, matemáticas y humanidades)
La comunidad educativa debe favorecer en los progenitores un espacio donde se pueden atender las necesidades educativas de orientación en cuanto a la educación de hijas e hijos de altas capacidades que se caracterice:

- Por dar información precisa y no sesgada.
- Ayudar a cambiar actitudes y romper estereotipos.
- Trabajar las ansiedades que provoca tener un descendiente de altas capacidades.
- Mejorar la relación familia -escuela-medio social.
- Crear recursos educativos a las necesidades educativas desde un enfoque interdisciplinario.

Michael Shaughnessy: ¿Qué es exactamente CEPAC? ¿Y qué estás tratando de lograr?
What exactly is CEPAC? And what are you trying to accomplish?

Julián Betancourt Morejón: El CEPAC funciona como un centro educativo de la secretaria de Educación del Estado de Jalisco, México, siguiendo el modelo educativo para la educación obligatoria establecido a nivel nacional, a través de la modalidad del agrupamiento, acompañado de la aceleración y enriquecimiento áulico a través de la diferenciación curricular y trabajando la profundización y la complejidad.

CEPAC es un sistema integral de atención al talento que comienza en primaria y culmina en preparatoria. Entre sus indicadores de impacto en sus seis años de existencia son los reconocimientos y medallas alcanzadas por sus alumnos más de 200 y de estas 50 internacionales sobre todo en el área de las Matemáticas. Es el primer Centro en su tipo en Latinoamérica, y la primer Escuela Pública Oficial, reconocida por el World Council for Gifted and Talented Children y el European Council for High Ability.

Siguiendo esta línea de pensamiento el centro educativo surge entre otras muchas razones porque el estudiante dotado intelectualmente presenta necesidades educativas por ser sobresaliente que en la mayoría de las ocasiones no son satisfechas en la escuela. Él es un pensador rápido, tan veloz al punto que los maestros necesitan hacer planes especiales y proporcionar educación diferenciada para ella o e él de acuerdo con sus altas capacidades. Una pregunta central que se debe hacer es si los educadores, en nuestras escuelas están cumpliendo o han cumplido con las necesidades educativas de los dotados intelectualmente. Por ejemplo, ¿Qué pasa con el alumno en el primer grado que lee a nivel de quinto grado y ha aprendido todos los conceptos y procesos aritméticos contenidos en el plan de estudios primario? ¿Pueden los

educadores satisfacer adecuadamente las necesidades de los estudiantes de altas capacidad del último año de secundaria sin una formación en el tema? , ¿Qué condiciones necesitan los educadores para garantizar que estas personas reciban la educación adecuada? ¿Es posible que el profesor del aula en la situación habitual satisfaga las necesidades inusuales de estos alumnos? ¿cómo evitar que sean etiquetados como alumnos con TDAH?, ¿cómo prevenir el bullying que son objeto?, ¿qué características debe tener una escuela para este tipo de alumnado? Las respuestas a estas preguntas dieron lugar a CEPAC.

El objetivo general del CEPAC es proporcionar un modelo de educación, centrado en los avances de la cuarta revolución industrial con aulas 4.0, para potenciar el desarrollo intelectual, emocional, académico y social de los estudiantes de altas capacidades. Partiendo de este propósito se considera que:

- Los estudiantes de altas capacidades prosperan académica, social y emocionalmente en una institución educativa donde se les valora por lo que pueden hacer y no por lo que no pueden hacer.
- Los alumnos se benefician de un ambiente de aprendizaje en la que la enseñanza es diferenciada y las clases son con grupos pequeños.
- Los educandos necesitan coetáneos intelectuales, sociales y emocionales similares para favorecer el aprendizaje significativo.
- Los alumnos se merecen profesores no de altas capacidades, pero sí altamente calificados, comprometidos con la educación y con deseos de seguir superándose.

CEPAC sigue la teoría de Francoys Gagné sobre dotación y talento. Los ***dones*** son capacidades naturales destacadas al menos en un área y que sitúa al individuo en el 10% superior a otros de su misma edad. Estos pueden ser mentales y físicos.

Dentro de los mentales se encuentran los dominios intelectuales, creativos, sociales y perceptuales; por su parte dentro de los físicos se encuentran el muscular y el control motor. Para Gagné los **talentos** son las capacidades sistemáticamente desarrolladas, a las que denomina competencias, al menos en un campo y que sitúa al individuo en el 10% superior en relación a su grupo de edad. El talento es la transformación progresiva de los dones donde incide un tercer elemento: el proceso de desarrollo del Talento

El proceso de desarrollo del talento incluye las actividades, el progreso y la inversión. Es decir, cuando un estudiante es identificado con algún don y se le da acceso a un programa para altas capacidades, este tiene la oportunidad de acceder a un contenido que favorece y potencializa sus dones, esta propuesta de intervención puede tener diferentes formatos, ya sea incluido en el currículo o bien como parte de actividades extraescolares. Pero no solo esto es importante, sino que estas actividades a las que accede el infante deben tener niveles de progresión o etapas, a las que Gagné las ejemplifica como **novicio, avanzado, competente y experto** y también toma en cuenta la inversión en términos del tiempo, dinero y energía.

Este proceso de desarrollo, está a su vez, influenciado por catalizadores ambientales e intrapersonales, es decir la familia, la cultura, la apariencia, el temperamento, la personalidad, la conciencia de sí mismo, la motivación y la voluntad.

Entre sus principios pedagógicos se encuentran:

- Los estudiantes de altas capacidades prosperan académica, social y emocionalmente en una institución educativa donde se les valora por lo que pueden hacer y no por lo que no pueden hacer.
- Los alumnos se benefician de un ambiente de aprendizaje en la que la enseñanza es diferenciada y las clases son con grupos pequeños (15 como máximo)
- Los educandos necesitan trabajar sus habilidades sociales y emocionales para el desarrollo su talento. Es decir, deben ser cultivar sus fortalezas personales y promover visiones personales de crecimiento humano, así como abordar sus cargas adicionales de afrontamiento: cumplir con los altos estándares y metas personales, protegerse presión social de diversos tipos, y (c) tratar con la inestabilidad emocional de la vida interior cuando esta aparece
- Los alumnos se merecen profesores no de altas capacidades, pero sí altamente calificados.

- Los estudiantes de altas capacidades deben aprender de acuerdo a su ritmo. No debe existir un techo para su aprendizaje.
- Los padres de familia se convierten en creadores de oportunidades y colaboradores de sus hijos y escuela,
- El desarrollo del talento significa probar cada día caminos nuevos o mudarse a un territorio desconocido o nuevo.
- EL desafío óptimo. Motivacionalmente, la tarea debe estar confinada dentro una zona óptima, donde sea lo suficientemente desafiante para mantener un estado de alerta, comprometido y activo en el pensamiento, el razonamiento y la resolución de problemas, pero no hasta el punto de abrumar al alumnado con su nivel de dificultad inexplorado
- El compromiso intelectual profundo. Los maestros deben sembrar las semillas de la creatividad en el alumnado al activar su imaginación ante el conocimiento que van construyendo con nuevas interpretaciones, explicaciones y aplicaciones.
- Cerebro social. El educador fortalece las habilidades sociales y aprendizaje cooperativo.
- Continuidad de las experiencias curriculares y de relevancia. Estas tienen ramificaciones sociales, personales y sociales. Una experiencia curricular es personalmente relevante si está conectada con la experiencia y el conocimiento pasados del alumno y demuestra su significado en el esquema más amplio de las cosas y si suscita su interés y capitaliza las fortalezas e inclinaciones del educando.
- Fomento de habilidades blandas en los estudiantes que fortalezcan las altas capacidades: **esfuerzo, tenacidad, tolerancia y proactividad.**
- Desarrollo del pensamiento de alto orden (creativo y reflexivo)
- El tercer maestro como ambiente físico que educa y transforma. Por ejemplo conquistando cada espacio del centro educativo con mensajes, cuevas de bibliotecas y arboles para la educación por la paz. Al inicio de una de las escaleras de CEPAC dice: *el talento no ocupa elevadores sino escaleras.* Otras de sus escaleras están llenas de imágenes de mujeres sobresalientes de la historia.

Los anteriores principios se acompañan en nuestro centro de tres valores esenciales: equidad, diversidad y excelencia. La equidad establece que cada alumno merece una educación que ayude a realizar todo su potencial y facilitar su desarrollo óptimo. El de la diversidad subraya valorar diferentes tipos de dones. Además, que la diversidad engendra excelencia. Este último, establece que el objetivo principal de la educación para altas capacidades es ayudarlos estudiantes a alcanzar un nivel de excelencia acorde a sus dones y capacidades demostradas.

In this second podcast, the director of #CEPAC Jalisco of the Jalisco Ministry of Education, Dr. Julián Betancourt Morejón, talks to us about the particularities of teaching children and young people with high capacities, refutes several myths and opens up new scenarios to promote a better didactics from the regular classroom and emhance the talents of our students.

What were the main points that you wanted to make in this presentation?

En este segundo podcast, el director de #CEPAC Jalisco de la Secretaría de Educación Jalisco, Dr. Julián Betancourt Morejón, nos habla sobre las particularidades de la enseñanza de niños y jóvenes con altas capacidades, refuta varios mitos y abre nuevos escenarios para promover una mejor didáctica desde el aula regular y detonar los talentos de nuestros alumnos.

Michael Shaughnessy: ¿Cuáles fueron los puntos principales que quería hacer en esta presentación?

Julián Betancourt Morejón: https://www.youtube.com/watch?v=narDABLUkwQ

La importancia de la estrategia de atención del agrupamiento para alumnado para altas capacidades que se debe acompañar de otras modalidades de intervención (enriquecimiento y aceleración). Por esta razón surge el Centro Educativo Para Altas Capacidades de Jalisco (CEPAC) y lo importante de este tipo de escuelas innovadoras para transferencias metodológicas al salón de clases de cada una de las escuelas en cuanto a metodologías de enriquecimiento áulico para la atención de alumnado de altas capacidades.

Existen toda una serie de razones para defender el agrupamiento como una modalidad provechosa en la atención al alumnado de altas capacidades entre las que se encuentran: 1) rentabilidad en cuanto a los recursos empleados para dichos estudiantes, es decir los alumnos con altas capacidades reunidos en el centro especializado pueden aprovechar mejor los recursos humanos y materiales. ,2) alto desafío y expectativas de los estudiantes, o sea, permite que los altamente dotados accedan a niveles apropiados de desafío y complejidad 3) progreso más rápido a través de los planes de estudio, 3) facilidad administrativa en la observación de los servicios educativos a ofrecerles, 4) un atmósfera educativa de mayor comprensión de los estudiantes y una mejor oportunidad para abordar las necesidades psicológicas del alumnado 5) experiencias educativas de enriquecimiento específicas para los talentos específicos, 6) atención especializada para estos educandos , por lo que hay un alto grado de motivación y produce resultados académicos positivos 7) mayor conocimiento del alumnado con similares características e intereses, 8) mejores niveles de socialización, 9) es posible atender al educando de una forma más individualizada, teniendo en cuenta sus características especiales durante todo el día o parte del horario escolar, 10) permite que el aprendizaje sea más eficiente, 11) Se evita el aburrimiento, el desinterés y la pérdida de tiempo, 12) promueven altos niveles de logros y reducen las brechas de excelencia entre sus estudiantes, 13) el alumnado gana confianza en sí mismos cuando se les enseña con alumnos con habilidades similares, estos se sienten menos abrumados y en su participación en clase se observa menos ensombrecido, además les permite una comparación sana con su coetáneos de alta capacidad y tener una percepción más precisa de sus propias habilidades , 14). los estudiantes de altas capacidades pueden sentirse más cómodos en un grupo de compañeros con similares características y aprender a trabajar a su máximo potencial, 15) permite aumentar el rendimiento estudiantil a lo largo del tiempo. y compañeras que pueden aprender aproximadamente a la misma velocidad.

Por otra parte, el centro educativo sigue los programas de la Secretaria de Educación Pública de México, pero ampliándolos y profundizándolos a través de metodologías de enseñanza basada en las nuevas tecnologías, el aprendizaje basado en proyectos, la taxonomía de Sandra Kaplan para darle mayor rigor al contenido y fomentar el pensamiento reflexivo a niveles más elevados(indicadores: ética, cambios a lo largo del tiempo, grandes ideas, reglas, a través de disciplinas, tendencias, patrones, lenguaje de la disciplina, preguntas sin respuestas, detalles) y la aplicación de las Apps Suite de Google for Education. En el caso de la secundaria no se trabaja por asignaturas sino por campos formativos. En este sentido no existe un profesor por asignatura sino por dichos campos formativos siguiendo el formato de las telesecundarias.

En el modelo educativo de CEPAC la tecnología es la parte neurálgica del proceso de aprendizaje, es a través de los medios digitales como el alumno tiene acceso a la información con los que habrá de construir y desarrollar los proyectos, diseñar y resolver los problemas y tomar decisiones, el aula tradicional se convierte en un Aula 4.0 donde el alumno deja de ser un actor pasivo receptor de contenidos y se transforma en un verdadero sujeto de cambio. Se aplican las Apps Suite de Google for Education ya que Google proporciona herramientas sencillas que a los alumnos se les facilita usar en cualquier momento, desde cualquier lugar donde se encuentren y con cualquier dispositivo. Para esto los educadores se han estado certificando en las herramientas de google. Además, los estudiantes cuentan Chromebooks que emplean en Google Classroom y Google Forms, como herramientas de soporte al aprendizaje. Con Google Forms lograron realizar encuestas a escala para conocer la percepción de los alumnos sobre los nuevos contenidos y tecnologías utilizadas en el aula.

Por otro lado, para llevar a cabo el aprendizaje integral que demanda el alumnado con altas capacidades el CEPAC desarrolla acciones específicas de enriquecimiento extracurricular a través de clubes, talleres y laboratorios. Entre los que destacan: Arte, Creatividad e Innovación, Ciencia Tecnología Ingeniera y Matemática (STEAM), Learning Commons, Talento Deportivo, Competencias Socioemocionales. Idiomas, Innovación e Incubación Social, Ciencias entre otros.

Los sábados el centro educativo abre sus puertas para alumnos de altas capacidades tanto del mismo como externos para ofertarles **menús de elección.** Estos son una lista de actividades que los estudiantes puede elegir según sus intereses, estilos de aprendizaje o nivel de habilidad. Estos menús que se trabajan los sábados en CEPAC son actividades muy valiosas de anclaje a las que los estudiantes de altas capacidades pueden recurrir cuando terminan tareas con anticipación o necesitan un desarrollo adicional. Es importante comenzar, en los talleres que se ofrecen en este menú, con los últimos

indicadores de la taxonomía de Bloom y asegurarse de que vayan abordando varias y sino todas las inteligencias múltiples. Entre los que actualmente tenemos se encuentran: ajedrez, pintura, plastilina creativa, guitarra, danza, robótica, matemática recreativa, oratoria entre otros

También el romper con falsas creencias sobre las diferentes modalidades de intervención en las altas capacidades y el defender el agrupamiento desde una inclusión moderada y con sentido de equidad.

https://www.youtube.com/watch?v=narDABLUkwQ

In this third You Tube interview, you discuss many important issues. Can you tell us your most important ideas?
En esta tercera entrevista de You Tube, discute muchos temas importantes.

Michael Shaughnessy: ¿Puedes contarnos tus ideas más importantes?

Julián Betancourt Morejón: La importancia de CEPAC como una comunidad educativa imán para identificar y fomentar el desarrollo del talento en el alumnado de altas capacidades. No es una escuela común es una escuela donde los sueños de las niñas y niños de altas capacidades se convierten en realidad. Además, donde se van formando los futuros lideres del mañana. Para lograr lo anterior es importante tomar en cuenta estas sugerencias pedagógicas que se aplican en CEPAC :

- Ofrecer a los estudiantes la oportunidad de hacer menos problemas, pero más difíciles.
- Animar a los estudiantes a crear un aula receptiva caracterizada por el respeto, entendimiento, el asumir riesgos y aprender de los errores
- Reír, cuidar y apreciar la energía, la creatividad y el humor en el salón de clases
- Conocer, incorporar y desarrollar los intereses de los estudiantes. A medida que aprendemos sobre los intereses de los alumnos, estos pueden incorporarse al currículo y servir de base para futuras clases y aprendizajes
- El docente se interesa en la enseñanza del alumno y es un educador interesante (maestros que cuentan historias, otros se visten de personajes de la historia, mientras que otros emplean la música para que aprendan por solo citar unos ejemplos)
- Compartir los intereses de los educadores con los estudiantes de manera de servir de modelo para enriquecer la vida de los mismos
- Elegir la controversia. La mayoría de las áreas de estudio tienen temas polémicos. La discusión argumentada es una poderosa arma de aprendizaje por su poderosa naturaleza reflexiva ante el conocimiento que se va edificar.
- Favorecer que el alumno pueda producir conocimientos a través de que aprendan a preguntar sobre lo que están estudiando.
- Aprovechar el curso espontaneo de los intereses y preguntas de los educandos para proporcionar profundidad y complejidad.
- Ayudar a los estudiantes a encontrar respuestas a problemas complejos.
- Cree espacios de incertidumbre y ambigüedad en cuanto al contenido que se está impartiendo. Proporcionar menos detalles, estructura y realizar preguntas donde existen múltiples respuestas que alientan al alumnado a pensar y desarrolla una actitud de indagación. Esta última piedra angular del desarrollo intelectual.
- La palabra desafío debe estar presente en cada actividad que realice diariamente, semanalmente, mensualmente (comience con el último capítulo del libro de texto, preguntas sin respuestas entre otros ejemplos).
- Deje que los alumnos elijan su contenido. Dicha elección tiene un gran potencial educativo para involucrar a los estudiantes y comprometerlos con sus proyectos y tareas.
- Brindar oportunidades para trabajar solo o juntos a los alumnos. El trabajo cooperativo es clave para el desarrollo de habilidades sociales y crea una atmósfera agradable de aprendizaje. Cuando el objetivo de aprendizaje, por ejemplo, es que los alumnos comprendan un tema, entonces es importante considerar sus estilos de aprendizaje para darles la posibilidad de trabajar solos o juntos.
- Ayude a los estudiantes a considerar y evaluar la importancia de su trabajo escolar al plantear preguntas como: ¿a quién le importa?, ¿cómo podría tener un mayor efecto? ¿para qué te sirve para tú vida lo estudiado?

- Conecte el trabajo escolar con el mundo cotidiano, que se llama vida, de manera deliberada y frecuente mediante la participación de la comunidad, el aprendizaje como parte de un compromiso social.
- Ser educadores que no solo faciliten, medien, implementen sino también que inspiren.
- Dialogar sobre el proceso de meta cognición. Comprender como piensan los estudiantes, ayudarlos a comprender su propio pensamiento y reconocer que los alumnos razonan de forma diferente los unos a los otros proporciona una base sólida para el crecimiento cognoscitivo y el rendimiento estudiantil.
- Crear una comunidad de aprendizaje positiva en el aula, donde los alumnos de altas capacidades puedan reconocerse mutuamente no solo por ser de altas capacidades sino también por sus fortalezas, áreas de oportunidades e intereses.

https://www.youtube.com/watch?v=1PPuLk1TUYw

What have I neglected to ask ?

Qué me he olvidado de preguntar?

https://www.youtube.com/watch?v=narDABLUkwQ

Qué caracteriza a las y los maestros de la secretaria de Educación de Jalisco que trabajan en CEPAC

La respuesta sería: pasión, compromiso, deseos de superación, preparación permanente en las altas capacidades y ser gestores del talento.

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Interview Article

An interview with Linda Silverman: What is giftedness—2023?

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Abstract

Linda Silverman is an important scientist known worldwide for his work on psychology of gifted and giftedness. We asked him questions on important issues related to her research field and he answered sincerely. We would like to state that this interview contains important codes for researchers and practitioners study on the field of gifted education.

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Michael Shaughnessy: Can you provide a brief bio about yourself, your education and your experiences?

Linda Silverman: Linda Kreger Silverman, Ph.D., is a licensed psychologist, and is the founder and director of Gifted Development Center/ISAD (GDC). Since 1979, Gifted Developmental Center has assessed more than 6,500 children, most of whom are twice exceptional.

After receiving her Ph.D. from USC in Educational Psychology/Special Education, she served for nine years on the faculty of the University of Denver in counseling psychology and gifted education. Linda has been studying the assessment, psychology and education of the gifted and twice exceptional since 1961.

She has over 300 contributions, including *Counseling the Gifted & Talented, Upside-Down Brilliance: The Visual-Spatial Learner, Advanced Development: A Collection of Works on Gifted Adults*, and *Giftedness 101*. She founded *Advanced Development*, the only juried psychological journal on adult giftedness.

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Michael Shaughnessy: About how many children and adolescents have you actually tested?
Linda Silverman: In the last 44 years, GDC has tested over 6,500 children. We are a research center as well as an assessment center. We have the largest data bank of exceptionally and profoundly gifted children, with IQ scores of 160 or above. In the first ten years, approximately one-sixth of the children we tested were twice exceptional. In the last ten years over 90% of our clients are 2e. Our database is available to graduate students and researchers.

Michael Shaughnessy: Now, of those 2e children, what exceptionality seems to be the vast majority?
Linda Silverman: Throughout our practice, more children have shown visual processing deficits than any other exceptionality. This was apparent in low Processing Speed scores and other visually presented subtests. In the last year, most of our clients have had ADHD, and a growing number have symptoms of ASD. We have developed a *Checklist for Recognizing Twice Exceptional Children*, which includes 17 general 2e characteristics, as well as symptoms of visual processing deficits, central auditory processing disorder, sensory processing disorder, ADHD, dyslexia, ASD, and anxiety and depression. This tool has helped parents become aware of the multi-exceptionalities in their children.

Michael Shaughnessy: How is your philosophy different from talent development?
Linda Silverman: I see giftedness as REAL, not as a social construct. It has deep implications for the psychological well-being of the individual throughout the lifespan. Giftedness is innate. Gifted children ask about the meaning of life when others are just trying to figure out how to tie their shoes. You see it in 2 year olds and 92 year olds. Giftedness doesn't go away—even if the person does not become famous. When giftedness is defined as potential for eminence, it is achievement-based. Achievement, especially recognized achievement, is culturally bound. It favors those who are affluent. The vast majority of the world's gifted population are poor, for whom eminence is unreachable.

I believe that giftedness is color blind: it is apparent in all ethnic, cultural and national groups. I see giftedness as developmental advancement. In all cultures, there are children who:

- Develop at a faster pace from early childhood on
- Are inquisitive to a greater degree than agemates
- Generalize concepts earlier than their peers
- Demonstrate advanced verbal or spatial capacities at an early age
- Have superb memories
- Grasp abstract concepts
- Love to learn
- Have a sophisticated sense of humor
- Prefer complexity
- Are extraordinarily insightful
- Have a passion for justice
- Are profoundly aware
- Experience life with great intensity

Achievement-based definitions (including talent development) are also prejudicial against the neuro-diverse. You have to DO something unusual to be recognized as talented (e.g., be a talented pianist). Neuro-diverse children develop atypically, due to one or more learning or emotional differences. Neuro-diverse gifted individuals may not demonstrate talents or do well in school; yet they ask probing questions; they feel things deeply; they are fascinated by their passions (which may or may not be considered worthy of recognition).

Michael Shaughnessy: In my own work, I have seen that gifted kids seem to experience being an outsider, with no one to relate to and few friends. What are your thoughts?
Linda Silverman: I completely agree. Few people "get" the experience of being gifted—being an outsider in a society suspicious of outsiders. I started my chapter on "Counseling Asynchronous Students," in the *Handbook for Counselors Serving Students with Gifts & Talents* (T. L. Cross & J. R. Cross, editors) with the following paragraph:

"Disguised as cunningly as espionage agents, gifted students pass for normal. They play the game and avert exposure. The rules are 'never reveal anything that will make you stand out,' 'act like everybody else,' and 'do not draw attention to yourself.' The gifted excel at the art of imitation, but the cost of leading a double life is inauthenticity, self-alienation, and inner conflict (not to mention the pain of having no one to celebrate their successes). Especially where provisions for advanced students are inadequate, the gifted tend to camouflage their abilities to try to blend in with their classmates—a prescription for loneliness."

Michael Shaughnessy: Are the gifted emotionally sensitive? If so, where does this come from?
Linda Silverman: Yes, I see a strong correlation between high IQ scores and emotional sensitivity. Not only do gifted individuals think differently; they also feel differently. I believe the cause of emotional sensitivity is innate emotional overexcitability. The gifted are wired to respond with greater emotional intensity. Emotional sensitivity is a good thing. It needs to be understood. See the new book, *Sensitive*, by Jen Granneman and Andre Solo.

Michael Shaughnessy: Let's talk interventions—acceleration or enrichment or something else?
Linda Silverman: I have found that gifted children need each other more than anything else. I am a big fan of schools and programs for the gifted, where gifted children have close contact with others like themselves. If a school or full-day program is not available, children who are exceptionally advanced or highly gifted should be given the opportunity to accelerate. GDC offers an acceleration study to see if the child is a good candidate for subject or full-grade acceleration. Homeschooling is also an option that should be seriously considered. Enrichment and differentiation are likely to have less impact on the lives of gifted children. School districts often eliminate enrichment programs, considering them "frills." Differentiation is complicated and depends on the skills of a specific teacher. ("We had a gifted program. She moved.")

Michael Shaughnessy: I have been documenting giftedness myself, starting with the WISC-R, and we are now at the WISC-V. Have we gotten better at using these tests? Or how do we need to shift gears?
Linda Silverman: Yes, we have gotten better, but the ways are well-kept secrets. Pearson has not put extended norms and expanded index scores in their manuals. Examiners need to know that these are available on the Pearson website. I developed the Expanded General Ability Index (EGAI), which consists of 4 verbal subtests, 2 spatial subtests, and 2 mathematical subtests. It is a powerful indicator of giftedness. The EGAI requires administering 3 supplemental subtests that most psychologists do not give: Comprehension, Information, and Arithmetic. I strongly recommend that all examiners of the gifted administer these additional subtests. NAGC has posted position statements about the use of the WISC-IV and the WISC-V, but many examiners do not know about them. That is why I am offering a series of courses to help psychological examiners understand the nuances of assessing the gifted.

Michael Shaughnessy: Can you tell us a bit about these courses?
Linda Silverman: In April of 2023, Gifted Development Center began a collaboration with Supporting Emotional Needs of the Gifted (SENG) to offer a series of professional development courses for psychologists and examiners of gifted and twice exceptional children. The series generates APA Continuing Education Units (CEUs), but others could enroll without earning the APA CEUs. The courses are also of interest to university instructors in gifted education, school counselors, therapists, coordinators of gifted programs, Directors of Admission at schools for the gifted, teachers, and parents.

The three courses for 2023 include "What is giftedness?" (April 27th), "New Ways to Identify Twice Exceptional Children on the WISC-V" (May 25th), and "Assessing Gifted Children with Dyslexia" (June 22nd). I am offering the first two courses. Drs. Brock and Fernette Eide, neurologists, will present the third course, June 22nd. They have recently released *The Dyslexic Advantage* (revised and updated). In 2024, we will offer four more courses on expanded index scores on the WISC-V, extended norms, using the DAS-II with the gifted (a new normative update is due to be released in May 2023), and assessing gifted children with ADHD or ASD by Dr. Deirdre Lovecky. Her book, *Different Minds: Gifted Children with ADHD, ASD, and other Dual Exceptionalities* (2nd ed.) will be released in June 2023.

All lectures are recorded so that individuals can order the sessions they missed. For more information, go to www.gifteddevelopment.org.

The first course was "What is Giftedness?" It involved the following principles:

Giftedness:

- Involves developmental differences in abstract reasoning, emotional sensitivity, and intensity.
- Is the experience of being an outsider.
- Can be observed in very young children.
- Can be documented on measures of general intelligence.
- Is lifelong.
- Creates qualitatively different life experiences.
- Leads to a set of issues unique to this group, making them vulnerable.
- Indicates significantly different needs from the norm.
- Requires early identification, intervention and accommodations to assure healthy development.

Michael Shaughnessy: Two tangential areas: creativity and talent. Do you address these realms?

Linda Silverman: Not specifically. Academics tend to focus on creativity and talent development. I believe gifted individuals are generally creative. In Polish, there is no word for "giftedness." Kazimierz Dabrowski studied creative individuals. That is how "overexcitabilities" were first observed. I am opposed to the idea of substituting "talented" for "gifted." They are two different populations with very different needs. The talented fit in better socially than those who are gifted.

Michael Shaughnessy: What else have I neglected to ask?

Linda Silverman: I would like to share how my education udergirds my perspective. I come from a special education background. I see giftedness as the mirror image of intellectual disability. No one thinks intellectual disability is simply a "social construct." At 2 SD above the norm, as with individuals 2 SD below the norm, there are SIGNIFICANT DIFFERENCES that need to be addressed. The same cannot be said of those who are in the top 10% and the lowest 10%. If we took all the children in the lowest 10% of the school population and placed them in programs for the intellectually disabled, we would be in court within the day.

The talented come from a broader spectrum. Those in the top 2-3% can be overlooked when they are placed in programs for children in the top 10%. I believe that we need to recognize degrees of giftedness: mildly, moderately, highly, exceptionally and profoundly. Degrees of severity are recognized at the bottom end of the spectrum. Every standard deviation is a functional difference. Children 5 SD below the norm do not group well with children 2 SD below the norm. The same is true for children who are 2 SDs above the norm and those who are 5 SDs above the norm. Those who study the profoundly gifted have very different perceptions of what giftedness is from those who are interested in developing talents in the top 10%, 25% or 33% of the population. While developing talents is a noble cause, it does not meet the unique needs of children who are significantly different from 98% of the school population.

Michael Shaughnessy: I am pretty sure giftedness is lifelong—you are still working hard, helping, consulting, doing workshops (I get tired just listing them all). How do you do it?

Linda Silverman: I'm on a mission! That gives me the energy I need to continue to help families, even at the age of 82.

Autobiography of Linda Silverman

Linda Kreger Silverman, Ph.D., is a licensed psychologist, and is the founder and director of Gifted Development Center/ISAD (GDC). Since 1979, Gifted Developmental Center has assessed more than 6,500 children, most of whom are twice exceptional. After receiving her Ph.D. from USC in Educational Psychology/Special Education, she served for nine years on the faculty of the University of Denver in counseling psychology and gifted education. Linda has been studying the assessment, psychology and education of the gifted and twice exceptional since 1961. She has over 300 contributions, including Counseling the Gifted & Talented, Upside-Down Brilliance: The Visual-Spatial Learner, Advanced Development: A Collection of Works on Gifted Adults, and Giftedness 101. She founded Advanced Development, the only juried psychological journal on adult giftedness. Web: https://gifteddevelopment.org/linda-silverman

Biodata of Author

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