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Interdisciplinary Approach in Primary School Mathematics Education

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Abstract

Life is a set of relationships in which countless factors interact and go on together. Each of the interacting factors is handled and used as a different discipline when the time comes. Depending on the spirit of the times and the structure of societies, the importance of some discipline areas may change and their place in the agenda may decline. However, this does not apply to mathematics. Because mathematics has served as a constant reference tool for the development of all other scientific fields. Activities that are put forward by ignoring this relationship of mathematics with other disciplines, turn out to be a waste of time and energy. This situation is also valid for educational activities. When mathematics is isolated from other disciplines, ambiguity of meaning and purpose emerges, loses its importance, and becomes a source of concern. The resulting confusion causes mathematics to be perceived as an academic obstacle to be overcome, rather than as a useful tool. It is in the hands of teachers to eliminate this perception and to teach mathematics as the common language of all disciplines. To achieve this, understanding must be changed, and mathematics must be taught based on an interdisciplinary approach.

Keywords: Teaching, Mathematics Education, Interdisciplinary Approach, Primary School, Primary School Teacher

1. Introduction

Despite the developments in science and educational technologies, education adopted and continued in primary schools today is based on the understanding of teaching subject areas (TDK, 2021) under disciplines that are or may be the subject of teaching and then reuniting them by the individual when necessary for complex applications (Wicklein & Schell, 1995, p.59). The curriculums of most developed and developing countries are divided into separate subjects or disciplines such as science, mathematics, literature, social studies, and the arts. In the curriculum, students are expected to focus on one area of knowledge. Curriculum developers express this as a discipline-based Curriculum (Kridel, 2010). It is assumed that disciplines consisting of different concepts, principles, theories, skills and applications will provide students with a depth of understanding, and that the knowledge specific to the field will be structured and can be used with other fields of knowledge in different contexts when necessary. There is a need for a transformation of understanding in the Turkish education system, which seems not to realize this assumption as expected. While how to transfer what is taught in schools to real life remains a big problem that needs to be answered, students are not questioned about the usefulness of this

information, which is divided into different disciplines, in daily life. As this search for meaning becomes longer, the time and cost spent for education increases, and the quality of education in schools is far from meeting the expectations. Taking different perspectives on the agenda in the education system, which must somehow be rescued from the spiral of exam-oriented teaching, and the evaluation and implementation of solution tools are among the most important problems of today's education. Since schools are the meeting point of all stakeholders of education and the field of application of the pending problems of the education system, the places where the effects of the solutions to be implemented will be seen most clearly are the classrooms where students come together with their teachers. Because all kinds of development and change targeted in educational policies are ultimately knotted in the teacher-knowledge-student relationship.

Since the unit approach is centered in the traditional teaching approach, each discipline has been evaluated within itself, causing the student's thinking skills to not develop at a high level (Kansızoğlu, 2014). In the Education Vision of 2023 it is, current practices in the field of education are unsustainable; While the need for an interdisciplinary educational background where formalism, uniformity and routines are not consecrated is clearly stated in many sections of the document (MEB, 2019), the use of interdisciplinary teaching approach is advocated in most of the curriculums from primary school to university in order to increase the quality of education especially in the western world in recent years (Lenoir & Hasni, 2016). It is suggested that paradigms that focus on interdisciplinary studies based on cooperation and team spirit will facilitate the emergence of a learning path that will motivate students to be more successful in the future (Lucchiari & Folgeri, 2017).

According to Gestalt theory, the whole is different, original and more than the sum of its parts. The individual perceives the whole in integrity, not by decomposing it into its parts. It consists of the dynamic and organic relationships of the parts that make up the whole. This integrity has been exemplified as the instruments playing in the orchestra are not analyzed separately, on the contrary, it makes sense as a whole (Senemoğlu, 2012; Aydın, 2007). Integrity is also essential in interdisciplinary teaching design. The approach is based on the principle of arranging different subject areas in harmony or bringing together different disciplines in any setting (Demirel, 2019). In the interdisciplinary approach where cooperation is essential and the distance between life and school is shortened, it is aimed to understand the subjects and concepts located at the intersection points of different courses, the connections between different disciplines and the relations of these connections with the real world. Here, the concepts, theories and methods of two or more course contents are combined, emphasizing more process and holistic meaning than product and content (UNESCO, 2020).

The interdisciplinary perspective includes a holistic approach to lessons at any level of education. It is based on the understanding that the best and meaningful learning takes place when the knowledge learned by individuals coincides with various disciplines (Furner, 1995). In interdisciplinary approach, students are instilled with the necessary knowledge and skills to approach a subject through multiple frameworks and disciplines. Thus, students can confidently approach all subject areas from various perspectives. An interdisciplinary curriculum combines multidisciplinary skills as well as interdisciplinary critical thinking and problem solving skills (Hathout, 2016). In short, it requires the combination of methods and analytical frameworks from more than one academic discipline to examine a problem, and it involves the effort to produce alternative solutions from the perspective of two or more disciplines. With the interdisciplinary holistic teaching approach, it is essential to teach with real life and as many disciplines as possible, where the expected development of students is achieved (Demir, 2009).

1.1. Interdisciplinary Approach to Mathematics Teaching in Primary School

All fields of science have emerged from a need and many disciplines have developed in this way. Mathematics is also an important branch of science that is located at the intersection of numerous disciplines. Although the idea of bringing these disciplinary fields together when necessary does not attract much attention at first glance, all sciences that contain human beings are somewhat intertwined and can be used to interpret each other when necessary. Sometimes the boundaries between them become blurred and infinitely many new disciplines may emerge (Williams, et al., 2016).

In the past, mathematics has always been used as a tool to organize and understand the physical sciences. Today, it is applied to other disciplines such as biology, medicine, management, linguistics and social sciences (William & Mary, 2021). Mathematics is essential for activities in daily life such as calculating, money management, and building things. In addition, many career fields such as engineering, architecture, accounting, banking, business, ecology and aviation require a strong mathematical foundation. Mathematics is important in developing computing technology and software that underlies the technologically advanced and knowledge-based world as well as economically and financially (Lindquist, Philpot, Mullis, & Cotter, 2019). Mathematics is a tool that provides viable answers to scientific, technological, social and economic challenges. Since it is a field of science that is related to other disciplines in different ways and expresses life with abstract concepts, its importance in primary school education is indisputable. Because math is useful in everyday life and is necessary in many types of employment. While it can be easily applied to other learning areas, it provides an opportunity for the development of intellectual skills such as problem solving, reasoning, creative thinking and communication. Mathematical experiences in primary school give students pleasure, as they enable them to express their cognitive skills with numbers. However, the situation is different for students with high math anxiety. These students have a negative attitude towards their math achievements and potential regarding this lesson. On the other hand, for many students, mathematics is one of the hurdles that must be overcome to reach a point academically. For this reason, from kindergarten to adult education, it is increasingly important to develop a mathematical understanding of students as a means of perceiving and defining the world rather than disappointment and unsuccessful experiences (Biller, 1996).

Although the developments in recent years about the meaning of mathematics and how it should be taught have not been seen in practice, it has brought about a change in understanding. In traditional teaching, mathematical information was presented to the students by the teacher in small skill pieces, and students were expected to repeat this information with exercises. The questions had a predetermined solution method and only one correct answer (Olkun & Uçar, 2020). Today, traces of the traditional teaching mathematics in Turkey is perceived as a course generally feared. Perhaps the most important reason for this is the thought that mathematics consists of only certain formulas or operations that are detached from daily life and that a strong memorization ability is a prerequisite for learning (Toptaş & Olkun, 2020). As a result, it is seen that students' achievement in mathematics is quite low compared to other courses and is far behind other countries. The fact that the results obtained in the central and international exams in the field of mathematics are far from the target is an indicator of this. For this reason, trying to teach mathematics without being associated with daily life makes it very difficult to understand and learn, and to achieve the expected development (İlgar & Gülten, 2013). In the event of failure, it leads to disappointment in many children, causing discussions about how to teach an important lesson such as mathematics. Different solutions are proposed to this question. Interdisciplinary approach in mathematics teaching can be an approach that will change the negative perception of students towards mathematics and positively affect the teaching of other disciplines.

Emphasizing that mathematics is a part of life in the mathematics curriculum, it is especially stated that every opportunity is used for the development of mathematical thinking. For this purpose, it was stated that mathematics should be associated with other courses when appropriate (MEB, 2018). In all of the curricula of the Ministry of National Education, a curriculum structure that guides the use of metacognitive skills, ensures meaningful and permanent learning, is solid and associated with previous learning, and is integrated with other disciplines and daily life within the framework of values and competencies (MEB, 2018). At the center of the interdisciplinary approach to mathematics teaching are the problems that guide learning activities. However, students at school often grapple with abstract problems. Whereas Engineers, architects, and urban planners use mathematics to solve real problems arising from the obstacles they face in their daily work. While we shop, estimate distances, or play games, we solve mathematical problems hidden in our daily lives (Winograd & Higgins, 1994).

By adopting an interdisciplinary perspective and associating mathematical gains with other lessons, the solution of daily life problems can be used as a teaching tool. In this way, students can apply what they have learned in a mathematics lesson to a different discipline that has a concrete equivalent in daily life in order to deepen their learning experiences. Practices based on an interdisciplinary approach are not limited to teaching more than one

discipline, but also a tool that enables them to see the connection between disciplines as they exist in the world, we live in. With the emergence of connections between disciplines, students' interest in mathematics will increase, and building newly learned knowledge on connections will turn mathematics into a challenging, interesting, and exciting learning experience (Hathout, 2016).

The main purpose in teaching mathematics with an interdisciplinary approach is more than the transfer of operation skills in an abstract form. Most of the time, students in Mathematics lessons confine themselves to the way of thinking of a certain discipline and experience a purpose-means confusion. It is very important to perceive the learned mathematical skills as a tool to reach various goals and solve problems related to different issues encountered in daily life (Yıldırım, 1996). When students realize that Mathematics is not only made up of numbers, but also a tool that they can use in Science and Social Studies, exciting rich learning experiences will emerge, and different disciplines will be brought together pragmatically with this integration of teaching (Duman & Aybek, 2003).

1.2. Associating Mathematics with Other Disciplines in Primary School

Nowadays, it is seen that one of the lessons given up from the first grade in order to train the curriculum in the basic courses, including mathematics in many classes in primary schools, is music lessons. However, research shows that this is an erroneous approach. Mathematics teaching supported by musical activities in primary school positively affects the remembering skills of students (Bütüner, 2010), improves the positive attitude towards mathematics by increasing success (Dinçer, 2008), adds, subtracts, counting and problem solving of lessons made on the basis of interdisciplinary approach with musical activities attached to mathematics lessons, Positive / significant effects were observed on mathematical skills such as creating tables (An, Capraro, & Tillman, 2013). In another study, it was revealed that primary school students combined mathematics with musical activities positively affected the classroom climate, and they gained skills related to geometric shapes and symmetry with the development of conscious rhythm and vocal tones by singing and applauding (Hudakova & Kralova, 2016).

It is seen that classroom teachers pass the Physical Education lessons (Pehlivan, Dönmez, & Yaşat, 2006), do not care enough (Bozdemir, Çimen, Kaya, & Demir, 2015), and these courses are far from the desired quality in terms of implementation (Arslan & Altay, 2008). Families also view Physical Education lessons negatively because they think that sports activities in primary school negatively affect the success of children in their lessons. However, sports and games are one of the easiest and most effective ways to reach children (Güven & Öncü, 2006). In a study, a significant relationship was found between students' angle knowledge and the development of dribbling skills (Arslantaş, 2006). It has been observed that Physical Education and Mathematics lessons conducted with an interdisciplinary approach significantly increase students' mathematics attainment (Uslu, 2019). The practice of a classroom teacher working in Samsun province by drawing a multiplication table on the floor of the school garden to develop students' movement and mathematics skills together is a remarkable and good example of the interdisciplinary approach to teaching (Samsun News, 2018).

Although it was thought that some of the acquisitions in the Social Studies curriculum could not be associated with mathematics (Aladağ & Şahinkaya, 2013), mathematics skills were effective on map, graphic and table reading skills, which have an important place in Social Studies teaching (Pala & Başbüyük, 2019). It has been stated that problems arising from mathematics in the Social Studies course cause loss of time, grow away from the lesson, and low motivation (Gürbüz & Kuzu, 2018). Associating mathematics with social studies and social studies lessons is necessary for a learning that has become meaningful with experiences between social and digital sciences. It was stated that in the mathematics curriculum, areas such as waste, recycling, healthy and planned life, which are encountered in daily life or are among the subjects of the Life Science and Social Studies course, should be taught in an interdisciplinary approach in association with mathematics (MEB, 2018).

STEM education which enables mathematics subjects to be taught in a holistic manner by integrating them with science, technology, and engineering fields (Benek & Akçay, 2018), is one of the most up-to-date examples of

the adaptation of interdisciplinary teaching understanding to contemporary education. Primary school 4th grade students stated that they had not seen any education in which the fields of science, mathematics, technology, and engineering were combined before, but they liked it after the application (Canbazoğlu & Tümkaya, 2020). The results regarding the positive attitudes of primary school students towards learning technology-supported mathematics (Hacıömeroğlu, 2019) indicate that these practices should be carried out continuously and widely. Since a student with high mathematics skills will have high science skills, science and technology cannot develop independently from mathematics (Çetin, 2013), these courses should be taught with an interdisciplinary approach. Since quantitative data in science cannot be expressed correctly without knowing mathematics, it can be said that mathematics skill is important for scientific achievement (Deringöl & Gülten, 2016). For example; Science and mathematics disciplines can be associated practically in an acquisition of the correct use of energy resources in the primary school science course curriculum. Students may be asked to work on a project on how to make more efficient use of electricity and water at home. In conducting such a study, basic mathematical calculations can be used, as well as subject-related skills such as data collection and processing. Thus, the learned mathematics will be permanent and take its meaning from real life.

1.3. The Role of Classroom Teachers in Teaching Mathematics with an Interdisciplinary Approach

Mathematics can be attributed to everything. For example: jumping, walking, and climbing stairs can be used as a way to practice counting. When children recognize, draw, play with, and combine shapes, they not only learn about geometry, but also experiment with visual arts, architecture, and science (Clements, 2021). However, Sharma (2018) stated that the methods adopted to teach mathematics in schools are largely inaccurate and are far from the learning experiences that may attract students' attention. Teachers who love music and art lessons in these areas stated that teachers who are bored or even afraid of mathematics should not teach mathematics. Because positive motivation is very important in the healthy conduct of mathematics lessons. As a matter of fact, it was observed that as the negative opinions of students towards their teachers increased, their math anxiety levels also increased (Keklikçi & Yılmaz, 2013).

It is known that classroom teachers working in primary schools take the time of other lessons in order to teach mathematics to students. This situation causes students to sacrifice other lessons that will support different development areas and enjoy and spend more time in a single learning area. Since this situation is often not criticized by the school administration and parents, and sometimes even positively welcomed, this way followed by the teachers is reinforced. Considering the fact that Turkey is low overall average achievement in mathematics shows that this is not the way toward a solution. Classroom teachers can take an interdisciplinary approach instead of sacrificing the time planned for other lessons to teach mathematics. Thus, mathematics can be a useful tool for other disciplines as well, instead of remaining on the agenda in many other subjects and being a barrier to be overcome for students.

An interdisciplinary approach plays an important role in developing a student profile based on 21st century skills, which includes mathematical literacy seen as one of the main areas of literacy (World Economic Forum, 2015). For this reason, thoughts about how to teach mathematics and how to establish relationships with other disciplines are also questioned by teachers. Because applying the interdisciplinary approach is seen as a challenge for teachers (Santaolalla, Urosa, Martín, Verde, & Díaz, 2020).

Primary school students often need the guidance of their teachers in solving problems as they go through a very intense period in terms of cognitive, moral and physical aspects due to their developmental characteristics. When they can express themselves comfortably in classroom environments where a sense of belonging is provided in a healthy way, they can share their problems with their friends and teachers. Classroom teachers can analyze students' daily life problems correctly and turn these shares into opportunities in order to find solutions with an interdisciplinary approach. It is very important to address real life problems in teaching mathematics with an interdisciplinary approach. When the topics covered are adapted from life, classroom teachers can bring real life situations to the classroom by gathering students' attention. For example, while teaching decimal operations from the achievements of the mathematics lesson, a temporal study can be designed by associating it with the gains of

other lessons. In agricultural activities, length and weight calculations can be made, in which the height and weight index is regularly monitored, with a schedule regarding the air temperature that requires precise measurement or a temporal project on a healthy life. Thus, the achievements that constitute the goals of the curriculums and express the intentions and expectations can be realized by the students, and the learning can be demonstrated and evaluated in real life situations (Aslan, Durgun, & Yazıcı, 2020).

It is very important for teachers to have a high level of experience and competencies in the relevant discipline (Gürbüz, et al., 2018), to be prone to cooperation and to have an interdisciplinary perspective in terms of efficient and meaningful integration of lessons (Gerke, 2017). However, it is observed that classroom teachers working in the same school differ significantly in terms of performance in interdisciplinary teaching (Karakuş & Aslan, 2016). Since planning and applications in the interdisciplinary approach require more time, expertise and cooperation (Yıldırım, 1996), classroom teachers may need theoretical and practical support from people who are competent in their field when necessary. While planning in interdisciplinary teaching, help can be obtained from teachers who are experts in the relevant field, and experienced people working in the field can be used for clarifying the relationship of the mathematics lesson with other lessons in real life. An architect may be invited to the class to share and exemplify the connections between mathematics, science, and visual arts as part of his / her experience. It can be provided to share with students how a musician used mathematics while composing or creating rhythms.

2. Discussion and Conclusions

Skills in the mathematics course are one of the main criteria in evaluating school success in society and educational institutions. Even if they are not successful in other disciplines, a success displayed in mathematics helps students to take a step forward within their age group. Students who are not successful enough in mathematics can be seen as underdeveloped not only academically but also in terms of other skill areas. Moreover, failure in other subjects is also associated with inadequacy in mathematics. When the drawbacks of taking the success criterion in such a narrow framework are ignored, it can be said that there is a certain level of problematic awareness about the importance of mathematics in society, although it is not very healthy. However, such a perspective leads to the emergence of a wrong understanding among teachers that mathematics should be taught at all costs. As a result, the focus is on abstract and rote-based mathematics teaching by saving time and planning from other development areas. At this point, a vicious circle occurs and despite the intense efforts, the desired level cannot be reached in the teaching of Mathematics in primary school. There is a weight that is difficult to carry, and the energy and time of both students and teachers are wasted in mathematics teaching.

Considering the problems faced by people in daily life, it draws attention that they are somehow related to each other. In the social life, the problem in one of the fields of education, health, security and economy is not independent from the others, and the solutions applied are not independent from each other. Education in schools should be handled in this way, and problems dealt with in different disciplines should be resolved with an interdisciplinary approach. Thus, education will prepare the child for life with the network of relationships in life in accordance with its purpose. When we look at the events in nature and the flow of daily life, there is an integrity in the relations between beings. Although each discipline examines the world in different ways, daily life continues in unity within the framework of certain rules. The situation is the same for man, who is a part of nature. Attempting to teach science and knowledge to students by constantly categorizing it creates confusion in perceiving life as a whole. Trying to teach children who tend to perceive as a holistic approach by moving mathematics away from life and other subjects instead of organizing it together with other lessons does not coincide with the nature of education. Thus, students have difficulty in establishing a connection between what they learn and life. Mathematics is a discipline that emerged to understand, organize, plan and conceptualize concrete objects with their different characteristics. In this respect, isolating mathematics from other disciplines and trying to teach them separately disrupts the classroom climate and distances learning from the unity of life.

While the problems in teaching mathematics are so prominent, it is not realistic to expect the results to change and the success of mathematics skills to be increased with practices reflecting the traditional understanding.

Instead of transferring the failure in mathematics to other disciplines, using the teaching method by associating the skills and achievements in the mathematics curriculum with other courses with an interdisciplinary approach will have positive results. With an interdisciplinary approach, mathematics will be seen as a practical tool that students can use in solving problems in their daily lives, not an academic goal that is difficult to reach. For students who discover that mathematics works in other disciplines, a significant distance will be taken in mathematics teaching and learning experiences will gain meaning in this way. In order to achieve this, it is very important for classroom teachers to be aware of the benefits and applications of interdisciplinary approach as an alternative. Because it is very difficult to teach mathematics only in certain class hours by solving routine problems and by memorizing. In the information age, this understanding is no longer valid. The role of the teacher should not be reduced to the position of information transmitter in our age where technology has developed so much and accessed information is so easy. Today, the primary task of the teacher in teaching mathematics is to transform this lesson from an academic obstacle to a useful skill area that they can use in all areas of life. In order for students to see and use mathematics in all areas of life, it must first be associated with other disciplines. Thus, math will be a useful calculation tool instead of an account asking tool.

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