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PROF. DR. DENİZ BESTE ÇEVİK KILIÇ

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CONTENTS

Chapter 1

STEM EDUCATION AND MATHEMATICAL MODELING[1]

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1 This study was produced from a part of the second author's master's thesis.

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1. Introduction

Within the scope of this study, first of all, the history of STEM education, its definition, its place and importance in education, and the most common learning and teaching models applied in STEM education are explained. Then there is information on mathematical modeling, modeling, modeling perspectives, definition of mathematical modeling and its place in the mathematics curriculum, respectively.

1.1. History of STEM

Due to the competition between countries in the age of Industry 4.0, it has become a necessity for individuals to have some skills such as being more equipped, productive and creative. This is how STEM was born. The first competition With the Soviet Russia sending the Sputnik spacecraft into space in 1957, the United States of America, on the other hand, started to work in the field of space and technology and to work for the production of new inventions (Akay, 2018). In this context, applications for STEM education in the United States of America first started in the 1950s, and the interest in this approach is still increasing and continues as the interaction of different disciplines (Sanders, 2009). In the society we live in, the basic skills that individuals should acquire are the skills to cooperate, communicate, think creatively, associate and solve complex problems (WEF, 2016). It necessitates the use of these skills in educational approaches, and that these approaches are process-oriented and interdisciplinary; it should lead people to new inventions. When we look at the Industry 4.0 results, 21st Century Skills and PISA Exam results, STEM education comes first among the educational approaches (Akgündüz, 2016).

STEM education, which has undergone constant changes in its historical development, is still in the development stage due to its increasing popularity and being supported by countries with large budget funds. This education, which does not have a settled order yet, is also a platform where different ideas cannot meet. Practices for STEM education have started in the United States of America and studies have begun in this field in Turkey as well as in many countries (Akgündüz, 2018). When the historical development process of STEM is examined, we first encounter STEM as a discipline, then STEM as interpretation and the concept of integrated STEM education (Çepni, 2017).

When we look at the historical development, it can be accepted as the time when STEM started in Turkey, when there were Nizamiye madrasahs, Enderun schools and madrasahs in the Ottoman Empire. Educational approaches are similar to STEM education. They are institutions that focus on problem solving and provide all disciplines (Akyüz, 2012; Akay, 2018). If we look at the scholars who grew up in these madrasahs, they did not

only work in one discipline but also in many fields. For example, Ahmed al-Biruni is known for his work in astronomy, mathematics, science and natural sciences, geography and history. In another example, the system developed by his teacher İsmail Fakirullah in Siirt Tillo to illuminate the head of his grave during the equinox periods (March 21 and September 23) when day and night are equal is a complete STEM example (Pamuk, 2010; Çırak and Yörük, 2015).

1.2. Definition of STEM

One of the reasons for the emergence of STEM education was seen as an innovation for politicians and educators to seek solutions to economic problems. In this context, they stated that the concept of STEM, which is seen as an important approach for the economic development of countries, will play an important role in students' orientation to digital fields (engineering, space science, mathematics, technology) in their future professional lives (Şahin, 2019). Although the concept of STEM was emphasized by Rahmaley (2001) for the first time, its foundation dates back to the 19th century. In fact, there are many definitions and interpretations of what the concept of STEM means in school education (Bybee, 2010; Thomas, 2014). Its main purpose is to enable students to focus more on STEM fields starting from the pre-school period until university education, and to enable students to find solutions to the problems they encounter in daily life by using their STEM field knowledge (Thomasian, 2011).

STEM is used to teach the four disciplines (Science, Technology, Engineering and Mathematics) in association with each other, separately or simply to refer to science and mathematics or the integration of two of more disciplines (Beswick & Fraser, 2019; Meng, Idris & Kwan, 2014; Corlu, Capparo & Capparo, 2014). Specific pedagogical approaches, such as problem or project-based learning, are often associated with the combination of engineering and mathematics fields, similarly, student-centered inquiry or problem-solving approaches may be associated with the integration of science and mathematics teaching. In Australia, Hobbs, Clark, and Plant (2018) identified STEM teaching models used in schools.

Accordingly, in the S-T-E-M model, each discipline must be taught separately. In the model in the form of SteM, there is more emphasis on one or two of them while teaching in four disciplines. In the model in STEM format, there is an integration of every discipline. Integrated STEM teaching seems to be more common in the USA than in other countries and is strongly advocated in this country (Atkinson & Mayo, 2010). However, various approaches are seen in the USA and Australia, where integrated STEM teaching is also supported (Honey, Pearson, & Schweinngruber, 2014; Timms, Moyle, Mitchell & Weldon, 2018). Increasing awareness of

the importance of STEM disciplines in other parts of the world has led to a focus on improving the teaching of separate subjects, especially science and mathematics (Caprile, Palmén, Sanz, & Dente, 2015).

According to the report prepared on STEM Education in Turkey, different and new disciplines were tried to be added considering the needs of the country and the education programs. For example, new approaches are suggested, such as art/design STEAM (STEM+ART), programming STEM+C (STEM+Computing), reading/religion STREAM, entrepreneurship STEM+E (STEM+Entrepreneurship), as well as applications (Akgündüz et al., 2015; Kılıç & Ertekin, 2017).

STEM education; it develops students' problem-solving skills and creativity and enables them to make new designs in the field of engineering, to think scientifically and critically to develop and associate an interdisciplinary perspective. Students are self-confident, they learn in a fun and enjoyable environment, and they also understand and explain the nature of technology (Yıldırım & Altun, 2015). STEM education is a field that enables students to think multi-dimensionally and allows students to learn many disciplines (Roberts, 2012).

1.3. Importance of STEM in Education

STEM is an important educational approach for countries that want to advance in technology, raise individuals with 21st century skills, make new inventions and have a developed economy. In addition, STEM is important in terms of giving importance to the basic concepts in different disciplines and the development of skills in these disciplines. Therefore, the integration of STEM into lessons is of great importance.

The aim of STEM education is to prepare nations for future environmental and social impacts, global security and economic stability, and it is emphasized that nations' economic competitiveness and global employability are understandably high priorities for education systems (Kelley & Knowles, 2016). Therefore, STEM education can be seen to play a vital role in preparing students for the future (Fisher & Frey 2014; Wiseman, Onuczko, & Glanfeld, 2016). However, research shows that students face significant difficulties in developing their competencies to face today's problems such as energy efficiency and climate change, and their interest in these fields is rapidly decreasing (Bybee, 2010; Nyman, 2017). These concerns about quality STEM education are also reflected in the literature. Wienk (2017) emphasizes that the students choosing the 12th grade advanced mathematics course decreased by 32% from 1995 to 2015. Bybee (2010) has argued that despite increasing interest in science and mathematics, a lack of attention in technology and engineering in schools is part of students' growing concern about twenty-first century

skills. Nations interested in future innovation are devising strategies for integrating the STEM approach into the curriculum to address students' twenty-first century skills.

Five prominent topics in the academic literature for STEM education integration in schools; STEM education perspectives, approaches to STEM integration, STEM discipline representation, equity in access to STEM education, and the extension of STEM to STEAM (include the arts) (English, 2017). They are recognized as they directly influence policy and curriculum decisions and enhance STEM education in the classroom. The many methods involved in integrated STEM activities are examined, the integration of modeling and engineering design can be given as an example.

Examining the perspectives on STEM integration, Honey et al. (2014) simply defines it as "working in the context of complex phenomena or situations on tasks that require students to use knowledge and skills from more than one discipline". Even the use of the term integration is defined differently. For example, Sanders (2012) and Wells (2013) argued that integrative STEM and STEM integration are different from each other and that integrative, unlike integrated, refers to an "ongoing, dynamic, student-centered teaching and learning process". They emphasized that integration is a more static, teacher-led process.

When examined in the context of curricula, there has been an increase in STEM understanding within the scope of science curricula in our country in 2017. Howard Gardner is of the opinion that the new generation should have the knowledge and skills to do the jobs that machines cannot do. Especially; A technology age where devices that can produce their own energy and can produce instantly when needed (3D-4D printers) can share data with other devices (internet of things) will provide convenience to people. Gardner also emphasizes the importance of 21st century skills here.

STEM education aims to enable students to use the knowledge they learn in science and mathematics lessons in real life and to improve their thinking skills (Yıldırım & Altun, 2015; Pekbay, 2017). Therefore, since STEM education enables students to be active, it can be stated that it will improve productivity, creativity and originality, while increasing their desire to learn and transforming theoretical knowledge into practice (Altunel, 2018; Eroğlu & Bektaş, 2016). STEM education is important for students to acquire 21st century skills. Two complementary frameworks are used in the literature for the integration of STEM. The first framework for integrated STEM is Moore, Stohlmann, Wang, Tank, Galancy, and Roehring (2014), a quality integrated STEM motivator should be engaging, engineering design, math and/or science content, student active, and good

communication. Given an engineering design centrism in the integrated STEM program, the second framework is the Quality K-12 Engineering Education Framework (Moore, Glancy, Tank, Kersten, & Smith, 2014), This framework design process, application of SEM knowledge, engineering thinking, engineer and engineering concepts It consists of nine stages: engineering tools and processes, problems, solutions and effects, ethics, teamwork, and engineering communication (Roehrig, Dare, Whalen, & Wieselmann, 2021). In the analysis of twenty studies on STEM curriculum integration, it was reported that the integration of science and mathematics content was weak (Guzey, Harwell, Moreno, Peralta, & Moore, 2017).

For STEM education, which is based on the fusion of disciplines, the United States and England have changed their curricula and methods in order for students and teachers to adapt to the system more easily. Changes have been made to enable education to gain real-life experiences. Thus, the interests, achievements and perseverance of teachers and students have been increased. US President Barack Obama, in a speech on STEM in 2014; "Teachers are doing a great job preparing their students with skills suitable for the new economy in problem solving, critical thinking, math, science, technology and engineering. Making this change is not easy. But it's worth it and it works.' According to Obama, the USA should prepare its student to excel in STEM fields. For this reason, the Presidency increased its investment budget for STEM education in 2015 by 3.7% compared to 2014 and allocated $2.9 billion (White House Office of Science and Technology, 2014).

STEM education has started to be researched and implemented in Turkey as well. The tendencies of other countries on this subject are followed through scientific publications and news. When what is done about STEM education around the world is researched, the situation of our country is an issue that needs to be investigated (Poyraz, 2018).

With the researches on STEM education (TÜSİAD, 2017; Akgündüz et al., 2015), the education systems of countries with different levels of development were examined and helped to shape our education system (Akgündüz, 2018; Aydeniz, 2017). In this regard, it has been stated that it is important to provide an interdisciplinary learning that has been transformed into practice with engineering from pre-school to higher education through studies on STEM education in Turkey.

2.1. Concept of Mathematical Modeling

It was stated by Pollak (1969), who used the term Mathematical Modeling for the first time, in his research named "How Can We Teach Applications of Mathematics" for its integration into mathematics education by determining the limits of modeling. He brought mathematical modeling

into education with an approach based on a realistic modeling perspective (Gürbüz & Doğan, 2018). Pollak (2007) defines mathematical modeling as: First you identify something you want to understand in the real world. At the end of this stage you have a real world problem. (understanding the problem); Then you identify the variables that are important for this question and the relationships between them, that is, the important concepts. Then you decide what to keep and what to ignore (Simplification); You transfer this version to the math language. (Mathematization); The obtained mathematical model is solved. (Study mathematically); The result obtained is an idealized version of the original problem. (Interpretation); Finally, the assumptions at the beginning of the solution process and the solution of the mathematical models created based on these assumptions are verified (Verification) (Gürbüz and Doğan, 2018).

2.2. Model Building

In general, a model can be defined as conceptual systems that are expressed using external representation systems and that are used to construct, describe, or explain the behavior of other systems, and that contain rules governing relations, elements, operations, and interactions (Lesh & Doerr, 2003). Models according to this definition; they can be classified according to their functions (explanatory-descriptive-descriptive), appearance (abstract-concrete), and scientific (Güneş, Gülçiçek, Bağcı 2004). Accordingly, the classification of the models is given below:

Scaling Models: Scaling models used to describe colors, structural features, and external shapes are often like toys. For example, they are scaled models of animals, airplanes, plants, buildings and cars.

Pedagogical Analogical Models: It enables the model to share information with the target and to make the atom and molecule accessible to students.

Symbolic Models: Formulas and equations are symbolic models.

Mathematical Models: Physical properties, mathematical equations and graphs.

Theoretical Models: Electromagnetic field lines and photons.

Maps, Diagrams, and Tables: Examples include the periodic table, weather maps, family trees, circuit diagrams, and the food chain.

Concept-Process Models: Many science concepts, such as acid-base reaction models.

Simulations: It is used in situations such as pilot trainings or traffic accidents.

Mental Models: It is mental representation,

Models; it is used in the field of science, engineering, technology, in short, in all areas of working life. Students also use concrete, symbolic or mental models in the classroom or in their daily lives (Doruk, 2010). Students can establish relationships between concepts and eliminate possible misconceptions through models (Van De Walle, John et al., 2019).

2.3. Modeling Perspectives

In many studies on mathematical modeling, it is seen that researchers have different perspectives. In order to interpret these differences, it is important to reveal and classify the different perspectives that researchers have. These different perspectives have an important role in putting mathematical modeling on a more solid theoretical foundation (Çelik and Temurtaş, 2018).

Realistic/Applied Modeling: It is defined as understanding realistic or authentic problems, establishing creative solutions, and developing modeling and modeling skills (Bukova Güzel, 2016; Çelik, Temurtaş, 2018).

Contextual modeling: It is the understanding of solving verbal and open-ended problems involving learners to learn mathematical concepts in appropriate contexts related to daily life (Bukova Güzel, 2016; Hıdıroğlu & Ö. Hıdıroğlu, 2016).

Educational Modeling: The purpose of this modeling is to model mathematical concepts for the development of students' thinking skills in appropriate contexts (Hıdıroğlu & Ö. Hıdıroğlu, 2016; Çelik, Temurtaş, 2018).

Socio-Critical Modeling: It covers the discussions of the students in the mathematical modeling process and the studies carried out to develop critical thinking skills that they can use in their own culture and society. It also includes evaluating the interpretation of the problem situation and its concepts, and revealing thoughts about how the solution of the problem will be more effective (Hıdıroğlu & Ö. Hıdıroğlu, 2016; Çelik, Temurtaş, 2018; Bukova Güzel, 2016).

Cognitive Modeling: Cognitive modeling, which adopts the understanding of analyzing and understanding the cognitive processes taking place in the modeling process, emphasizing models as mental images or modeling as mental processes such as generalization and abstraction supports mathematical thinking processes (Çelik, Temurtaş, 2018).

Mathematical Modeling as a Purpose: According to this approach, mathematical modeling is to solve real-life problems using mathematical

concepts and operations. In order to solve real-life problems, the individual must first complete the processes such as transforming the problem into mathematical form, analyzing it with mathematical methods, obtaining the results, and then interpreting it. In addition, mathematical modeling should be approached from an interdisciplinary perspective (Doğan, Şahin, Çavuş Erdem, & Gürbüz, 2018).

Mathematical Modeling as a Tool: Mathematical modeling is when students consider mathematical concepts as a learning tool. It is based on the idea that the learned information will be more permanent and effective. The most important approach that takes mathematical modeling as a tool is the Model and Modeling Perspective approach developed by Lesh and Doerr (2003). This approach is a comprehensive theoretical approach that provides detailed explanations about the knowledge of reality, concept development, problem solving and teaching, and also emphasizes the importance of teacher development. Mathematical models are a two-component structure consisting of conceptual systems in the mind and their external representations to interpret real-life problems (Kertil, Çetinkaya, Erbaş, & Çakıroğlu, 2016; Çelik & Temurtaş, 2018).

2.4. Mathematical Modeling Definition

Mathematical modeling means using mathematics to solve non-mathematical problems, and mathematical modeling is process-based. In this view, mathematical modeling refers to the iterative process of transforming a real-world problem into a mathematical problem to be solved, solving the mathematical problem, and using the results to address the first real-world problem (Kaiser, 2017). or the entire conceptual system used to describe, think, interpret, explain, or make predictions about the behavior of the experienced system (Doerr & Tripp, 1999). Mathematical modeling is more than 'translating' a real-world situation into a mathematical representation; It needs to maintain the relationship between the mathematical structure and the real-world system it is intended to represent. (Czocher, 2018). Focusing on mathematical and cognitive activity allows questioning the sub-processes that make up the modeling process. Modeling competence refers to the ability to simultaneously recruit cognitive resources (holistic approach) to drive the entire transformative process and the ability to perform processes related to the construction and exploration of mathematical models (Niss, Blum, & Galbraith, 2007).

Since mathematical modeling improves students' critical thinking, generalization and abstraction skills, he states the importance of doing many activities on mathematical modeling (Boaler, 2001; NCTM, 2000). In this regard, mathematical models are created in line with the problems related to daily life, and they are created with the help of functions,

graphics, tables, inequalities, system of equations, geometric figures in which the relationship between the variable is explained. In addition, mathematical modeling skill in a real-life situation means the ability to identify questions, assumptions or appropriate variables, to analyze and compare given models (Guzel, 2016; Niss, Blum, & Galbraith, 2007).

Modeling and modelling are two structurally different but interrelated concepts. While modeling means the process of creating a model; The model can be defined as the product that emerges as a result of this process. Accordingly, the concept of modeling can be defined as the process of coordinating problem situations in the process of interpreting events and problems, arranging them in the mind, organizing and finding a pattern, systematizing and creating different schemes and models in the mind (Kertil, 2008).

According to Haines and Crouch (2007), the stages of mathematical modeling are as follows; The expression of the daily life problem consists of the stages of creating a model, solving the designed model mathematically, interpreting the obtained solution, evaluating the obtained interpretation, and finally, correcting the model before reviewing the daily life problem and repeating the cycle.

2.5. The Place of Mathematical Modeling in the Mathematics Curriculum

The fact that most of the research in mathematics education focuses on "how mathematical concepts develop and students' understanding of these concepts" has led to insufficient studies on the development of skills on how these concepts are used in different disciplines and in real life. The inadequacy of mathematics education and the problem solving approaches underlying the reform movements in the curriculum in recent years in preparing students for real life has caused mathematical modeling studies to gain importance (Gürbüz and Doğan, 2018). In recent years, the necessity of using mathematical modeling in mathematics teaching has been emphasized more and more in order to raise individuals who can think analytically, produce solutions to real-life problems and have the equipment required by the technology age (Dost, 2019).

In the secondary school mathematics curriculum, it was stated that mathematical modeling is among the skills that students need to develop and it is important in terms of mathematics education. Mathematical modeling is a method that makes it easier to see the relationships in the nature of real-life problems, to express them in mathematical terms, to classify, to generalize, and to reach conclusions. Through mathematical modeling, students' tendency to see mathematics as a separate discipline from real life was eliminated, and they were made to realize that one

dimension of mathematics is a way of thinking that produces solutions to real-life problems through modeling.

The report of the National Council of Teacher Mathematics (NCTM), 2000, emphasizes the necessity of giving more space to modeling activities in school mathematics. In parallel with this, studies on mathematical modeling activities have increased in recent years. Despite the studies on integrating mathematical modeling into the teaching process, it is seen that mathematical modeling has little place in classroom teaching environments (Ferri & Blum, 2013).

In summary, within the scope of this study, first of all, the history of STEM education, its definition, its place and importance in education, and the most common learning and teaching models applied in STEM education are explained. Then there is information on mathematical modeling, modeling, modeling perspectives, definition of mathematical modeling and its place in the mathematics curriculum, respectively.

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Chapter 2

USE OF TECHNOLOGY IN SPECIAL EDUCATION

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1.INTRODUCTION

Equality and convenience in accessing information is getting easier day by day for all individuals with the developing technology. Individuals with special needs who need integration/inclusion education due to their disability are among the groups that should benefit from this facility at the highest level. Integration in special education is more important point than individualization, because it is necessary to benefit from the methods of education and training approaches that will give the opportunity to minimize the differences in order to be educated in the same environment with their peers. One of these approaches is the technology that has started to be used more frequently in distance education due to the virus spreading rapidly all over the world. The use of technology in special education provides support at many points such as developing different interests and abilities of the individual, providing accessibility and individual evaluation opportunities. From this point of view, the main purpose of this section is to examine the use of technology from a developmental perspective in order to meet the educational needs of individuals with special needs.

2. USE OF TECHNOLOGY IN EDUCATION

The use of technology in every field brings the speed, and thanks to this speed, it provides many benefits such as more effective use of knowledge and skills, instant feedback, and opportunity to try different methods and techniques (Smith, Spooner and Wood, 2013). Considering the benefits and outputs of using technology in the industrial sense, technology integration is striking in the education investments of developing countries in order to experience similar effects in the field of education (Odabaşı, 2010). At the same time, this integration ensures that the fields of science, technology and education mutually feed each other and include them in the development process (Çobanoğlu, 2018).

Education has benefited from these enrichments at every stage of technological developments, and tools such as radio, overhead projector and video have been frequently used in educational studies. However, the way technology is integrated into human needs and social life is also an important point. The effect of technology on the organization and functioning of educational institutions, the method used in the education process, the content of education and the social sphere through education should also be taken into account (Aksoy, 2003). Thanks to the integration of technology into education, learning can take place in any environment beyond place and time, and this can provide student-centered environments that provide social learning and self-management as well as individual learning (Fu, 2013).

Technology creates a bridge between education and goals in order

to provide equal opportunity in education services for children with special needs (Lee and Templeton, 2008). This approach is also included in the statement "Relevant services, including technological support, are provided by the relevant units of the Ministry to the students who cannot directly benefit from formal education services, in order to enable them to follow their courses through distance education" (Ministry of National Education, 2020). The use of computers and tablets, which are rapidly becoming widespread today, provides the opportunity to be used as an educational material for individuals with disabilities. The preparation of the software by considering the differences and competencies of the disabled individuals will enable them to be used more effectively (Higgins, Boone and Williams, 2000). In addition, being able to be used individually without support, the opportunity for continuous repetition, providing an individual learning environment and increasing self-confidence also affect learning positively (Doğru and Aslan, 2008).

3. USE OF TECHNOLOGY IN SPECIAL EDUCATION

In the Legislative Decree No. 573 on Special Education dated 6.6.1997, special education is defined as "the education provided by specially trained personnel, developed training programs and methods to meet the educational needs of individuals in need of special education, and in an environment suitable for their disability and characteristics" (Ministry of National Education, 1997). Individuals in need of special education can also be examined in various groups according to the type of disability they have. In the literature, there are many classifications such as mental retardations, learning difficulties, severe and multiple disabilities, emotional and behavioral disorders, visual and hearing disabilities, communication disorders, intellectual giftedness, disabilities due to physical drawbacks, autism spectrum disorder, traumatic brain injury and deficiencies due to health problems (Ministry of National Education, 2020). Individuals with special needs have difficulty perceiving stimuli unlike their peers. In order to overcome this difficulty, different adaptations, materials and special teaching methods are used according to the type of need (Aral and Gürsoy, 2007).

The main purpose of special education is to use their capacities at the highest level in line with their qualifications, interests and abilities, and to prepare them for higher education, professional life and social life (Ministry of National Education, 2020). In order to achieve this goal, it is necessary to benefit from assistive technologies, which are special tools, services and methods used to individualize the education of individuals with different special needs, increase their independence and improve their quality of life (Reed and Bowser, 2005).

Along with the use of technology in education, the use of technology in special education can facilitate the perception of stimuli by individuals with special needs. From this point of view, it is important to use adaptable and supportive educational technologies for a wide variety of disability groups, which differ according to the types of disability, in terms of creating an accessible learning environment for everyone (Rose, Hasselbring, Stahl and Zabala, 2005). Technology plays an important role in special education through the points such as providing opportunity to frequent repetition and being encouraging (Xin and Rieth, 2001), providing versatile solutions (Zhang, 2000), and creating an individualized learning environment (Blackhurts, 2005). When the assistive technologies used in learning environments of individuals with special needs are evaluated in terms of ease of accession and economic purchasing power, they are grouped in three categories as low, medium and high level, as seen in Table 1 (Çakmak, 2016; Sani Bozkurt, 2017).

Table 1. Accessibility and economic purchasing power of assistive technologies

Low	Visual cards, custom pens and tools
Middle	Reading pen, talking calculator and dictionary
High	Tablet, computer and virtual reality etc. applications

Table *2. Examples of assistive technology use for different disability groups*

Autism spectrum disorder, intellectual disability, learning disability	Visual charts, reminders, audiobooks, word checkers, digital assistants, robots
Visually impaired	Digital screen magnifiers, remote viewing magnifier, screen readers, voice alert systems, braille keyboard and printer, optical character identification, smart glasses, tactile watches.
Hearing impairment	In-ear hearing aids, visual and physical stimulants, voice recognition software, speech device.
Language and speech disorder	Digital and synthesis devices (recorded sound and artificial sound producing), voice-over from text.
Physical/orthopedic disability	Switch and scanning solutions, KinectRom system: sound, head, foot, mouth and eye control, environment control

(Sani Bozkurt, 2016, 2017).

The method and content of the education that an individual will receive can change with the disability types of individuals with special educational needs. This change is also reflected in the use of technological tools, and

the use of technological tools also changes depending on inadequacy and need of the individual.

Visual charts, reminders, audiobooks, word checkers, digital assistants and robots can be used for autism spectrum disorder, intellectual disability and learning disabilities.

Examples for visually impaired individuals are digital screen magnifiers, remote viewing magnifier, screen readers, voice warning systems, braille keyboard and printer, optical character identification, smart glasses and tactile watches.

In-ear hearing aids, visual and physical stimulants, voice recognition software and speech devices are used for individuals with hearing impairment.

Digital and synthesis devices and text-to-speech technologies can be given as examples for individuals with language and speech disorders.

Switch and scanning solutions, Kinectrom system, devices controlled by voice, head, foot, mouth and eyes can be used for physically/orthopedic disability (Sani Bozkurt, 2017). Switch and scan enables movement of the selection box on the units on the screen with the help of a switch system, and when the desired function is selected with the same switch, the function can be completed (http://www.ms.com.tr/?page_id=28&lang=tr). On the other hand, the Kinectrom system is defined as a system that can make the necessary measurements and evaluations without the need for touch in the performance of physiotherapy exercises (http://fizyosoft.com/media/fizyosoft-brosur.pdf).

Educators/teachers, who will offer rich learning environments and provide flexible access opportunities to individuals in different disability groups, have important duties in the use of technology in the field of special education, taking into account the differences of individuals in need of special education (Çay, Yıkmış and Sola Özgüç, 2020). The use of computers in the educational environment has led educators to have the opportunity to develop materials that are richer in terms of visual and audio with various computer programs (Kargın, 2010). It is emphasized that the greatest responsibility falls on educators/teachers in utilizing this opportunity (Özdemir and Kılıç, 2007). In a study, educators/teachers stated that their views on technology use in special education are within the scope of professional needs or student needs (anne, krista, timothy, and peggy, 2010). Examinaton of the literature showed that the common point of the studies examining the attitudes of special education teachers towards assistive technologies are teachers' expectations for ready-made content, software deficiencies, technology-method confusion experienced

by teachers, changing conditions and professional obligations (Arslan and Şendurur, 2017; Sydeski, 2013; Kutlu, Schreglmann and Cinisli, 2018).

Educators/teachers working in the field of special education were reported to have limited knowledge about technology use, therefore, "technology assisted teaching in special education" and "material development" courses and in-service trainings will lead to more effective results in the use of technology (Çay, Yıkmış and Sola Özgüç, 2020). In addition, it is considered important to update the existing course contents in parallel with technological developments, as well as creating courses for the use of technology in supporting typical and atypical children in undergraduate programs of departments such as special education, child development, pre-school teaching, where specialists working with children are trained.

4. INTEGRATION OF TECHNOLOGY USE IN SPECIAL EDUCATION AND ITS EVALUATION

Examination of the contributions of the use of technological tools and equipment in the education of children with special needs showed that technological tools and equipment contribute to academic success and to the development of life skills (Raskind and Higgins, 1999; Van Daal and Reitsma, 1993). It has been determined that computer-aided animations in the academic success of hearing-impaired children (Keser and Kapıdere, 2016), the use of digital stories in the listening comprehension of children with intellectual disabilities (Sümer and Çetin, 2018), multimedia materials on the interests and attitudes of children with literacy difficulties towards the lesson and their literacy skills (Şahin and Çakır, 2018), educational computer games in the psychomotor development of children with mild intellectual disability (Karal, Kokoç, and Ayyıldız, 2010), compared to traditional methods, computer-assisted education in the willingness of individuals who have communication disorders due to deficiencies such as severe hearing loss, cerebral palsy or autism to participate in activities (Geoffrion and Goldenberg, 1981) has positive contributions.

Different applications have been developed considering the characteristics, needs and individual differences of individuals with special needs. In the literature, it is stated that applications performed using virtual environment with individuals having autism spectrum disorder are effective in supporting the skills of understanding and expressing their emotions, establishing eye contact, attention, playing and safety (Boser, Goodwin, and Wayland, 2014). There has been an increase in the use of augmented reality, virtual reality, web resources, game-based applications and mobile applications especially as of 2013 (Cheng and Lai, 2020). Thus, some application examples that can be used within the scope of special education are explained below.

Virtual reality/Augmented reality: Virtual reality (VR) is an interactive simulation in which computer-created three-dimensional environments are experienced with more than one sensation (Muscott and Gifford, 1994). Augmented reality (AR), on the other hand, is the transformation of objects into visuals on the screen in technological devices and displaying them by creating a sense of reality in the user (Çakır, Solak, and Tan, 2015). VR applications can offer very important opportunities in terms of enabling applications to be done safely, ensuring active participation of children, presenting appropriate representations for real situations, giving appropriate feedback and customizing applications according to needs (Özdemir, Erbaş, and Yücesoy-Özkan, 2019). In the literature, there are studies showing effective use of AR applications in various disability and disability groups such as physical disabilities, sensory disorders, mental disabilities, autism, learning difficulties, attention deficit, and behavioral disorders (Jeffs, 2010). With the increasing interest in AR studies in the field of special education, systematic analysis of research results shows that AR applications support individuals with special needs (Baragash et al., 2020).

E-Books: Today, digital books are developed that contain multimedia elements such as audio, video, animation, offer more options than printed books, support individual differences, support AR technology and are appropriate for individual use because of the customization tools. In this context, in the process of transforming from a printed book to a digital book, firstly "transferring to digital as is" was made, and then materials with "unique" qualities were developed with the integration of multimedia technologies (Spanovic, 2010).

Mobile Applications: With the widespread use of mobile devices such as phones and tablets, the ease of internet access increases the frequency of use of mobile applications. Applications developed within the scope of special education offer activities that support the developmental areas of children, and also guide families and educators. Examples of mobile applications prepared in this context are explained below.

"Özelim Eğitimdeyim**" Application:** It was developed by the General Directorate of Special Education and Guidance Services of the Ministry of National Education in Turkey in 2020 and is open to use by everyone. In the application, a wide variety of activities such as daily life activities, music activities, art activities, physical activities, game activities are offered, as well as there are topics such as school adaptation activities, visually impaired, hearing impaired and autism spectrum disorder, concept and skill training videos under the title of special education. Along with many adapted activities, different activities for special talents are also included in the application.

The App can be accessed through: (https://play.google.com/store/apps/

details?id=com.meb.ozelimegitimdeyim&hl=tr&gl=US) web-address.

"Tohum Eğitim" Application: It has been prepared by the Ministry of National Education in partnership with Tohum Turkey Autism Early Diagnosis and Education Foundation, with the sponsorship of TANAP Dogalgaz Iletim INC. in line with the "Road to Education Project". The application has been prepared to support the cognitive development of children with typical and atypical development and consists of "Listen Understand", "Object Matching", "Object Recognition", "Our Body" and "Actions" modules.

The App can be accessed through: (https://play.google.com/store/apps/details?id=com.tohum.tohumotizm&hl=tr&gl=US) web-address.

"Dinle Konuş" Application: Similar to "Tohum Eğitim", has been prepared by the Ministry of National Education in partnership with Tohum Turkey Autism Early Diagnosis and Education Foundation, with the sponsorship of TANAP Doğalgaz Iletim INC. in line with the "Road to Education Project". The application has been prepared to support the language and communication skills of children with typical and atypical development. The App consists of the categories Shapes, Zoo, Count With Me, Imitate Sound, Parts of the Body, Upright Aerobatics, My Dear Family, Rainbow Colors, Tools, Basic Sounds. The App can be accessed through: (https://play.google.com/store/apps/details?id=tr.org.tohumotizm.dinlekonus&hl=tr&gl=US) web-address.

The technology tools used have a different site and mechanism of action. In assistive technology, modern technology is employed at the level of the individual student to help him or her overcome barriers in the curriculum and living environments.

5.CONCLUSION

The use of technology in education is becoming a necessity in every field of education. Especially in the education of children with special needs who need inclusion and integration education due to their individual differences, the development of computer technologies can provide new methods to meet the needs of children with special needs, considering the decrease in costs, portable products, ease of accession and application convenience. In the use of technology in special education, support can be provided to ensure continuity with practices such as the selection of the most appropriate educational technologies by making a requirement analysis according to the learning needs of the individuals with special needs, encouraging the teachers working with children with special needs to use technology in education, mobile applications in out-of-school environments by providing family participation.

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Chapter 3

KALIMBA IN MUSIC EDUCATION

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Introduction

Education is one of the most important factors in the development and progress of individuals and societies. Education is the sum of the processes in which the individual acquires skills, orientation and other behavioral patterns that have practical value in the society they live in (Demirel & Kay, 2002). The indispensable dimensions of an education are physical and health education, science education, technical education and art education. In these dimensions, art education is divided into various branches in itself (Uçan, 1997). Art education; It is the expression of feelings and thoughts that arouse a sense of beauty in the individual with skill and imagination. In order to develop people and achieve a modern society, people who have reached a high level of thinking in art are needed. Therefore, every society needs individuals who have received art education and have developed the necessary aesthetic appreciation. According to Öz (2001), every person is in a versatile musical environment while continuing his education and training throughout his life. Music education has an important place for children and young people to receive a solid soul and personality education. The process, which started with the search for different sounds from human body and voice, continued for thousands of years and reached today's instruments. This never-ending process is the basic element of music education. Instrument education is the process of educating, developing and gaining artistic aesthetics by a person or a group through an instrument in a planned process (Kurtuldu & Ergan, 2011).

It is an indisputable fact that today, where information and communication technologies are a part of life, the accumulation of knowledge is increasing day by day and it is necessary to benefit more from this accumulation. (Şahan, 2007) Rapid technological developments have caused individuals to deal with more complex problems by creating changes in all occupational fields. It has become inevitable for education systems to be dynamic and constantly updated in order to meet new demands (Erdamar, 2007). Schools provide a teaching service for students to acquire new behaviors, complete the deficiencies in their behaviors, and correct the mistakes (Demir, 2007). Today, when social media has become a part of life, instruments belonging to different cultures attract the attention of the young population, and the ease of accessibility to these instruments increases this interest. Kalimba has become one of the traditional instruments that attracts attention on social platforms in recent years and its popularity is increasing day by day. Within the scope of the research, it is aimed to reveal the usage situation in music education by examining the general dimensions, historical process, structure and characteristics of the Kalimba instrument.

Kalimba throughout the history

The kalimba is a musical instrument that has been present in various parts of Sub-Saharan Africa since at least the Late Iron Age. It consists of a series of flat iron rods fixed to a wooden stick and is sometimes enclosed in an open gourd, which also functions as a resonator to amplify the sound (Kumbani, 2020). One end of each of these metal keys is placed between metal bridges to secure the instruments. The free ends are played with the thumb and index fingers, hence the name "thumb piano". It is known by numerous names, among which mbira, mbila, sansa or sensa are perhaps common in different parts of Africa. It is a small instrument played with holding it in the palms (List, 1968; Tenzer, 2017). The oldest known type of kalimba is "Mbira dza vadzimu" (Tracey, 1963).

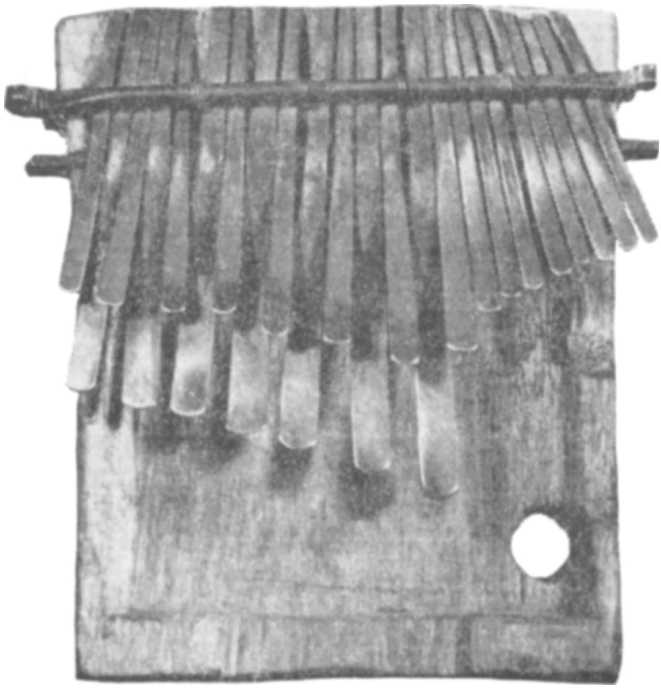

Figure 1. Mbira dza vadzimu (Tracey, 1963)

Kalimba-like instruments can be found in the West Indies and South America. Members of the xylophone family, these instruments are made of tuned wooden slats of different lengths with various sizes of pumpkin resonators. Sound is obtained by hitting the laths with sticks. In parts of Central and Southern Africa, such instruments are played together. (Curtiss, Edwards, & DeNevi, 1969) Marimba is known to be one of the names used by the Portuguese for xylophones in southeast Africa. The word Kuimba was used in Sofala in 1505 and is still a general term for this group of

instruments. (List, 1968: 58)

Although kalimba has spread to different parts of South Africa, it takes different names in different regions and differs in shape (Figure 2). For example, in the yoruba region of Nigeria, agidigbo are called molo in smaller sizes, but they have lost their popularity today. The molo instrument, like the kalimba, is used both as a solo and accompaniment instrument (Thieme, 1967). Mbira dzavadzimu is a musical instrument commonly associated with Zezuru, a sub-ethnic group of the Zimbabwean Shona (Matiure, 2011).

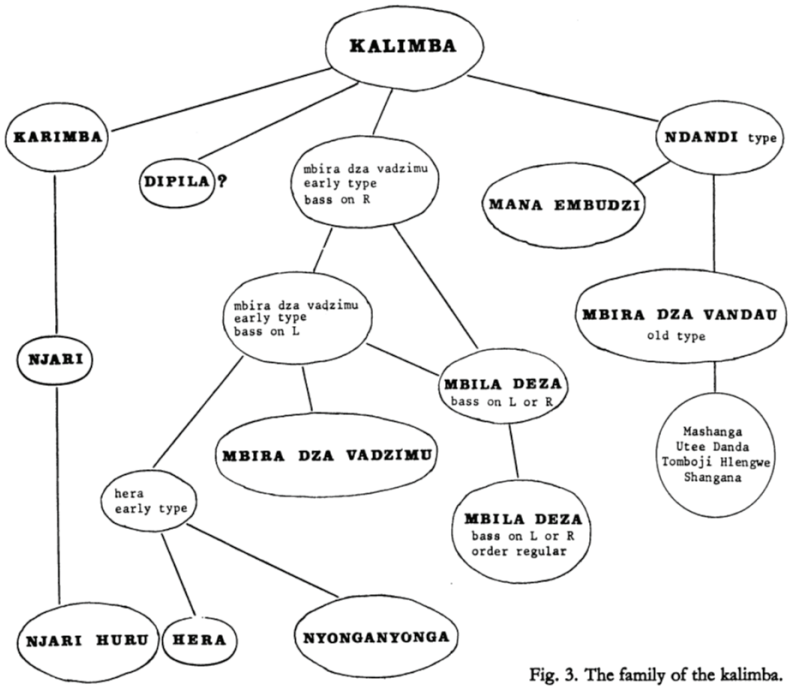

Figure 2. Kalimba varieties by region (Tracey, 1972)

Music occupies a central position in Zimbabwe's cultural life, accompanying people from the cradle to the grave. Kalimba music plays an important role in socio-cultural life today. Historically, the important role of Kalimba during and after the struggle for Zimbabwean independence and the international success of some Zimbabwean musicians such as Thomas Mapfumo, Stella Chiweshe, Oliver Mtukudzi and the Bhundu Boys have been instrumental in the popularization and development of music (Chidanyika, 2008) (Barnett, 201; Maguraushe, 2017; Tenzer, 2017). In Shona culture, one or more Kalimba players accompany the ceremony. He accompanies the singing instrument throughout the ceremony (Kyker, 2009). The hardwood called "mubvaropa", also known as the blood tree

specific to the Shona region, is used in Kalimbas made with traditional methods in 21st century Africa. Although natural ores were used as metal in the past, today it is produced by melting and shaping iron or ready metals from scrap dealers (Figure 3). (Berliner, 1980)

Figure 3. Making Kalimba with Traditional Methods (Berliner, 1980)

Turino (2010) noted that what made Kalimba internationally famous was the activities of ethnomusicologists, tango, rumba, steelband and meringues in the Caribbean and Latin America, as well as the aesthetics and desires of fans worldwide after the mid-1980s and the radio scene of the 1960s. As such, foreign interest in a local tradition has resulted in it being chosen and popularized as a preeminent national musical idiom within the country. With the spread of churches in Africa, Dave Dargie was involved in religious music studies with Kalimba and rhythmic instruments between 1979-1988, and he used different signs in notation for the sounds of instruments outside the tonal pattern. However, he made some changes in the touches. The arrow directions in Figure 4 indicate the microtonal direction (Dargie, 2013).

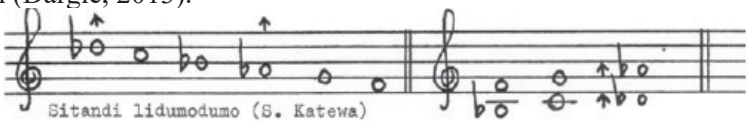

Figure 4. Microtonal Sound Signals

In the 21st century, Kalimbas are produced in different sizes. The standard 17-key Kalimbas are in heptatonic arrangement from the center outward (Figure 5). (Perman, 2015)

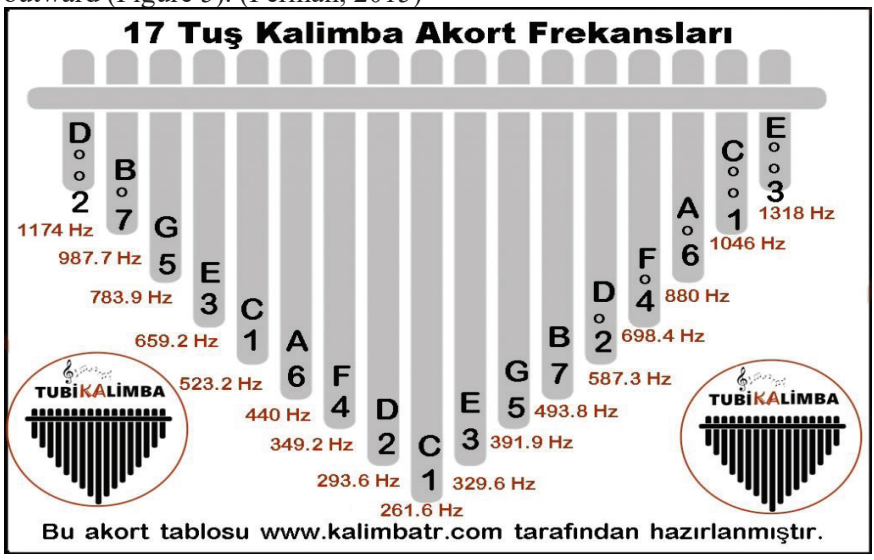

Figure 5. 17 Key Kalimba Tuning System and Frequencies (kalimbatr.com, 2021)

It is not known exactly when Kalimba was brought to the Americas, but it is known that it was brought to the South American region by the Spanish. However, with the spread of radio, the popularity of Kalimba began to increase (Garfials, 1983). With the increasing popularity of the Hippie lifestyle in the 1960s, western musicians' interest in traditional

instruments played an important role in the spread of Shona music culture and therefore the Kalimba instrument to the world (Turino, 2010).

The digitalization process, which started with the computer called ENIAC, which was produced by the American army in 1946 to calculate the cannonballs, accelerated in 1958 with the invention of the integrated circuit as a computer chip by Jack Kilby and Robert Noyce (Zimmermann, 2017). In 1976, the launch of the Apple computer by Steve Jobs and Steve Wozniak, and the use of the WINDOWS operating system and the www (World Wide Web) extension in 1985 are seen as important dates in technological developments (Woodford, 2018). In the 1970s, Dr. The smartphone world, which was developed under the leadership of Martin Cooper (Murphy, 2013) and will completely change today's world, gained a new dimension with the iPhone introduced by Steve Jobs in 2007. This phone, which was introduced, created the beginning of changes that can be considered as a revolution in technology with its video playback, web pages, e-mail reading and the applications it contains.

Social media, which is one of the concepts of the digital world and one of the important communication channels of the 21st century, changes the communication and interaction of societies to a large extent, while providing the universalization of traditional cultures. Thanks to the social media platforms where traditional music is shared, people can listen to music from different cultures, as well as buy instruments belonging to those cultures through e-commerce sites. The fact that traditional instruments are sold on the internet, and the increase in instrument training video and service providers attracts the attention of the young population. The kalimba instrument is attracting more and more attention on video streaming sites and social media in terms of its different playing technique, size and sound color. It is possible to say that there is a similar situation in Türkiye.

Usability of Kalimba in music education in Türkiye

In the relevant literature, there are not enough studies on the usability of the Kalimba instrument in music education. However, the main idea of the research is that there is a very high rate of Turkish education videos on social media and video playback sites, as well as in different languages about Kalimba education. School instruments that started with the mandolin in the Republican years were forgotten when the Village Institutes were closed and replaced by other instruments such as the soprano recorder (Sakar, 2019). Orff instruments and melodica were added to the soprano recorder instrument over time. In the 21st century, in addition to these instruments, piano and guitar are used as accompaniment instruments (Küçükosmanoğlu, 2012). From this point of view, the use

of Kalimba in music education has been demonstrated by comparing the soprano recorder, piano, guitar and melodica instruments with the Kalimba instrument in different dimensions.

Soprano recorder, which entered music education with the courses organized for music teachers by Prof. Hermann Auer, who came to Ankara in 1953, started to become widespread in Türkiye with the work of music educator Saadettin Ünal (Say, 2002). Soprano recorder is seen as an instrument that can be used in music lessons, thanks to its ease of performance, cheapness, and love of music by young students (Sakin, 2017). With the soprano recorder performance, the student finds himself in music literature in a short time (Takmaz, 1997; Yayla & Dalmışlı, 2014). In their research, they stated that music teachers preferred the soprano recorder in their lessons because of its ease of carrying, lack of tuning problems, and being economical. Kurtaslan & Köksoy (2011) conducted a similar study and stated that more than half of the classroom teachers do not use instruments in music lessons, and half of the teachers who use instruments use the soprano recorder. However, as a result of both studies, it was revealed that the teachers did not consider the music lessons conducted with the soprano recorder instrument to be sufficient in terms of quality and to achieve the desired goals. The soprano recorder is an instrument that has many disadvantages with its advantages. Although the soprano recorder is sufficient in teaching songs at the primary school level, it is insufficient for the level of reaching the intended goals and behaviors of music education, since it cannot be used as an accompaniment instrument, is insufficient in ear training and is not suitable for polyphony. (Üstün & Özçimen, 2015; Küçükosmanoğlu, 2011; Acar 2009).

Although there are no studies on the use of the Kalimba instrument in music education in Türkiye, it is possible to see many students playing Kalimba on social media platforms. Similarly, it is seen that the kalimba is used alongside orff instruments in some private schools. The kalimba is similar to the soprano recorder in that it is inexpensive, easy to carry and has no tuning problems. However, the fact that the kalimba is polyphonic and can be used as an accompaniment instrument stands out as a more functional instrument compared to the soprano recorder in achieving the objectives of primary education music lessons.

Using a polyphonic instrument and accompanying the works in the curriculum have a positive effect on the learning levels of the students in reaching the goals and achievements of the music lesson. The piano can be seen as a very important instrument in realizing this purpose. In some studies conducted in Türkiye, it is seen that teaching singing with piano accompaniment has positive effects on children (Demirtaş, 2011) and it has a positive effect on students' attitude towards the lesson compared to

soprano recorder (Levent, 2013). However, Jelen (2013) stated that the piano lessons given in music teaching departments were insufficient to achieve the expected goals and that they could not reach the desired goals in accompaniment. The fact that the piano is an expensive instrument is one of the obstacles to using it as the basic instrument of music education. However, problems such as carrying and placing the piano and tuning questions are other obstacles to the use of the piano in music education due to the lack of music classrooms in every school in Türkiye (Uluocak, 2008).

Kalimba's portability and usability as an accompaniment instrument allow students to play not only vocal accompaniment but also instrument (Gordon, 2020). In his research on the musical skills of primary school students, he stated that the students liked the sound of Kalimba, it was easier to play than the piano, and it changed their musical tastes significantly. Evaluating instrument efficiency from a different perspective (the ratio of useful energy output to energy input), Jorda (2004) stated that Kalimba can be considered a more efficient instrument than piano and violin. In this respect, the kalimba can be considered as an alternative instrument compared to the piano in achieving its teaching goals.

The guitar used in entertainment music when it first came to Türkiye (Elmas, 2003) found a place in a different dimension thanks to the classical guitar concerts given by Andrea Paleologo (Kanneci, 2001). The inclusion of guitar in higher education was carried out by Erol Küyel in 1973-74. Over time, the guitar has become a very popular instrument because it can be played both with accompaniment and solo, can be used in different music genres, and is easy to carry and obtain (Kalaycıoğlu, 2016). In their research, Yılmaz & Temiz (2012) concluded that the instruments most preferred by university students are guitar and baglama, and when the popularity status is examined, the guitar is preferred by a large margin. In general music education, guitar plays an important role in teaching and popularizing folk songs or school songs as solo and accompaniment (Erim & Yondem, 2007). Although the guitar is not a suitable instrument for performing and accompaniment due to its structure, it is widely used to perform and accompany Turkish Folk Music, which is simpler than Turkish Classical Music (Özkan & Mustan Dönmez, 2014). Thanks to some structural changes made in the guitar (fretless guitar, Microtonal guitar), the use of the guitar in maqam Turkish music is increasing day by day. The guitar is a very useful instrument in terms of sound beauty and ease of transport. However, the fact that it is polyphonic and can be used as an accompaniment instrument like the piano makes the guitar an important element of general music education.

Although there are many advantages of using the guitar in music education, there are some disadvantages. Although guitars suitable for children are produced, guitars produced as standard are structurally large for small children. (Known, 2014). Working in harmony on the guitar requires physical strength (Erim, 2016). Considering that the average class size in Türkiye is 25, it can be said that guitar teaching will be quite difficult. In addition, due to the inadequacy of music classrooms and the structure of school desks, it is very difficult for children to provide the correct holding and sitting position. Although the guitar is not an expensive instrument compared to the piano, it is an instrument that parents will find difficult to buy in Türkiye, where more than half of the population lives below the poverty line.

The kalimba is a cheaper instrument when compared to the guitar. Due to its small size, it requires less physical strength compared to the guitar. Since it is a polyphonic instrument, it can be thought that it will be effective in the development of children's auditory skills. Another advantage of Kalimba is that it is easier to learn than the guitar. The fact that it can be played in any environment and has a beautiful voice shows that Kalimba can be effective in socializing children through music. In this respect, the Kalimba can be recommended as an alternative instrument to achieve teaching goals compared to the guitar.

Melodica has been an instrument preferred by music teachers in recent years due to its affordability, easy portability and polyphony. The fact that the melodica is a wind instrument makes it impossible for students to perform the act of playing and singing individually at the same time. The tonality restriction of the melody is another obstacle to the creativity of the students. Since the kalimba is an instrument that students can use as solo and accompaniment, it can be considered as an alternative instrument to melodica. In this context (Karataş & Kılıç, 2017), they suggested that the achievements of music education should be determined according to the level of students, and that instruments other than the soprano recorder and melodica should be used.

Conclusion

Social media has become one of the biggest communication and interaction tools of the 21st century. The fact that 7.83 billion people live and 4.20 billion of these people use social media shows how widespread social media is. The typical social media user in the world now spends 2 hours and 25 minutes on social media every day, which corresponds to approximately one waking day of their life each week. Social media usage in Türkiye is above the world average and is 2 hours 57 minutes per day (Kemp, 2021). In the 21st century, where social media is at the

center of life, traditional teaching methods are losing their functionality with each passing day. Against the colorful world of social media, it is not possible for trainers to convey information to students with traditional learning methods such as only narration and demonstration methods. The same is true in music education. It is very difficult for music teachers to realize their musical tastes and music education goals and objectives with only listening, singing and playing actions. In this respect, music teachers need to create music education programs by determining methods and strategies suitable for current educational understandings. Despite the negative view towards popular music in the world and in Türkiye (Aksoy, 2020), the use of popular music as one of the educational tools by music educators will create a difference in their universal perspectives as well as motivating students. (Khoury, 2017). Most importantly, students' playing and recognizing different musical instruments will increase their interest in music (Brabson, 1990). Knowing the instruments in different cultures in music teaching departments and playing the instruments that can be used as school instruments will enable prospective teachers to be more beneficial to students in their future professional lives (Tait, 1972). The Kalimba instrument, which takes place more and more on social media and video playback sites, has become an interesting instrument especially for children and young people. Including Kalimba in teaching materials by music teachers will contribute to the realization of the goals and objectives of the curriculum as well as improving the musical tastes of the students.

The weight of the bags that children carry has been a matter of debate for many years in Türkiye. Demir & Çırak (2012) stated in their research that children have lower back pain due to the weight of their school bags, which can lead to serious back and spine diseases in later ages. Along with this problem, having children also carry instruments will increase the existing problem. In this case, the fact that the Kalimba is light and small enough to fit in a bag makes it advantageous compared to other instruments.

It is seen that children who play instruments have pain especially in the back, waist and arm regions due to playing the instrument, and girls are affected more than boys (Ranelli & Smith, 2011). Kalimba's ease of playing, usability as an accompaniment instrument and learning in a short time will greatly reduce the physical problems that children may encounter while playing the instrument, and this will ensure that children receive more enjoyable education. Azim (1999) stated that it is difficult for western students to learn to play improvised Kalimba according to Shona culture, but playing Kalimba arouses considerable excitement and interest in them.

Although the number of primary schools in Türkiye is increasing, there is no significant decrease in the number of students per class. In 1997-1998, the number of students per class was 26.5. Despite the increase in the

schooling rate, this rate was 24.5 students in 2015-2016 (Turkish Statistical Institute [TUIK], 2017). However, music lessons being 40 minutes a week, inadequacy of music classes, lack of lesson tools and equipment are some of the obstacles in reaching the desired goals and objectives of music education (Toraman, 2013). Kalimba (Jones, 2008), which was designed and started to be used as a school instrument in Zambia, Mozambique and Zimbabwe by local music educators in the last century, will play an active role in reaching the goals and objectives of the music lesson.

Kalimba; It is concluded that it is an alternative instrument to the existing instruments in terms of being easily accessible, affordable, easy to play, having a short learning period and being small in size. In this regard, it is suggested that Kalimba be included in the dimension of music education in all levels of general music education, in institutions providing amateur music education, in preschool teaching, classroom teaching and music teaching programs.

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