RESEARCH HIGHLIGHTS IN EDUCATION AND SCIENCE 2020

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SECTION 1
TEACHING AND LEARNING

The Impact of Vygotsky's Theoretical Framework on the Role of Mediation for Students with Learning Disabilities

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Introduction

In the past three decades there has been a growing interest of research on the effect of mediation on the cognitive development and social skills of students with various learning abilities (e.g., Byrnes, Miller-Cotto & Wang, 2018; Englert & Mariage, 2003; García & Fidalgo, 2008; Guk & Kellogg, 2007; Maheady, Harper & Mallette, 2000; Radziszewska & Rogoff, 1991; Palincsar, 1986; Palincsar & Brown, 1984; Tzuriel, 2013) and diverse students' populations, including English language learners (e.g., Hajizadeh & Ahmadi, 2013; Richardson, 2010; McCafferty, 2002; McMaster, Kung, Han & Cao, 2008; Mustafa, 2012; Mustafa, Alias, Isa, Mat & Abdullah; 2019; Nassaji & Cumming, 2000; Pathan, Memon, Memon, Khoso & Bux, 2018). Most specifically, students with learning disabilities have been emphasized by various studies to promote their reading comprehension and social skills (e.g., Daneshfar & Moharami 2018; Hendrym 2009; Maheady, 2000; McMaster et al., 2007; Mastropieri et al., 2001).

The concept of 'mediation' and its relation to the cognitive development of learners, was thoroughly discussed by Lev Vygotsky in the early twentieth century (Gindis, 1999; Haywood, 2020; Kozullin, 2003; Taber, 2020; Wells, 1994; Wertsch, 2007). Vygotsky, in his original publication in the early 1930s, examined this relation within a sociocultural context. One of the main features about the sociocultural model is the assumption about the nature of the context of learning (Englert & Mariage, 2003). Human psychological processes, as conceived by sociocultural model, are joint-mediated activities, and thus, are social in origin (Englert & Mariage, 2003). Sociocultural theorists place a strong emphasis on the active position of the learner, which is crucial for the development of life-long learning skills (Kozulin, Gindis, Ageyev & Miller, 2003; Verenikina, 2008). As Wertsch (2007) argues, mediation is a central theme throughout Vygotsky's writing:

In his view, a hallmark of human consciousness is that it is associated with the use of tools, especially "psychological tools" or "signs." Instead of acting in a direct, unmediated way in the social and physical world, our contact with the world is indirect or mediated by signs. This means that understanding the emergence and the definition of higher mental processes must be grounded in the notion of mediation. (p. 178).

Mediation refers to human's intentionally insert items between their environment and themselves, so that they are able to modify it and gain specific understanding (Vygotsky,

1978). Mediation is the key advocator of Vygotsky's theory of constructivism (Kozullin, 2003). His theory offers a corresponding viewpoint to the behaviorist view. Vygotsky's theory of constructivism supports that the use of mediators who help the human to modify their environment, for a better interaction with the nature.

Students and followers of Vygotsky have expanded his original concepts of psychological tools, such as mediation, and divided the term into two distinguished faces of mediation, one human and the other is symbolic (Kozullin, 2003). The first type is human in which mediation is defined by Vygotsky (1978) through the notion that every human's act appears twice, once through the involvement with their surrounding, while the second time it develops internally as a type of psychological functions. Kozullin (2003) explains that much of the evidence on such transitions from external environment to internal awareness, which mainly brought upon the child's attention through an adult, was observed in a mother-child interaction in empirical conditions.

In the experiment that examines the interactions between a mother and her two and a half year old daughter during a child play with a puzzle, the researchers observed how the child mastered the skill in a gradual process starting from an external type of mediation and ended with an internal symbolic mediation. At the beginning, according to Kozullin (2003), the child would ask the mother where each piece of the puzzle should fit. The mother, then, would direct the child to the puzzle model using verbal cues, until she succeeds in assembling the puzzle. In a later stage, the child would refer to the model using similar verbal cues, signaling his or her ability to internalize the process that was initiated throughout the interaction with the mother in the first trial. Thus, according to Kozullin (2003), the model explained here aims to demonstrate how children can transfer their experience in a two-processed step from an 'interpersonal' where the human adult is the mediator, to an 'intrapersonal' learner, where the lead is being performed internally by the internalized processes of the child him or herself.

The second type of mediations is the symbolic mediators (Murphy, 2012). Vygotsky (1978) distinguished between experiences created as a result of direct contact with the environment and experiences produced by symbolic tools. Such symbolic tools are illustrated by Vygotsky (1978) as "casting lots, tying knots, and counting fingers" (p. 127). Counting fingers, as explained by Vygotsky serves as "a bridge between immediate quantitative perception and counting" (p. 127). The child would use the fingers of his left to count, then, when that proves insufficient, the child would continue counting the forearm, elbow, and the other hand's fingers until he completes the problem. This act of counting fingers demonstrates how an object, e.g. fingers, can serve as an external symbolic tool that organizes cognitive functions involved in basic operations (Vygotsky, 1978). Kozullin (2003) contends that one cannot expect that the child would be able to detect symbolic relations on his own. Therefore, they need an expert adult or a trained

partner to coach them. Further, symbols, according to Kozullin (2003) will remain "useless unless their meaning as cognitive tools is properly mediated to the child" (p. 24).

The Emergence of the 'Zone of Proximal Development' (ZPD)

Vygotsky (1978) argued that higher mental functions originate in shared problem solving between children and more skilled partners (Englert & Mariage, 2003; Gauvain & Perez, 2015; Gindis, 1999; Moss, 2013; Rassaei, 2017; Vygotskiĭ, 2012). Vygotsky (1978) referred to such processes that allows for maturation in the child's cognitive functioning as the zone of proximal development (ZPD). ZPD is defined as "the distance between a child's actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under guidance or in collaboration with more capable peers." (Vygotsky, 1978, p. 86).

Vygotsky (1978) explained how the ZPD is being constructed and internalized at the learner's level. The zone of proximal development "defines those functions that have not yet matured but are in the process of maturation; functions that will mature tomorrow, but are currently in embryonic state. These functions could be termed the 'buds' or 'flowers' of development rather than the fruits of development" (p. 86). Vygotsky (1978) suggested that "what is in the zone of proximal development today will be the actual developmental level tomorrow-that is, what children can do with assistance today they will be able to do by themselves tomorrow" (p. 87).

McCafferty (2002) and Moss (2013) explain that the ZPD is a function of co-construction in which assumes that when learners construct meaning, they share their social, psychological, and physical world. Thus, according to Wells (1999), the ZPD is not fixed; rather it is an emergent, "open-ended," "reciprocal" trait of a learner. McCaffery (2002) and Palincsar (1998) argue that the ZPD includes not only people interacting with each other but it can also refer to the setting and artifacts that are used throughout the learning process (e.g., books, technology, and various library and community resources), and that ZPDs are embedded in activities and contexts.

The Emergence of the Concept 'Scaffolding'

In the past three decades researchers used Vygotsky's ZPD concept as a springboard for various interpretations of learning and teaching including 'scaffolding', 'co-construction', and 'assisted performance' (Houng, 2007). The concept 'scaffolding', in particular, has been widely used by educators and researchers to support the learning of students in all discipline areas including reading and comprehension (e.g., Ankrum, Genest & Belcastro, 2014; Dabarera, Renandya & Zhang, 2014; Beed & Hawkins, 1991; Simon, 2008), social studies (e.g., Brophy, Alleman & Halvorsen, 2016; Beyer, 2008;

Vacca, 2008), sciences (Abels, 2015) and mathematics (e.g., Anghileri, 2006; Bakker & Smit, 2017; Fund, 2007). The scaffolding concept has become even more popular among researchers of English Language Learners struggling with reading (e.g., Proctor, Dalton & Grisham, 2007; Walqui, 2017) and was applied heavily in research that address students with learning disabilities, especially in the reading comprehension area (e.g., Broza & Kolikant, 2015; Calhoon, 2005; Clark & Graves, 2005; Palincsar, 1986, 1998; Palincsar & Brown, 1984).

The term scaffolding was originally used by Wood, Bruner and Ross (1976). Stone (1998) in agreement with Houng (2007) believes that these authors, especially Bruner, were influenced by the work of Vygotsky and the use of the concept "ZPD". Bruner, according to Stone (1998), was the author who wrote the introduction of the first translated edition of Vygotsky's book 'Mind in Society' in 1962. Thus, a closer look at the definition of scaffolding and the way it was explained by Wood and colleagues would shed light on the relationship between 'scaffolding' and "ZPD".

Nassaji and Swain (2000) define scaffolding as "the collaboration of both the learner and the expert operating within the learner's ZPD" (p. 36). Wood and colleagues (1976) define scaffolding as "that enables a child or novice to solve a problem, carry out a task or achieve a goal which would be beyond his unassisted efforts" (p. 90). Wood et al. (1976) describe the process as involving the adult's "controlling those elements of the task that are initially beyond the learner's capacity, thus permitting him to concentrate upon and complete only those elements that are within his range of competence" (p. 90). Stone (1998) elaborates on this definition and explains that children's new understanding of how to attain their goal is accomplished through continuous interaction where the adult provides careful and gradual assistance to the child to maximize the learner's competence in solving this shared problem. According to Daniels (2001) and Wells (1999), scaffolding as a metaphor term is in the heart of the zone of proximal development (ZPD) as proposed by sociocultural framework of Vygotsky.

Wood et al., (1976) describes the scaffolding process as having six crucial roles for the tutor, or more capable peer. These roles include: (a) recruitment, in which the tutor enlist the learner's interest in any given task and adhere to the requirement of the assignment, (b) reduction in degrees of freedom which means that the teacher or trained adult would reduce the steps and requirements of the required task so it would be easily followed and mastered by the child, (c) direction maintenance which requires varying goals that emerge from the learner throughout the task, (d) making critical features in which the tutor selects relevant assignments that would be of value and interest for the learner, (e) reducing frustration throughout the task so that it would not yield dependency on the tutor, and (f) allow for demonstration where the tutor models different types of solutions, which will provide the learners with opportunities for imitations until the task is mastered.

Van Lier (1996) adds that in a scaffolding learning environment, the tasks are continuously repeated with variations and are connected to one another like parts of projects. Further, in scaffolding mode, the teacher encourages students to explore knowledge in a safe, supportive environment and promotes access to means and goals in a variety of ways. Furthermore, it allows for mutual engagement and establishing rapport among students in a nonthreatening participation in a shared community of practice. Finally, Van Lier (1996) contends that in a scaffolding learning, students are increasingly taking over roles which ultimately enhance their self-esteem and empower them. Wells (1999) identifies three essential features that provide the educational scaffolding its unique character: a) the essential dialogical nature of the discourse in which knowledge is co-constructed; b) the significance of the kind of activity in which knowing is embedded; and c) the role of artifacts that mediate knowing (Wells 1999, p.127).

Due to its pervasive use among educators, according to some critiques, the "scaffolding" metaphor has been misused by researchers in the field (see e.g., Palincsar, 1998; Stone, 1998; Verenikina, 2008). Verenikina (2008) argues that the term 'scaffolding' appears to become an umbrella term for any kind of teacher support, due to its diverse interpretations, and thus, it does not provide educators with clear and definite guidelines on the exact methods that it should be applied to attain successful teaching. Verenikina (2008) adds that scaffolding tends to be interpreted as a variation of direct instruction, of a teacher-student one way teaching. As a result, "it loses the richness of the original meaning implied by socio-cultural theories and invalidates Vygotskian idea of teaching as co-construction of knowledge within student-centered activities" p. 162.

Stone (1998), in agreement with Verenikina (2008), argues that the use of the metaphor "scaffolding" has been used increasingly among educators in the field of learning disabilities as an instructional innovation. Stone (1998) contends that this metaphor has become popular among educators due to its appealing connotations, especially, because it appeared to provide temporary assistance to children as they strive to accomplish a task beyond their capability. In this approach, adults are perceived as providing a scaffold similar to that used by builders in erecting a building; and this metaphor seems very appealing to many educators and researchers. Further, the scaffold metaphor connotes a custom-made support for the "construction" of new skills, which can be gradually removed as the learners become more acquainted with the necessary skills. Furthermore, scaffold, according to Stone (1998), connotes a structure that allows for the accomplishment of some goals that would be difficult to attain otherwise.

Verenikina (2008) compared the metaphor 'scaffolding' to the original views of Vygotsky on the role of teachers within the "ZPD". Verenikina (2008) argues that Vygotsky viewed children and adults as both active agents between the learner and the mediator, which are dialogical in nature, become vital to the learning development. The metaphor

'scaffolding' in this case, as perceived by Verenikina (2008), doesn't capture the two-way interaction between the teacher and a student. Instead, it implies a one-sided view of this engagement where a teacher provides a support for the learner. This view is being perceived by researchers as a modified version of direct instruction ().

The Impact of Mediation on Students' Academic and Social Competence

Researchers have implemented the concepts 'mediation' and 'scaffolding' interchangeably within the ZPD, based on the sociocultural theory. in order respond to the needs of increasingly challenging classrooms with learners of various abilities, especially, with students with learning disabilities. As previously discussed, the concepts 'mediation' and 'scaffolding' within a ZPD were widely used to enhance the learning and social competences of students across various age and ability groups within the school system. Two areas, in particular were the focus of the research, the learning achievement in the core subject areas and the social competence of students. In the following section, I will discuss the use of such framework within the area of reading comprehension and social skills by providing examples from the field on how these approaches affect the learning and social competence of students with learning disabilities (LD).

Guk and Kellogg (2007) argue that the research cannot avoid the interaction between the teacher and students and students among each other, especially when encountering with a whole class instruction with students of various learning abilities. Vygotsky himself, according to Guk and Kellogg (2007), when working with children taught a whole class of learners in public education system. According to Houng (2007) the sociocultural theory developed by Vygotsky and his colleagues proposes that human thoughts arise in social interactions. Thus, a learning community in a classroom would make the natural interaction of all learners, particularly in the form of peer interactions in small groups and dyads.

Since the mid 1980's and early 1990s, among many other approaches, two main frameworks emerged from a social learning theory that emphasized a learning community in the form of classwide peer mediated learning strategies for reading comprehension (for reviews see e.g., Liang & Dole, 2006; Maheady, Mallette & Harper, 2006). The use of reciprocal teaching (RT) developed by Palincsar and Brown (1984), and the George Peabody College Peer-Assisted Learning Strategies (PALS) model developed by Fuchs et al., (1991), in particular, have been proven as promising approaches for students with LD in the area of reading comprehension (Maheady et al., 2006). In the next section, I will briefly describe each model separately and compare between the two models in relation to the use of mediation as perceived by Vygotsky's concept ZPD.

Peer-Assisted Learning Strategies (PALS)

PALS is a classwide peer learning strategies framework, whereby children work together with the monitoring of an expert teacher to support each other's learning (Dion, Fuchs & Fuchs, 2005). Since it was originally developed and implemented in grades 2-6 in the early 1990s by Fuchs, Fuchs, Philips, Hamlett, and Karns (cited in D. Fuchs et al., 2001), PALS framework has received a growing interest among researchers who investigated its impact on students' performance at all grade levels, including at the kindergarten and first grade levels (e.g., Mathes, Grek, Howard, Babyak & Allen, 1999; Mathes, Howard, Allen & D. Fuchs, 1998), and at the middle and high school grade-levels (e.g., Mastropieri, Scruggs & Graetz, 2003; Mastropieri, Scruggs, Mohler, Beranek, Spencer, Boon, Talbott, 2001). Further, PALS was extended to assess the learning of racially, linguistically and diverse ability students (Thorius & Santamaría Graff, 2018); and finally PALS was examined for its impact on students' social preference and friendship making (see Dion, Fuchs & Fuchs, 2005). Although, not all PALS applications yielded statistically significant results with all students (McMaster, Fuchs & Fuchs, 2007), the overall picture demonstrates its success among different subgroups of students, particularly, for students with LD (e.g., Calhoon, 2005; Fuchs, Fuchs, Mathes & Martinez, 2002).

The purpose of PALS is to support the capacity of the general education to meet the academic standards for all students, including students with disabilities (D. Fuchs, L. Fuchs & Burish, 2000). Most specifically, PALS reading was designed to develop students' reading fluency and comprehension (Fuchs & Fuchs, 2005). The original ideas of PALS were derived from the novice work of Palincsar and Brown (1984) on Reciprocal Teaching, and the Cooperative Integrated Reading and Comprehension (CIRC) which was developed in the 1980s (D. Fuchs et al., 2001). The recent studies on the reading comprehension instruction for students with disabilities indicate that appropriate grouping practice, specific cognitive strategy instruction, extended practice opportunities, and breaking down tasks into smaller components, are related to significant improvement in reading and comprehension skills (Calhoon, 2005). PALS framework engages students in all these components (Fuchs & Fuchs, 2005). PALS focuses on teaching a set of comprehension strategies that assist students to comprehend a variety of narrative and informative texts (Liang & Dole, 2006).

PALS framework incorporates structured activities that allow for continuous mediated interactions between peers who alternate in tutoring and tutee role exchanges, and immediate corrective feedback. Thus, students in PALS, contrast with traditional teacher-led instruction that reduces the practice time opportunities, stay engaged at almost all allocated time for the session. Fuchs and colleagues (2002) add that PALS structure one-to-one interaction allows for (1) frequent opportunities for students to respond, (2) facilitating immediate partner's feedback, (3) increasing academic engagement time,

(4) students' social engagement and support. PALS is set to be structured, according to Fuchs and colleagues (2000), because it has been scientifically proven that a lack of structured peer interaction activities would lead to ineffective results, and that the immediate feedback and reciprocity in role taking would significantly enhance learning.

PALS activities require considerable direct support from teachers' supervision and involvement throughout the entire process. The teacher moderates the learning of the strategies, and continuously prompts students to accurately apply the strategies, and provides feedback and rewards on the correct tutoring and team collaborative behavior (Liang & Dole, 2006). In spite of high teacher involvement, PALS provides more frequent opportunities for student's time spent on task, as opposed to traditional teaching methods which lead to a remarkable loss of valuable instruction time (McMaster et al., 2007). Students in PALS, according to McMaster and colleagues (2007), are engaged most of the time with numerous opportunities for responses through verbal interactions between the partners. Partners' are continuously engaged in providing immediate corrective feedback to one another's performance. Such high interaction among students contends McMaster and colleagues (2007) ensures higher rates of academic success.

Maheady and colleagues (2006) compared four classwide peer tutoring models that are scientifically based interventions, in the area of reading and reading comprehension, for their effectiveness in preventing the reading failure of struggling students who come from various backgrounds, such as students with learning disabilities, English Language Learners, and students who come from a low socioeconomic background. The programs include, PALS, ClassWide Peer Tutoring (CWPT), START, and Classwide Student Tutoring Teams (CSTT). The researchers report that PALS is one of the most extensive classwide peer assisted intervention to support the reading comprehension of diverse ability students (Maheady et al, 2006). PALS is being described as tutoring model program in that it is the only program in which high functioning readers go first in all tasks, which provides an opportunity for a modeling role for the low performing readers; that the pairs utilize materials that are instructionally appropriate for the lower performing students.

Because students with reading disabilities lack the ability to monitor their own work (Calhoon, 2005; Greenway, 2002), and they need sometimes guidance on how to provide constructive feedback, praise, and encouragement; hence, the teacher must provide them with cueing cards for such specific task (Ramsey et al., 2007). Such cueing cards, according to Ramsey and colleagues (2007) are helpful during PALS sessions and should be practiced prior to engaging in the activity. In addition, teacher's encouragement to those who use such cuing correctly is essential for the success of such implementation, as well. Once the partners are in their respective dyads, the higher functioning partner models his or her role in the task, such as, reading aloud in front of the lower functioning

partner; then, the second partner takes a turn and models the reading, through which both partners in the dyad are fully engaged in providing constructive feedback on each other's reading (Ramsey et al., 2007). The dyads reciprocally continue to play the role of tutor and tutee, as needed. Once the procedures are mastered by the students and become more familiar among all class members, the teacher, later, switches between the partners in the dyads so that students receive fair chances of enriching and being enriched by other partners in the class.

Reciprocal Teaching

Reciprocal Teaching (RT) was originated and described in the 1980s by the novice work of Palincsar and Brown (1984) with middle school struggling students in English literacy classrooms. Shortly, after its wide success, RT has became highly popular and was recommended by a remarkable body of research (see e.g. Greenway, 2002; Hashey & Connors, 2003; Kelly, Moore, Tuck, 1994; van Garderen, 2004) who reported on impressive gains across all grade levels and students with various needs, including students with LD (Lederer, 2000) and English language learners (Klinger & Vaughn, 1996; Proctor et al., 2007). Many studies have demonstrated the effectiveness of RT strategy on the reading comprehension level of students with various abilities, particularly students with LD at various grade levels (see e.g., Brown & Palincsar, 1982; Klinger & Vaughn, 1996; Lederer, 2000; Palincsar, 1986; Palincsar & Brown, 1984).

Palincsar and Brown (1984) describe RT as an instructional strategy that aims to enhance students' reading comprehension. The process is best characterized as a dialogue between teacher and students (Slater & Hortsman, 2002). Thus, the term "reciprocal" describes the nature of the interactions among the learners and the teacher. This dialogue is structured by the use of four strategies: predicting, questioning, clarifying, and summarizing (Palincsar & Brown, 1984). These strategies, according to Palincsar and Brown (1984), can be conducted, flexibly, in any order. Palincsar and Brown (1984) explain that the rationale behind choosing these four strategies, in particular, because they provide for reciprocal interaction that can be both comprehension-fostering and comprehension- monitoring activities. By engaging students in the process of predicting the content and events of passage, briefly stating the main ideas, generating questions related to the passage, and by clarify the various new concepts, students will be actively involved in the so called "self-monitoring" strategy. Consequently, by engaging in these activities, the readers will become more aware of their reading process (Palincsar & Brown, 1984).

The main premise of RT as described by Palincsar and Brown (1984) and their extended articles (Palincsar, 1986; Brown & Palincsar, 1989; Palincsar, & Klenk, 1992) is to help poor readers become good readers, by teaching them strategies that work for good

readers when encounter new reading tasks. Students would be encouraged to look for meaning in the text, at both levels the sentence and the passage. In addition, the purpose behind teaching RT strategy is to demonstrate how poor readers can benefit from self monitoring strategies through a set of procedures that can be implemented at any order (Palincsar & Brown, 1984; Slater & Hortsman, 2002).

Greenway (2002) asserts that RT makes explicit metacognition strategies by emphasizing on student's understanding of the main idea, by asking students about their understanding of the passage which will ultimately assess them in monitoring their own comprehension strategy, by connecting their previous knowledge to the one that is being read, and finally by prompting them to summarize their information into meaningful memorable segments. RT, as described by Palincsar and Brown (1992), is implemented gradually beginning with guided practice. Further, it includes other components, such as instructional concepts of expert modeling 'the teacher', expert support as the students emerge to implement the strategy, students support and guide each other, and gradually the support will be faded as the students demonstrate competence in their skills (Palincsar & Brown, 1992).

Greenway (2002) noted that RT is not the only reading comprehension intervention that was implemented with students with various needs. Other reading programs were used as well and provide valuable improvement, such as, Inference Training (IT), and the Correction Reading (CR). RT, however, was the only program of the three to invite the student to take over the teacher's role, which is by itself a powerful strategy that allows for student's self-monitoring and would increase his or her self-esteem (Greenway, 2002).

Over the past two decades, RT has been used in various learning content areas including, science, mathematics, and social studies, and with almost all ages, including kindergarten and at the college level. Rosenshine and Meister (1994) reported in their meta-analysis of the 16 empirical studies that were implemented between the years 1984 and 1994, on positive gains with an average effect size of .88 across all studies under investigation (cited in Proctor et al., 2007). Later the National Reading Panel (2000) reported on additional 11 studies that were not listed in the Rosenshine and Meister report with positive gains. The following three studies are only a few of the many examples that illustrate the various gain effects on students learning and social outcomes.

The first study was reported by Greenway (2002). The researcher investigated the application of RT in a literacy based 6th grade classroom in an inner city school in Britain. The purpose of the study was to improve the achievement scores of students in reading comprehension on standardized assessment test. The students had average decoding skills but performed poorly in reading comprehension. The researcher used a quasi-experiment intervention for a full year with one classroom after a long introduction

and guided practice was given to the teacher who taught the children. The strategy implemented was guided by the main four strategies used by Palincsar and Brown (1984) and was called SPIQ, which stood for summarize finding the main idea, predict what will happen next, investigate unknown word, and question or interrogate the text. The results as reported by Greenway (2002) show increased level of reading comprehension significantly from 6.08 comprehension age at pre-test to 7.75 comprehension age at post-test time. In addition the researcher reports on an improvement in the self-esteem rate based on students' self-reporting.

The second study was conducted by van Garderen (2004). The author reported on a modified reciprocal teaching strategy which was implemented in mathematic lessons with students who experience difficulties in word problems solving, and who spoke English as a second language, at the middle school levels. According to van Garderen (2004), mathematic textbooks depend heavily on increasing number of abstract concepts and solving word problems that students have to process in order to comprehend the content. The teacher in a mathematic reciprocal teaching lesson, based on the original four components strategy of Palincsar and Brown (1984), would divide the whole class into small groups, and a group-leader would be assigned for each group. The modified strategy includes the following components: (a) clarifying, (b) questioning, (c) summarizing, and (d) planning. The leader would instruct the group members to silently read the problem, and ask for *clarification* about any new term or phrase that they encounter. Any group member then would provide the meaning for the new phrase. After all new concepts are cleared and discussed the group leader would pose *questions* for understanding the problem by analyzing its parts. Next, the leader would *summarize* all the possible answers and guide the members through a *plan* to solve the problem. Finally, students would attempt to solve the problem and check whether it makes sense before they submit their answers (van Garderen, 2004).

Finally, Klingner and Vaughn (1996) investigated the efficacy of a modified RT as an instructional intervention for reading comprehension with 26 seventh and eighth grade level students with LD and who use English as a second language. Klingner and Vaughn modified traditional reciprocal teaching as described in Palincsar and Brown (1984) by including a strategy to activate prior knowledge. This strategy benefits ELL students with LD because students have the opportunity to dialogue, express their ideas, and collaborate with each other. By adding the activation of prior knowledge to RT, the researchers helped the students to connect what they already know to the new concepts which facilitated and impacted their learning and comprehension. Although the results were statistically insignificant, the Klingner and Vaughn report that there was an impressive increase in the reading comprehension abilities of the students who participated in the study compared to the comparison group, and that both groups would

benefit from minimum adult instruction when the strategy is explicitly explained and modeled to all students prior to the intervention.

It can be concluded from the aforementioned studies on RT that these strategies embrace the reciprocal roles of learners among each other, and teachers and students role exchange. Students who are engaged in this process tend to constantly monitor their role sharing, and therefore, they become aware of their reading process. Further, it can be assumed that students, when engaged in the RT strategies become socially more involved with each other. Consequently, students gain academic and social skills in a supportive responsive learning environment.

The Impact of Mediation on the Social Competence of Students with LD

Another dimension that can be directly connected to the sociocultural learning domains inspired by Vygotsky's framework is the impact of the collaborative work that characterizes the type of learning on students' social skills (Palincsar & Herrenkohl, 2002). Social competence of students at risk for school failure has been regarded by researchers as a crucial component for school success including academic achievement (e.g., Gresham, Sugai & Horner, 2001; Peterson Nelson, Caldarella, Youong & Webb, 2008). Peterson Nelson and colleagues (2008) define social competence as "the ability to interact successfully with peers and significant adults" p. 6. It is associated with peers acceptance, teacher acceptance, positive relationship between the children, and academic success (Peterson Nelson et al., 2008). Social competence becomes very critical for students with disabilities as they progress throughout the upper grades of their schooling years (Gresham & MacMillan, 1997).

Researchers address the issue of social competence of students with learning disabilities within a reciprocal constructivist and collaborative work among classmates on equal grounds within their own dyads or in small groups (Palincsar & Brown, 1984; Palincsar & Herrenkohl, 2002). In a reciprocal constructivist approach, the teacher assumes less authority in the classroom and hands on the power gradually to students who become active learners and cooperative participants. (needs transition to next paragraph)

Palincsar and Herrenkohl (2002) argue that in a sociocultural framework, students are encouraged to collaborately work together to create a meaningful experience for the learners. Given the complexities inherent in collaborative learning, Palincsar and Herrenkohl (2002) list three main features related to the instructional environment to which one could attend: (a) the support of interactive patterns. In order to promote collaboration between the learners a common ground on which to build shared understanding must be established. In such case the learning environment would allow for interactive patterns among students and their peers on a common goal, e.g., shared understanding of a text; (b) the nature of the problem space, which can affect the activity

of constructing meaning and promoting opportunities for attaining consensus; and (c) the process of creating a shared social context. In this process, Palincsar and Herrenkohl (2002) argue that through engaging in collaborative creating, the learners create a shared social world together.

Harper and Maheady (2007) argue that Peer-mediated instructional approaches, if implemented properly, allow for students' active engagement, permit frequent opportunities to respond one to another, immediate error correction and feedback on the correctness of responses and, consequently, motivate students learning.

A Comparison between PALS and RT

Although both models, PALS and RT, were developed based on sociocultural theory or other models that depart from a sociocultural framework, these two approaches, however, do not fully share the same understanding of the term' mediation' within the ZPD, as fully explained by Vygotsky (1978). When Vygotsky referred to the child's zone of proximal development, he meant cognitive development which occurs in an evolving process (Radziszewska & Rogoff 1991; Wells, 1999). The child is encounter with other challenging concepts and experiences that will lead to his or her understanding in a joint process, where both the child and the 'expert other' craft together a new understanding of the shared experience (Palincsar, 1998). Further, the notion 'mediation' as previously explained involves two phases, one is through human interaction, the other phase develops internally, as the child's understanding matures (Kozullin, 2003). This means that, in order for a cognitive development to happen, the child needs the 'expert other', at least at the beginning, to mediate the process of learning. The expert other based on the research, is either an older trained partner in a cross age tutoring condition, or as mostly the case, is the teacher or an expert adult (Englert & Mariage, 2003; Gindis, 1999; Kozullin, 2003).

In PALS, for example, the idea being explained is that a child masters specific skills, such as oral reading and asking questions (Fuchs & Fuchs, 205). Thus, such behavior does not necessarily explain how the child is cognitively developing. When children engaged in PALS, the students are given pre-prepared roles by the expert adult, the teacher, instructing them how to react and work on the tasks, e.g., the more advanced reader reads first for five minutes, followed by the second reader for five more minutes (Maheady et al., 2006; Ramsey et al., 2007). These roles are, mostly, written on cueing cards that are placed on students' tables. The more advanced tutor reads the instruction and prompts his or her less advanced partner to proceed with the various parts of the activities. Therefore, due to its high structure, PALS offer limited choices for students on how to engage in the assigned activities. In such cases, students are trained to be task oriented at all times. The role of the expert teacher is to monitor the role exchanges

and the application of the activities, and thus, the teacher becomes less engaged in a real dialogue with the students. Such process may hinder their creativity and limit their interaction. Consequently, this limits students' cognitive development.

In RT, on the other hand, the process of learning, although seems structured around the four basic strategies, it involves, however, multiple interactions between the teacher and students. Students are involved in a structured, yet flexible enough process that allows for an open dialogue between the teacher and his or her students. The teacher is constantly mediating the process by posing questions, reflecting on the different parts of the passage that is being read. Students, while engaged in the prediction activity are encouraged by the teacher to think about their own experience and share their lived experiences. They are encouraged to share their prediction with their peers, constructively refine their work, and represent the new information to the whole class. RT has more merit, compared to PALS, in creating a dialogical learning environment, where students and the teacher work together to construct new understanding. Students, in RT model, can see the change in their thinking and, thus, in their product. They become more aware of their learning process as constructive learners.

In conclusion, the concept 'mediation' as explained by Vygotsky (1978) has a deeper meaning than just a meeting between peers or a top-down traditional instructional delivery, where teachers direct their students, step by step, on how to acquire knowledge. In a cognitive learning process, an 'expert other', carefully and purposefully mediates the learning collaboratively with the learners. Students are in charge of their learning and can take a major role in constructing their knowledge. Two models were explained and compared with each other in this article, PALS and RT. Although, both models share several important elements, such as, peers interactions, students' work together to construct knowledge, and a various teacher's roles, both models, however different in teacher's defined role and the level of involvement. In PALS, the teacher is setting the roles and the process, and thus, controls the interaction at all times. RT, on the other hand, has more flexibility and allows for an authentic dialogue between students and the teacher, which makes it closer to the intended mediation concept defined by Vygotsky.

References

Abels, S. (2015). Scaffolding inquiry-based science and chemistry education in inclusive classrooms. *New developments in science education research*, 77-96.

Anghileri, J. (2006). Scaffolding practices that enhance mathematics learning. *Journal of Mathematics Teacher Education, 9*(1), 33-52.

Ankrum, J. W., Genest, M. T., & Belcastro, E. G. (2014). The power of verbal scaffolding:"Showing" beginning readers how to use reading strategies. *Early*

Childhood Education Journal, 42(1), 39-47.

Bakker, A., & Smit, J. (2017). Theory development in design-based research: an example about scaffolding mathematical language. In Making Change Happen (pp. 111-126). Springer VS, Wiesbaden.

Beed, P. L., Hawkins, E. M. (1991). Moving learners toward independence: The power of scaffolded instruction. *Reading Teacher, 44*(9), 648- 655.

Beyer, B. K. (2008). How to teach thinking skills in social studies and history. *Social Studies*, 99(5), 196-201.

Brophy, J., Alleman, J., & Halvorsen, A. L. (2016). Powerful social studies for elementary students. Cengage Learning.

Broza, O., & Kolikant, Y. B. D. (2015). Contingent teaching to low-achieving students in mathematics: Challenges and potential for scaffolding meaningful learning. *ZDM, 47*(7), 1093-1105.

Brown, A., & Palincsar, A. (1989). Guided, cooperative learning and individual knowledge acquisition. In L. B. Resnick (Ed.), *Knowing, learning and instruction: Essays in honor of Robert Glaser* (pp. 393-451) . Hillsdale, NJ: Lawrence Erlbaum.

Byrnes, J. P., Miller-Cotto, D., & Wang, A. (2018). Children as mediators of their own cognitive development: the case of learning science in kindergarten and first grade. Journal of Cognition and Development, (just-accepted).

Calhoon, M. B. (2005). Effects of peer-mediated phonological skill and reading comprehension program on reading skill acquisition for middle school students with reading disabilities. *Journal of Learning disabilities, 38*(5), 424-433.

Chaiklin, S. (2003). The zone of proximal development in Vygotsky's analysis of learning and instruction. In A. Kozulin, B. Gindis, V. S. Ageyev & S. M. Miller (Eds), *Vygotsky's Educational Theory in Cultural Context* (pp. 15-38). Cambridge, UK: Cambridge University Press.

Clark, K. F. & Graves, M. F. (2005). Scaffolding students' comprehension of text. *Reading Teacher, 58*(6), 570-580.

Dabarera, C., Renandya, W. A., & Zhang, L. J. (2014). The impact of metacognitive scaffolding and monitoring on reading comprehension. System, 42, 462-473.

Dion, E., Fuchs, D. & Fuchs, L. S. (2005). Differential effects of peer-assisted learning strategies on students' social preference and friendship making. *Behavioral Disorders, 30*(4), 421-429.

Daneshfar, S., & Moharami, M. (2018). Dynamic assessment in Vygotsky's sociocultural theory: origins and main concepts. *Journal of Language Teaching and Research*, *9*(3), 600-607.

Daniels, H. (2001) *Vygotsky and Pedagogy*. NY: Routledge/Falmer.

Englert, C. S. & Mariage, T. (2003). The sociocultural model in special education interventions: Apprenticing students in higher-order thinking. In L. Swanson, K.R. Harris, S. Graham (Eds.), *Handbook of research on learning disabilities* (pp. 383-402). New York: Guilford.

Fuchs, D., & Fuchs, L.S. (2005). Peer-Assisted Learning Strategies: Promoting word recognition, fluency, and reading comprehension in young children. *The Journal of Special Education*, *39*(1), 34-44.

Fuchs, D., Fuchs, L. S., & Burish, P. (2000). Peer-Assisted Learning Strategies: An Evidence-Based Practice to Promote Reading Achievement. *Learning Disabilities Research and Practice, 15*(2), 85-91.

Fuchs, D., Fuchs, L. S., Mathes, P.G., & Martinez, E. (2002). Preliminary evidence on the social standing of students with learning disabilities in PALS and No-PALS classrooms. *Learning Disabilities Research and Practice, 17*(4), 205-215.

Fuchs, D., Fuchs, L. S., Thompson, A., Svenson, E., Yen, L., Al Otayba, S., Yang, N., McMaster, K. N., Prentice, K., Kazdan, S., & Saenz, L. (2001). Peer-assisted learning strategies in reading: extension for kindergarten, first grade, and high school. *Remedial and Special Education, 22*(1), 15-21.

Fund, Z. (2007). The effects of scaffolded computerized science problem-solving on achievement outcomes: a comparative study of support programs. *Journal of Computer Assisted Learning, 23*(5), 410-424.

García, J. N., & Fidalgo, R. (2008). Writing self-efficacy changes after cognitive strategy intervention in students with learning disabilities: The mediational role of gender in calibration. *The Spanish Journal of Psychology, 11*(2), 414-432.

Gauvain, M., & Perez, S. (2015). Cognitive development and culture. Handbook of child psychology and developmental science, 1-43.

Gindis, B. (1999). Vygotsky's Vision: Reshaping the Practice of Special Education for the 21st Century. *Remedial and Special Education, 20*(6), 32-64.

Greenway, C. (2002). The process, pitfalls and benefits of implementing a reciprocal teaching intervention to improve the reading comprehension of a group of year 6

pupils, *Educational Psychology in Practice, 18*(2), 113-135.

Gresham, F. M., MacMillan, D. L. (1997). Social competence and affective characteristics of students with mild disabilities. *Review of Educational Research, 67*, 377-415.

Gresham, F. M., Sugai, G., & Horner, R. H. (2001). Interpreting outcomes of social skills training of students with high incidence disabilities. *Exceptional Children, 67*, 331-344.

Guk & Kellogg (2007). The ZPD and whole class teaching: Teacher-led and student-led interactional mediation of tasks. *Language Teaching Research, 11*,(3)281–299.

Hajizadeh, R., & Ahmadi, A. R. (2013). New strategies and approaches of teaching dynamic assessment via using reading comprehension to ESL/EFL young university learners. *Psychology Research. 3*(6), 316-324.

Harper, G. F., & Maheady, L. (2007). Peer-mediated teaching and students with learning disabilities. *Intervention in School and Clinic, 43*(2), 101-107.

Hashey, J. M. & Connors, D. J. (2003). Learning from our journey: Reciprocal teaching action research. *The Reading Teacher, 57*(3), 224-232.

Haywood, H. C. (2020). Cognitive early education. In *Oxford Research Encyclopedia of Education*.

Hendry, H. J. (2009). Foreign language learning of students with language learning disabilities: An activity theory perspective of three middle school students. ProQuest, UMI Dissertations Publishing. Retrieved December 2013, from ProQuest, UMI Dissertations Publishing.

Houng, L. H. (2007). The more knowledgeable peer, target language use, and group participation. *The Canadian Modern Language Review/La Revue canadienne des langues vivantes*, 64(2), 329–350.

Kelly, M., Moore, D. D., & Tuck, B. F. (1994). Reciprocal teaching in a regular primary school classroom, *Journal of Educational Research, 88*(1), 53-59.

Klinger, J. K. & Vaughn, S. (1996). Reciprocal Teaching of Reading Comprehension Strategies for Students with Learning Disabilities Who Use English as a Second Language. *Elementary School Journal, 96*(3), 275-293.

Kozulin, A. (2003). Psychological tools and mediated learning. In A. Kozulin, B. Gindis, V. S. Ageyev & S. M. Miller (Eds), *Vygotsky's Educational Theory in Cultural Context* (pp. 15-38). Cambridge, UK: Cambridge University Press.

Kozulin, A., Gindis, B., Ageyev, V. S., & Miller, S. M. (Eds.). (2003). Vygotsky's educational theory in cultural context. Cambridge University Press.

Lederer, J. M. (2000). Reciprocal Teaching of Social Studies in inclusive Elementary Classrooms. *Journal of Leaning Disabilities, 33(1)*, 91-106.

Liang, L. A., & Dole, J. A. (2006). Help with teaching reading comprehension: Comprehension instructional frameworks. *The Reading Teacher, 59*(8), 747-753.

Maheady, L., Harper, G. E, & Mallette, B. (2000). Peer-mediated interventions and students with mild disabilities. *Remedial and Special Education, 22*(1), 12-55.

Maheady, L., Mallette, B., & Harper, G. F. (2006). Four classwide peer tutoring models: similarities, differences, and implications for research and practice. *Reading & Writing Quarterly, 22*(1), 65-89.

McCafferty, S. (2002). Gesture and creating zones of proximal development for second language learning. *The Modern Language Journal, 86*, 192-203.

McMaster, K. L., Fuchs, D. & Fuchs, L. S. (2007). Promises and limitations of peer-assisted learning strategies in reading. *Learning disabilities: a contemporary Journal, 5*(2), 97-112.

Mastropieri, M. A., Scruggs, T. E., & Graetz, J. E. (2003). Reading comprehension instruction for secondary students: challenges for struggling students and teachers. *Learning Disability Quarterly, 26*(2), 103-116.

Mastropieri, M. A., Scruggs, T. E., Mohler, L., Beranek, M., Spencer, V., Boon, R. T., & Talbott, E. (2001). Can middle school students with serious reading difficulties help each other and learn anything? *Learning Disabilities Research & Practice, 16*(1), 18-27.

Mathes, P. G., Grek, M. L., Howard, J. K., Babyak, A. E., & Allen, S. H. (1999). Peer-assisted learning strategies for first grade readers: a tool for preventing early reading failure. *Learning Disabilities Practice, 14*(1), 50-60.

Mathes, P. G., Howard, J. K., Allen, S. H., & Fuchs, D. (1998). Peer-assisted learning strategies for first-graders: responding to the needs of diverse learners. *Reading Research Quarterly, 33*(1), 62-94.

Moss, E. (2013). The socioaffective context of joint cognitive activity. In Children's development within social context (pp. 127-164). Psychology Press.

Murphy, C. (2012). Vygotsky and primary science. In Second international handbook of science education (pp. 177-187). Springer, Dordrecht.

Mustafa, R. F. (2012). Feedback on the Feedback: Sociocultural Interpretation of Saudi ESL Learners' Opinions about Writing Feedback. *English Language Teaching. 5*(3), 3-15.

Mustafa, M. C., Alias, A., Isa, Z. M., Mat, M., & Abdullah, N. Y. (2019). Tools and symbols as mediation: a central concept to understand ways of improving English acquisition and proficiency. *Universal Journal of Educational Research*, *7*(10A), 30-34.

National Reading Panel (2000). Report of the national reading panel. Washington, DC: Government Printing Office. Retrieved November 12, 2008 from: http://www.nichd.nih.gov/publications/nrp/upload/report_pdf.pdf.

Nassaji, H. & Cumming, A. (2000). What's in a ZPD? A case study of a young ESL Student and teacher interacting through dialogic journals. *Language Teaching Research* 4, 95-121.

Palincsar, A. S. (1998). Keeping the Metaphor of Scaffolding Fresh – A Response to C. Addison Stone's "The Metaphor of Scaffolding: It's Utility for the Field of Learning Disabilities. *Journal of Learning Disabilities, 31*(4), 370-373.

Palincsar, A. S. (1986). The role of dialogue in providing scaffolded instruction. *Educational Psychologist*, *21* (1 & 2), 73-98.

Palincsar, A. S. & Brown, A. L. (1984). Reciprocal teaching of comprehension-fostering and comprehension-monitoring activities. *Cognition and Instruction, 1* (2), 117-175.

Palincsar, A.S. & Klenk, L. (1992). Fostering literacy learning in supportive contexts. *Journal of Learning Disabilities*, *25* (4) 211-225, 229.

Pathan, H., Memon, R. A., Memon, S., Khoso, A. R., & Bux, I. (2018). A Critical Review of Vygotsky's Socio-Cultural Theory in Second Language Acquisition. *International Journal of English Linguistics*, *8*(4), 232.

Peterson Nelson, J. A., Caldarella, P. Youong, K. R., & Webb, N. (2008). Using peer praise notes to increase the social involvement of withdrawn adolescents. *Teaching Exceptional Children, 41*(2), 6-13.

Proctor, C. P., Dalton, B., & Grisham, D. L. (2007). Scaffolding English language learners and struggling readers in a universal literacy environment with embedded strategy instruction and vocabulary support. *Journal of Literacy Research, 39*(1), 71-93.

Radziszewska, B., & Rogoff, B. (1991). Children's guided participation in planning

imaginary errands with skilled adult or peer partners. *Developmental Psychology, 27*, (3), 381-389.

Ramsey, M. L., Jolivette, K. & Patton, B. (2007). Peer-assisted learning strategies (PALS) for reading in the EBD classroom. *Beyond Behavior*, Fall 2007, 2-6.

Rassaei, E. (2017) Tailoring mediation to learners' ZPD: effects of dynamic and non-dynamic corrective feedback on L2 development. *The Language Learning Journal*, DOI: 10.1080/09571736.2017.1343863

Richardson, B. K. (2010). Mexican immigrant transnational social capital and class transformation: examining the role of peer mediation in insurgent science. *Cultural Studies of Science Education. 5*(2), 383-422.

Shamir, A., & Lazerovitz, T. (2007). Peer mediation intervention for scaffolding self-regulated learning among children with learning disabilities. *European Journal of Special Needs Education, 22*(3), 255-273.

Simon, L. (2008). "I wouldn't choose it, but I don't regret reading it": Scaffolding students' engagement with complex texts. *Journal of Adolescent & Adult Literacy, 52*(2), p134-143

Stone, A. (1998). The Metaphor of Scaffolding: Its Utility for the Field of Learning Disabilities. *Journal of Learning Disabilities*, 3 (4), pp 344-364.

Slater, W. H., & Horstman, F. R. (2002). Teaching reading and writing to struggling middle school and high school students: The case for reciprocal teaching. *Preventing School Failure, 46*(4), 163-166.

Taber, K. S. (2020). Mediated Learning Leading Development—The Social Development Theory of Lev Vygotsky. In *Science Education in Theory and Practice* (pp. 277-291). Springer, Cham.

Thorius, K. A. K., & Santamaría Graff, C. (2018). Extending peer-assisted learning strategies for racially, linguistically, and ability diverse learners. *Intervention in School and Clinic*, *53*(3), 163-170.

Tzuriel, D. (2013). Mediated learning experience and cognitive modifiability. *Journal of Cognitive Education and Psychology, 12*(1), 59-80.

Vacca, J. S. (2008). Using scaffolding techniques to teach a social studies lesson about Buddha to sixth graders. *Journal of Adolescent & Adult Literacy, 51*(8), 652-658.

Van Garderen, D. (2004). Reciprocal teaching as a comprehension strategy for understanding mathematical word problems. *Reading & Writing Quarterly, 20*(2), 225-229.

Van Lier, L. (1996). *Interaction in the language curriculum: Awareness, autonomy, and authenticity*. London: Longman.

Verenikina, I, (2008). Scaffolding and learning: Its role in nurturing new learners. In P. Kell, W. Vialle, D. Konza & G. Vogl (eds), *Learning and the Learner: Exploring Learning for New Times,* University of Wollongong. Retrieved, October 21, 2008, from: http://ro.uow.edu.au/cgi/viewcontent.cgi?article=1043&context=edupapers

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes.* Cambridge, MA: Harvard University Press.

Vygotskiĭ, L. S. (2012). Thought and language. MIT press.

Walqui, A. (2017). The development of teacher expertise to work with adolescent English learners: A model and a few priorities. In Inclusive pedagogy for English language learners (pp. 117-140). Routledge.

Wells, G. (1999). *Dialogic Inquiry: Towards a Sociocultural Practice and Theory of Education.* New York: Cambridge University Press.

Wells, G. (1994, September). Learning and teaching "scientific concepts": Vygotsky's ideas revisited. In Vygotsky and the Human Sciences Conference, Moscow.

Wertsch, J. V. (2007). Mediation. In H. Daniels, M. Cole, & J. V. Wertsch (Eds.), The

Cambridge companion to Vygotsky (pp. 178-192). New York: Cambridge University Press

Wood, D. J., Bruner, J. S., & Ross, G. (1976). The role of tutoring in problem solving. *Journal of Child Psychology, 17*, 89-100.

What is (not) Active Learning? How to Learn Actively?

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The Stages of Active Learning Approach in Historical Process

According to Smith & Lusterman (1979), lots of models and theories have been developed to explain teaching-learning process and improve the quantity and quality of learning in education. It can be observed that researchers have focused on ''Active Learning Approach'' which is based on John Dewey's student-centered education and became even more important after 1980s. In the student-centered education, Dewey defines classroom as a democratic atmosphere where students learn interaction with each other and participate actively.

There are lots of definitions of active learning. Demirel (1999, p.198) thinks that active learning is an approach which makes individuals involve actively in the learning process. According to Karina D. Torralba & Loomee Doo (2020: 2), active learning is a student oriented approach that contains active participation of students in the classroom through readin, writing or discussion. Robert and Simons defines active learning as a learning process that an opportunity to decide for various aspects of learning process is given to the learners and students are forced to use their intellectual skills during learning (Ozkaya 2000, p.1). According to Harmin (1994) however, what accomplishes high student participation is the planning and executing of the courses. The most efficient way of this is to make students active in learning process at the possible highest level and make them responsible for their own learning. We can explain these definitions in two groups. These are;

- In the learning that emphasizes the organization of phases of learning process by the students a great deal; the student makes his/her own scheme, decides his/her goals and favorite activities, evaluates his/her progress, represents his/her mistakes and achievements.

- The student barely takes part in the decisions related to learning. The aims and activities, providing learning, and checking are teacher-controlled. Students attend scheduled activities actively instead of taking part active decision making about their learning (Stern and Huber 1997, p.19-21).

Active learning is compatible with the term of flipped classroom. This term has much gained popularity in that students are expected to equip themselves with fundamental knowledge before the class and attend the activities encouraging research, complex

thinking, peer-peer or peer-teacher interaction, and lastly do their homework in the classroom (Medina, 2017).

The Differences between Active Learning Approach and Direct Instruction Method Adopted Environment

Johnson, Johnson and Smith summarize the differences between teaching environments designed in accordance with Active Learning Approach and Traditional Education as: (Akt. Ozkaya 2000, p.5).

Direct Instruction Method Adopted Teaching Environment

Knowledge: It is transferred from the teacher to the learner.

Students: An empty vessel loaded by teacher.

The Purpose of the Teacher: Classify and separate.

Relations: There is no individual relationship between the teacher and learner.

Context: Competitive, individual.

Premise: Every expert can teach.

Active Learning Approach Adopted Teaching Environment

Knowledge: The teacher and learner structure together.

Students: Active, constructive, exploratory, translates information into his/her own knowledge.

The Purpose of the Teacher: To develop the student's abilities and proficiencies.

Relations: There is an individual relationship between the teacher and learner.

Context: Cooperation in the classroom and work.

Premise: Teaching is complicated. Requires training.

The main idea of active learning is to make students, who are passive in the traditional education, makers, doers, performers, in other words active individuals. Efficient participating is crucial for active learning. Nevertheless, it was not enough (Ozkaya 2000, p.2).

''What makes the learning active?'' When the learning is active, students do the most of the work. They use their brains, think, solve problems, and apply what they have learned.

Active learning is entertaining, supportive and personally occupies. Mostly, students cannot sit at their seats. They are on the move and think aloud.

‘’Why is activating the learning necessary?’’ Learning something well leads to hear it, see it, ask questions about it, and be able to discuss it with others. Further to that, students are eager to do it. They evaluate in regard to knowledge they have and have acquired (Silberman 1996, p.9).

How can we activate the students in the beginning?

Team Building: Assisting students to get acquainted with each other or establish a cooperative spirit and act together.

On-the-spot Assessment: Information about students’ behaviors, knowledge, and lives. Immediate Learning Involvement: Creating the first interest about the subject.

In addition to these techniques, students are encouraged for an active role from the beginning. How does our brain work? Our brain does not work like a tape or video recorder. Obtained information is continuously being questioned. Our brain’s process is like a computer in many aspects. We are the users. A computer should be on in order to work. When learning is passive, our brain is not on. A computer needs to interpret a compatible software to be able to work. Our brain tries to make a connection between what we know and how we think and what has been thought. If the learning is passive, then our brain cannot make a connection with our brain’s software. Consequently, a computer cannot keep the information it did not save. Our brain needs to test or store the information by explaining to someone. If the brain is passive, it cannot keep what is presented (Silberman 1996, p.3).

Active learning means students not only watch and listen but also participate actively in the process, act independently and research (Weikart, 1993, p.70). In active learning, students attribute what they have learned to themselves. They are efficient in the classroom. They read, write, speak, discuss, make connections with their past. They apply what they have learned to their daily lives (Lubbers and Gorcyca 1997, p.67-68).

Active learning is not only entertainment and game group. The value of active learning depends on discussing its point with others and mostly thinking on activities. Students are able to question how much they have learned by active learning. While carrying out education with active learning, there should be a reliable upbringing and limited aims. If content is minimized, teacher has time for activities, presentation, and practice. Active learning activities can beautify even dull and uninteresting information. Teaching interesting subjects is easy. Although the subject is dull, motivating the students is easy thanks to active learning activities. The key word is variety. Variety enhances a good

teaching. Lots of techniques related to the active learning provide alternatives to build small groups.

There is some threat, causing students to mislearn from each other in the group works of active learning approach. On the other hand, bringing a social aspect in learning is an advantage. The teacher should review the material constantly concerning students' self-learning and teaching each other (Silberman 1996, p.7-8).

Students solve the problems with group work, take part in the discussions, answer the questions, and write essays, aside from listening to the lesson in the process. Teaching activities include students doing something and thinking about what they did via strategies, which improve active learning (McConnell 2000, p.1).

Mitman and Lambert (1993, p.506) accepts that active learning approach contains each teaching and learning strategies. Critical thinking, cooperative learning, efficient communication, and project-based learning are the other methods and strategies that form active learning operations. Those operations focus on students' self-governance, development, and acquisition of higher thinking skills. Students have study and thinking abilities to arrange the study time, organize the work, identify the rules, make predictions based on events, recognize the prejudice, and figure out the reason based on similarities.

Whichever strategy is used, the classroom should be safe for students and long-term learning should be provided. McConnell states that these techniques applied in the classroom produce a powerful effect on students, students prefer active learning strategies instead of traditional method in many researches, and students' thinking and writing skills are improved according to the most researches evaluating students' success.

Challenges of Practicing Active Learning Approach

Practicing of active learning can be restrained because of some elements of teaching system especially student, environment, and teacher. For instance, students may not be accustomed to study independently or determine their own learning or some students put the responsibility on teacher's shoulders thinking that only the teacher can decide about learning. Teacher may observe students' state and feel that he/she has to take the responsibility. Therefore, we should not be content with leaving students independent, we should also persuade them to achieve this. Even if some students believe in active learning, they do not have cognitive strategies to apply. They even do not know what to do for that. For this reason, students need to be educated about active learning strategies such as orientation, management, examination etc. When this is accomplished, it is confirmed that students implement learning more actively and effectively (Vural, 2004, p.175-176).

Holdbacks, related to practicing active learning, stated at the result of Niemi's research (2002) are generalizable. These holdbacks are: due to the fact that available syllabuses are loaded and all of the subjects must be treated in academic year, active learning applications requiring long time cannot be given enough time; teachers do not want to waste time and energy because active learning needs far more preparations than traditional methods; teachers do not want to take risks because it includes structured activities and results cannot be predicted precisely; unwritten norms and a hidden curriculum cause pressure on teachers; teachers practicing active learning in the school feel alone; they cannot receive support, yet face passive resistance; the most important point is that the institutions training teachers cannot raise teachers, who are qualified to practice active learning. Otherwise, in schools and universities, existance of a passive learning culture between both students and instructors and the willingness keep old habits are significant holdbacks for active learning (Niemi, 2002, p.777).

It is known that the toughest of holdbacks is student related concerning active learning in teaching institutions. Others are because of the teacher or qualities of the teaching institution. The basis of teacher related holdbacks are student related holdbacks in fact because the teacher has been raised in the same atmosphere of that country. In all levels of education, including higher education, there may be educators, who did not experience or are not experiencing active learning, and they can even be education directors as well. Therefore, holdbacks due to the teaching institution are a result of the existence of these sort of educators and education directors, instead of the regulations these institutions are based on (Unal, 1999, p.377).

Troubles which could be encountered during the active learning process could be summarized as follows (Acikgoz, 2003, p.300-308; Bonwell and Eison, 1991; Niemi 2002, p.772-776; Ozkaya, 2000 ; Silberman, 1996, p.7-8; Duztepeliler, 2006, p.14-15):

- Some teachers' lack of self-confidence in practicing the activities.
- Teachers' requirement of creating very detailed plans.
- Teachers' requirement of excessive research.
- Teachers being forced to create the learning materials on their own.
- Some teachers' lack of energy to practice the active learning activities.
- Student's not being ready to be active learners.
- Some students' lack of acceptance into their groups by other students.
- Teachers' not being able to answer all the questions of the students.

- Requirement of spending time for students to learn how to learn.
- Requirement of spending time for students to teach them how to work within a group and individually.
- Teachers' not acceding to giving the responsibility of learning to the students.
- Students giving false information to each other in group learning or peer learning.
- Syllabus being fully loaded and the time requirement for the implementation of active learning strategies.
- Halting the plan due to the inability to fit into the established time for the activities.
- Inability to make students participate and interact in all the planned activities.
- Number of students being too high.
- Lack of sufficient education technology opportunities.
- Disorder and noise occurrence during the activities.
- Teachers' lack of knowledge in utilizing education technologies.
- Hesitance of teachers', who are nearing retirement, in trying a new strategy and developing a sarcastic behavior against the young teachers, who are trying.
- Lack of cooperation among teachers.

In conclusion, holdbacks in active learning may stem from many reasons, both in-class and non-class. When these reasons are considered, the reasons such as, student's and his/her family's past perceptions, teachers' lack of sufficient knowledge in practicing active learning, schools' physical attributes, lack of materials, test anxiety, time management issues, course hours, etc. and most importantly, wrong and deficient practice of active learning are viewed as the most significant holdbacks against active learning.

Benefits of Active Learning

Teachers, who use this strategy effectively are listing the benefits of active learning as follows;

It helps allowing more time to slow learners and gifted students.

It aids students to develop self-control.

It helps new teachers in class management.

It provides life long learning (Stern and Huber 1997, p.14). Teachers who use active learning in primary school are influenced by Piaget and are aware of the fact that students can learn better through substantial learning experiences based on activities, they can focus their attentions for a short time and their quiet sitting periods are limited (Silberman 1996: IX}. Students learn decision making and taking responsibility during active learning process. Students' motivation increase and class discipline issues decrase in active learning (Simons 1997, p.21-22).

Students themselves utilize the information sources in active learning. Teachers and students gather information from various sources and organize them. Students' organization and presentation of information is emphasized. In their projects students have both individual and group responsibilities. Each student work on a different topic but in such a way that they are related to each other and beneficial to the group project. Students share information, interact and cooperate (Ward and Tiessen 1997, p.22).

According to Bonwell and Eison (1996, p.2), there are five strategies of active learning. These are:

- Students take part in class, more than just listening.
- Improving the learning capabilities of the students are more important.
- Students are elevated to higher thinking levels such as analysis, synthesis and evaluation.
- Students are encouraged to do activities such as reading, writing and discussing.
- Student's own attitude and values are taken into consideration.

Student Activities in Active Learning

They think about possible goals and activities. They choose their individual learning goals. They trust in themselves and develop their self-confidence. They choose and plan learning activities. They motivate themselves. They determine a suitable beginning strategy, focus and use their previous knowledge. They read, listen, analyze, correlate and establish a scheme. They think and implement possible applications for a new situation. They express themselves with their own sentences. They try out new strategies. They think of possible situations to succeed another time. They evaluate the learning process and decide about their own performances. They consider the future rewards. They take a break from studying (Simons 1997, p. 20).

Five qualities are at the forefront in a class, where active learning is used. These are; confidence, energy, self-control, belonging in a group and being sensitive. Due to these

qualities, students participate in class instead of just listening. Improving their skills is more important. Active students become individuals, who are more willing, think further about a subject and merge their former knowledge with what they learned. Aside from students themselves being more active, they also help other students learn as well for the success of the group (Harmin 1994, p.3-4).

Confidence: Students feel safe and comfortable in clasroom. It can be observed that students, who trust in themselves and are ready to learn respect themselves.

Energy: Students are participants. There are no students who just wait around, get bored or waste their time in the class environment. Students do not want the class to end.

Self-Control: Students are responsible from their own learning. They manage and motivate themselves. They make their own choices. They begin, finish and if necessary correct their own studies. Students control their own learning speed and manage their studies.

Belonging in a Group: Students have already established positive relationships with managing personnel and other students and they listen to each other. They acknowledge and are acknowledged. They receive and offer respect. They do not feel rejection or separation.

Being Sensitive: Students are thoughtful and aware, knowing what is going on around the classroom. Students, who are attentive, curious, creative and diligent stand out.

Teacher's Role in Active Learning Approach

Many students in traditional classes worry about pleasing their teacher, understanding what is being thought and their classmates' reactions when they make a mistake and thus, fear learning. Excess worrying diminishes thinking. Students cannot think straight when they fear making a mistake or when they feel they have to learn immediately. Teachers can reduce the worrying of their students by using statements, which improve the self-confidence of the students while active learning approach is being used. If we were to provide a sample for these; teacher can write down statements such as, everybody requires time to learn and think. It's natural to make a mistake. That is how we learn. Each person has their unique learning style and learning time. It is smart to ask for help. No one can accomplish everything on their own. We are all smart at different things. No one needs to know everything. We all help each other, on cards and make a student read them first. Then, as a chorus, whole class can repeat those statements. In active learning, teacher makes learning interesting, uses inspirational statements and does not have negative feelings and expectations about his/her students. He/she knows that even the students, who did not do their homeworks had important reasons and thinks that

they will do it next time. Selective homeworks given by the teacher grab the attention of the students even more. When a teacher gives his/her students the right to reply, he/she listens to them without criticizing.

In active learning, group rewards are used instead of individual rewards. (i.e. This group demonstrated a tremendous development. You all work well together. You have learned very well, even though the topic was hard.). Many people enjoy being rewarded. However, the reward should be used very carefully. If not, it can create many negative effects. Students, who did not get a reward, could feel unworthy and they might think they are not good enough.

In active learning, teachers let their students know that they are understood, acknowledged and not alone, in other words they give the message of "I am with you". They use statements such as, "I could have done the same mistake. I can relate to how you feel. I share your troubles.".

In active learning, teacher provides a response to a student's correct answer by using statements such as, "Yes, correct. Alright. Thank you.". When a student gives a wrong answer, teacher does not offer a second student a chance to reply, but gives the correct answer himself/herself. "No, the correct answer is....." etc. In active learning, teacher determines students' mistakes and takes notes: He/she does a study on that topic some other time (Modell, 1996).

Teachers during the Active Learning process;

Ask interesting questions, which would help the students to become careful observers.

Let the observations be expressed in written or verbal form.

Provide students reading books about their questions.

Create learning experiences supporting scientific research and experiments and provide materials.

Are willing to share students' curiosities and questions about the world. Are innovative, creative and empirical individuals (Klein 1991, p.23-27).

Five-Step Model in Active Learning

Five-step model in active learning are establishing the need to learn, setting the goals of learning, determining the source material for learning, choosing the suitable learning strategies, anticipating the benefits of learning beforehand (Telman 1998, p.29). Active learning is not only necessary to provide excitement, but also knowing the individual differences as well.

Methods to Use to Prevent Wasting of Time in Active Learning

The duration of students' attention is directly related to the duration of the class. If the class is too long, the attention of students starts to fall away and students begin to have difficulty in learning and memorizing the subjects (Risko, Anderson, Sarwal, et al., 2012; Risko, Buchanan, Medimorec, et al., 2013). The methods to be used to avoid wasting time in active learning are as follows: Activities should be starting on time, clear instructions should be given, visual data should be prepared to gain some time, study papers should be quickly handed out, reporting of the sub-groups should be quickened, letting discussions go on and on should not be allowed, volunteers should be quickly determined, tired and unwilling groups should be prepared for, activities should be quickened from time to time, class' attention should be drawn on time (Silberman 1996, p.28-29).

Some Strategies Used in Active Learning Approach

The learning strategies that ease active learning are much more different than passive learning strategies. Passive learning strategies make teachers responsible for providing all the information and knowledge that his/her students need (Michel, Cater ve Varela, 2009; Smith ve Cardaciotto, 2011; Niemi 2002). Active learning necessitates students play an active role through using a material, reflecting the learnt subjects and appyling the knowledge to different contents and activities (Diamond, Koernig ve Iqbal, 2008; Smith & Cardaciotto, 2011; Thomas, 2009). Recent studies have indicated that active learning is of much more effective in learning of students than passive learning strategies (Michel et al., 2009).

Some strategies used in active learning approach are as follows: Composing a poem, writing a story, puzzles, determining what is known and what is desired to be known, invitation to share a new situation, motiveation increasing questions, question - everybody writes, conclusion sentence, to speak or to say pass, ask a friend.

Composing a Poem

Students sit as small groups. Each group member has one piece of paper. Everyone writes a line about the issued topic and hands it to the person next to them. In second round, second lines are written onto the papers that are given to them and again they are handed to the person next to them. This process goes along until the time ends. In the end, all groups have as many poems as they have members. Then, poems are presented to the class (Acikgoz, 2006).

Writing a Story

Stories may be used as a learning goal, at the point of combining intensive topics and

concepts and when they aim to create a chain of event. Creating a story helps improve innate memory. Since the first ages, stories are being used as tools to teach certain values and information. Stories help the brain, which works as a constant recording device throughout the day, as a strong supporter. Brain processes each event after seeking a meaning for them. With story writing, all code and information transformed into a meaningful whole helps brain do its work (Yavuz, 2005, p.203).

Puzzles

"The aim is to work on concepts and evaluate concepts within a certain logical frame. It is used when concepts and situations are being thoroughly evaluated during the learning process. Puzzles are such activities people have fun working on. They can be prepared and worked on for different goals. Aside from that, after a learning experience, teachers can prolong learning processes of students about the topic with a work sheet comprising of puzzles or a puzzle, comprised and filled with concepts, can be handed out and a study, where suitable questions are created for concepts of the puzzle can be conducted." (Yavuz, 2005, p.110)

Determining what is known and what is desired to be known

The main goal for identifying the subjects known or wanted to be known is to determine the level of knowledge of students about a subject that they know and other details they want to know while preparing them for s study or before beginning the lesson. Asking students what they want to learn is a kind of effort with the aim of satisfying their curiosity about something. The teacher may add the suitable questions into the subjects that are going to be taught or hang them somewhere in the classroom to later mention about them. Alternatively, the teacher may turn the questions into individual or group projects. Furthermore, the curiosity of a student may trigger that of others.

Invitation to Share a New Situation

The purpose of sharing a new experience is to gather the attention of students and create a healthy classroom environment. Students share their new or past experiences with classmates. The teacher may ask for volunteers eager to share a new or interesting experience and should accept any idea or experience on any subject and thank to the student. The main goal here is to provide students the opportunity of sharing their interesting, sad or happy experiences with their classmates, even it lasts for several minutes. This strategy gathers all the students' attention and enables students to concentrate on the class.

Motivation Increasing Questions

Starting the lesson by asking motivating questions let students brainstorm over a subject

since it is easier to go on the lesson when students are all ears.

Question - Everybody Writes

Within the quick-write strategy, a question is directed to students and each student is asked to write an answer. Students are given time to think and write their answers. The aim of writing the answers here is to prevent students whose answers are ready to get bored.

Conclusion Sentence

Besides, some students prefer reading rather than talking. If there is only one correct answer, students make a comparison with their classmates and correct their answers on their own. Within the asking for conclusion strategy, there are cards on a corner of the classroom written 'I learned that…' on. Students write such sentences on these cards as;

I learned that ……. in this lesson.

It was a big surprise for me to learn that …… in this lesson.

After all I learned in this lesson, I start to wonder ……..

The subjects I learned in this lesson made it possible for me to discover ……..

I think I disagree with …….

Now I understand that I want learn much about …….

I think, after this lesson, ……

To sum up, ……..

Students write down their conclusion sentences into their self-learning-logs. Students are not expected to learn a subject equally.

To Speak or to Say Pass

Talking or passing over strategy requires many students to take the floor and talk. The teacher may trigger the students by saying "Let's begin with the ones sitting near the window. When the turn is yours, you may either talk or give the turn to your classmate by saying 'pass me over'". This strategy could be used for either the whole class or just a section of the class and is particularly useful when the question has multiple answers.

Ask a Friend

The purpose of asking to a classmate strategy is to increase the inter-student support

and save time and energy for the teacher. Upon the questions of students as "On which page are we?" or "Could you please repeat the homework?", the teacher may direct the student to ask his/her classmate. Through this way, the teacher's load eases off and the interaction between the students increases (Demirci, 2006; Demirci, 2017).

Stages of Practicing the Activities in Active Learning

Activities help make learning active. These are; role playing, games, simulations, visualization, problem solving, etc. These benefit students in learning by experience, instead of learning by hearing.

- Explaining the goals: Students are explained what will happen and why it will happen.
- Establishing the games: Students are explained why we are doing these activities. Correlation between this activity and others are mentioned.
- Speaking slowly when giving directions: Directions should be clear. Visual aides are required.
- If the directions are complicated, activity is demonstrated: Students are presented with the activity before doing it.
- Students are separated into sub-groups before further directions are given: If this is not done, students may forget the directions when the groups are created.
- Students are informed about how much time they have: Time period is expressed before the activities. Periodically, they are told how much time they have left.
- Activity should be animated: All the things students do are not written on the board. Therefore, the activity is not halted. Also, discussions are not allowed to extend.
- Students are given the opportunity to compete: Lots of energy is required for the activity to create a certain amount of excitement. If the activity lacks energy, students do it halfheartedly.
- Activity is always discussed: When the activity is finished, students are given the opportunity to discuss their thoughts and what they learned.
- Practice experiences are carefully structured: Discussion is guided and only a few questions are asked. If the students are in a sub-group, they are given a short amount of time to share their responses.

Role playing is used in active learning to start a discussion, to practice skills and to figure

out what is being thought about the situation. Role playing can be conducted in two different ways; scripted and formatted (Silberman, 1996, p.26-28).

Ideal Sitting Formations in Classrooms, Where Active Learning Approach is Being Used

It can be said that a classroom's physical organization is one of the most important factors influencing the learning dynamic of that class. Therefore, classroom organization can be used as an effective education tool for students to attain desired knowledge, skills, attitude and comprehension. However, it can be observed that the typical classroom organization in many modern-day schools usually consist of a structure, in which seats and desks are arranged one after the other. This kind of a classroom organization is a determinant of whether the students have a passive or an active role in that class (Saban, 2004, p.177).

Classroom's organization of physical environment is important in practicing the chosen strategies. For why, classroom's physical environment either creates or destroys active learning. Thus, for active learning to take place in a class, principally, it befits that there are tables/desks/seats, which can be easily placed, to create different suitable environments in that classroom. Suitable sitting formation could be established by combining traditional desks as well. Students should be tasked with arranging desks, tables and seats. Which would make them active.

U sitting formation: It is suitable for multi-purpose use. Students can easily see each other's faces for writing and reading and they can engage in pair work. It is especially suitable, when there are two seats located on each side of the desk. This is an ideal formation. As you can reach different points with material sets.

Team style sitting formation: Circular grouping and long tables are placed in the classroom. This situation increases the interaction within the class.[1] Seats are located around the table and an intimate environment is created. That way, some students will be forced to turn their seats around to be able to see the front side of the classroom.

Conference table sitting formation: This is the most suitable method, if the table is round or square. This decreases the importance of the teacher and increases class's. The square table provides formality, if the teacher sits at the head of the table. If the teacher sits at the long side of the table, students, who would be sitting at the ends of the table, feel themselves unworthy. Conference table may be created by bringing amny small tables together.

Circular sitting formation: Students sit in their seats, without desks and tables, in a way that all of them are able to see each other. It creates a direct method for face to face

interaction. In following studies, students can be asked to quickly arrange their seats to create many sub-groups. If a group discussion is desired, they can be asked to place their seats around.

Group within a group sitting formation: A meeting table is placed in the middle. Circles of seats are placed around it.

Auditorium sitting formation: Seats are placed in an arc. That way, intimacy and a situation, where the students can see is created. If the sitting area is fixed, students are asked to sit closer to each other.

Traditional sitting formation: If it is not possible to arrange seats, desks or tables in aforementioned formations, then learning partners form groups of two among each other (Silberman 1996, p.9-16).

Referances

Acıkgoz, K. (2006). *Aktif öğrenme.* İzmir: Biliş Yayınevi.

Bonwell, C. C., & Eison, J. A. (1991). Active learning: Creating excitement in the classroom. 1991 ASHE-ERIC higher education reports.ERIC clearinghouse on higher education, The George Washington University, One Dupont Circle, Suite 630, Washington, DC 20036-1183.

Demirci, C. (2006) Fen bilgisi öğretiminde etkin öğrenme yaklaşımının bilgi düzeyi erişiye etkisi. (The effects of the active learning approach in the science studiesr teaching on knowledge level achievement). *Eğitim ve Bilim, 31*(139), 10-18.

Demirci, C. (2017). The effect of active learning approach on attitudes of 7th grade students. *International Journal of Instruction*, *10* (4), 129-144.

Demirel, O. (1999). *Kuramdan uygulamaya eğitimde program geliştirme:* Ankara: Pegem A Yayıncılık.

Dewey, J. (1938). *Experience and education.* New York: Collier Books.

Diamond, N., Koernig, S. K., & Iqbal, Z. (2008). Uniting active and deep learning to teach problem-solving skills: Strategic tools and the learning spiral. *Journal of Marketing Education, 30*(2), 116-129.

Duztepeliler, Z. (2006). İngilizce öğretmenlerinin *derse başlamada etkin* öğrenme *stratejilerini uygulama durumları.* Yüksek lisans tezi, Anadolu Üniversitesi, Eskişehir.

Harmin, M. (1994). *Inspiring active learning. A handbook for teachers.*

Johnson, D. W. Johnson, R. T. & Smith, K. A. (1991). *Active learning: cooperation in the classroom*. Edina, MN: Interaction Book Campany.

Karina D. Torralba & Loomee Doo 2020 Active learning strategies to improve progression from knowledge to action. *Rheumatic Clinics,*46, 1-19.

Klein, A. (1991). All about ants: discovery learning in the primary grades. *Young Children, 46* (5), 23-27.

Lumbers, C. A. & Gorcyca, D. A. (1997). Using active learning in public relations instructions: demographic predictors of faculty use. *Public Relations Review.* 23(1), 67-80.

Mackenzie, A. A. & White, R. T. (1982). Fieldword in geography and longterm memory structures. *American Educational Research Journal, 19*(4), 623-632.

Medina MS. (2017) Making students' thinking visible during active learning. *Am J Pharm Educ.* 81(3):41.

Mc Connell, J. J. (1999). *Active and group learning.* Canisius College.

Modell. H. İ. (1996). Preparing students to participate in an active learning environment. *Advances Physiology Education.* 15(1), 69-77.

Michel, N., Cater, J. J., & Varela, O. (2009). Active versus passive teaching styles: An empirical study of student learning outcomes. *Human Resource Development Quarterly, 20*(4), 397-418. doi: 10.1002/hrdq.20025.

Mitman, A., & Lambert, V. (1993). Implementing instructional reform at the middle grades: Case studies of seventeen California schools. *The Elementary School Journal*, 93(5), 495-517.

Naithani, P. (2008). *Higher education in the twenty- first century: ıssues and challenges*. London: Taylor & Francis Group.

Niemi, H. (2002). Active learning-a cultural change needed in teacher education and schools. *Teaching and teacher education*, *18*(7), 763-780.

Ozkaya, T. (2000). *Aktif öğrenme* http://www.agr.ege. edu.tr/trder/br2.html.

Risko EF, Anderson N, Sarwal A, et al.(2012). Everyday attention: variation in mind wandering and memory in a lecture. *Appl Cogn Psychol.* 26:234–42.

Risko EF, Buchanan D, Medimorec S, et al. (2013). Everyday attention: mind wandering and computer use during lectures. *Comput Educ*. 68:275–83.

Saban A. (2004). Öğrenme Öğretme *Süreci.* Nobel Yayın Dağıtım. Ankara.

Silberman, M. (1996). *Active learning 101 strategies to teach any subject.*Usa: Allyn and Bacon.

Simon. C. (1997). *Problems and principles in english teaching.* Oxford Pergamon Press.

Smith, J. M., & Lusterman, D. D. (1979). *The teacher as learning facilitator*, California: Wadworth Publishing Company, İne.

Stern, D., & Huber, G. L. (1997). *Active learning for students and teachers:* Reports from Eight Countries OECD.

Telman, N. (1997). *Etkin* öğrenme *yöntemleri.*Epsilon Yayıncılık. İstanbul.

Unal, S. (1999). Aktif öğrenme, öğrenmeyi öğrenmek ve probleme dayalı öğrenme. *M. Ü. Atatürk Eğitim Fakültesi Eğitim Bilimleri Dergisi, 11,* 373-378.

Vural, B. (2004). *Öğrenci merkezli eğitim ve çoklu zekâ.* İstanbul: Hayat Yayıncılık.

Ward, D. R., & Tiessen, E. L. (1997). Adding educational value to the Web: Active learning with Alive Pages. *Educational Technology*, *37*(5), 22-31.

Weikart, S. B. (1993). *Learning in adulthood.* San Fransisco: Jossey-Bass.

Yavuz, K. E. (2005). *Yeniden yapılanan sınıflar için aktif öğrenme yöntemleri.* (Birinci Baskı). Ankara: Ceceli Yayınları.

The Quality of the University Education in Bulgaria in the Case of Competition and Dynamicly Developing Educational System

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Introduction

The processes of economic and cultural globalization have increasingly highlighted the problems of quality education and quality of education. The increasing interconnection between the economy and the various social spheres, triggered by the fast development of information technologies and the free movement of capital, binds more and more the prosperity of the country and the individual with the knowledge and the technology, with the ability to learn and to grasp experience. In this context, national education objectives and the formulation of relevant policies are of paramount importance.

In recent years a global trend in education has emerged and established, focusing on practical orientation of learning and adaptation to business needs so that to achieve better quality at the exit of higher education. To respond to the increased demands and expectations of the labor market and the changed business relations the universities in the country should be focused on the European standards in the training of staff (Panayotov, 2009).

The focus is the assessment of the learning process as content and form and its relation to the professional training of future specialists. The factors of the educational process, influencing students' readiness and ability to work as specialists with a wide profile, are subject of researches.

Students' attitudes towards active forms of education have been studied and a positive attitude towards them has been established, which contrasts with their comparatively not that great supply and application in practice.

A condition for the successful inclusion of the Bulgarian educational reality in a modern educational project is the updating of the concept of the quality of education as well as of the systems for control and management of this quality.

Conceptual Basis of Quality in the Field of Education

Quality of Education

Education is a process that supports the learning and the acquisition of knowledge, skills, values, beliefs and habits. It is not only a conscious human activity aimed at improving the personality in a certain area but also an organized activity of the society.

The approach to understanding the quality in the educational sphere can be presented in the form of the following sequences: the need to obtain knowledge; the fundamental nature of knowledge; knowledge carrier; knowledge transfer; good knowledge transfer methods; updating knowledge; recipient of knowledge.

According to K. Peeva, there is no unambiguous definition of quality education. Each organization has its own definition, trying to unequivocally fix the most important features of such education that can guarantee the highest results (Peeva, 2013).

The 2005 "Education For All, The Quality Imperative" Monitoring Report of UNESCO states that, despite the differences in definitions, two main elements are present everywhere:

1. The ability of the individual to understand and orient himself in the surrounding environment determines the cognitive development of learners as the main goal of all education systems.

2. The role of education is to promote the values and attitudes of civil consciousness and to encourage the creative and emotional development of the learner in the spirit of peaceful coexistence, security and civil responsibility; equality and continuity of cultural values throughout the generations.

Improving the quality and effectiveness of education is among the priorities of the academic community in the European Union (EU). In 1998 the Council of the EU adopted *Recommendation 98/561/EC* to achieve a guaranteed quality in higher education by introducing mechanisms in all EU Member States as well as cooperation between national quality assurance agencies (Peeva, 2012). *The 1999 Bologna Declaration* is fundamental to creating a common European area of higher education, quality assurance and unification of university programs. It requires the development of criteria and methodology for assessing the quality of education (by establishing minimum standards and requirements in order to measure the qualification and the competence) and accreditation (programmatic and institutional).

The Lisbon Strategy specifies these provisions in order to improve the quality and the efficiency of education, to provide universal access and to open education systems to the world. *The Dakar Framework for Action* identifies education as a practice-oriented lifelong process and links its effectiveness to the qualities that are formed in the educated individual.

Assessment of the Quality of Education

In the field of education, the assessment is a method of systematically collecting information on the efficiency of learning. The obtained results provide information on

the achievement of pre-set goals and learning outcomes in the learning process.

In assessing the quality of education, the following considerations should be considered – the quality assessment is not limited to testing the learner's knowledge (although it remains one of the indicators of the quality of education) and the quality assessment of education is carried out in a complex way, taking into account all areas of activity of the educational institution.

Quality of education in higher education institutions in Bulgaria

One of the main goals of modern higher education is to increase the quality of the students' education, to ensure quality professional training and to implement innovative approaches so that the students can adapt and work after graduation.

Standards for Assessment of Higher Education in Bulgaria

The standards for the assessment of higher education in Bulgaria are based on the Higher Education Act. Pursuant to this law external evaluation and accreditation aim to provide mechanisms to ensure the opportunity through learning to develop the potential of students, to increase and maintain the quality of the offered education. The results are considered later when the state policy on higher education is being formed.

The modern education in higher education institutions in Bulgaria is a combination of forms of organization, methods of planning and management, systems of (self-) evaluation and control of quality and competences, means of communication and activities (educational, administrative, scientific, etc.) based on divided (by location, time and status of use), heterogeneous (human, information, communication and material) and diverse resources and technologies for teaching and learning, conducted by subjects with dynamically changing roles. It is a subject of multiple assessments that cover different aspects of the overall education process.

Higher education quality assessment tasks use a variety of metrics and models – assessment of teacher's performance in higher education, based on Bayes networks (Oztekin, et al., 2010), expert assessment of electronic education resources (Bethard, et al., 2009), assessment of the quality of software with classification methods (Eskenasi et al, 1999), self-assessment in the professional education, formalization of the evaluation methods and quality management in higher education institutions, assessing the level of eligibility of curriculum subjects as part of the assessment of the quality of curricula (Antonov & Antonova, 2009), etc. The ISO IT Portal of the International Organization for Standardization (ISO) for the use of web technologies has implemented the idea of shared document development and management related to standards involving users with different roles and powers and procedures of taking decisions by "voting", for example.

Quality Management Systems in Higher Education Institutions in Bulgaria

In order to be competitive on the European higher education market, Bulgarian universities pay serious attention to the problems related to the quality of education. When examining the issue of the rating of a specialty, the main emphasis is placed on the quality of education, on the realization of the specialists and on the created, respectively applied, scientific product.

The regulatory requirements also determine the need to establish and maintain internal control systems as well as to promote and manage quality. Therefore, they set up their own systems of guarantee and assessment of the quality of education on the basis of their compliance with the curriculum, the material resources, the scientific and methodological support, the education and the specific requirements for a governance structure imposed by the society, the individual and the state. This calls for different approaches to quality assessment in universities.

The Higher Education Act (Article 6, Paragraph 4 and Paragraph 5) obliges the higher education institutions in Bulgaria to develop Systems for assessment and maintenance of the quality of education (SAMQE). In compliance with this legal provision in all Bulgarian universities there are built-in internal systems for ensuring and maintaining the quality of education, but there are significant discrepancies regarding the content and structure of the used approaches. The lack of Bulgarian experience and development in the creation and use of information systems for quality assessment is presented (Dragusheva, et al., 2017). In Figure 1 a model of the Vroeijenstijn quality management system is shown (Vroeijenstijn, 1995).

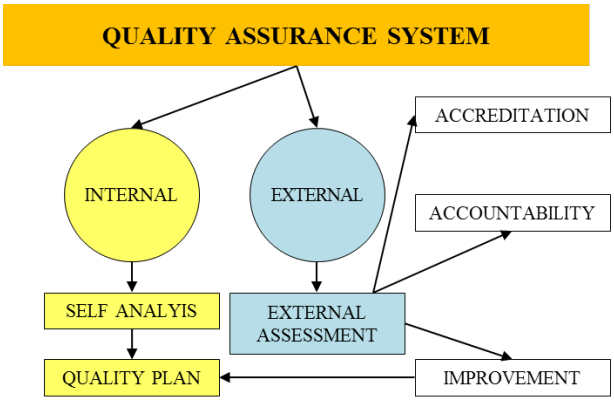

Figure 1. A Model of the Vroeijenstijn Quality Management System

Although the specific policies and procedures of quality assessment systems are governed by internal university regulations, they contain some general elements of a regulatory nature: authorities and their powers to implement the SAMQE; indicators for assessing the quality of education; quality assessment standards; quality assessment procedures; rules for the functioning of the SAMQE.

The organizational structure of the SAMQE includes existing and new structural units – quality assessment and management bodies. They have to: coordinate the continuous collection of data on the quality of education and analyze them; assess the outcomes of learning and teaching at different stages; organize and conduct surveys among students, lecturers, employers and graduates; explore both national and foreign experience of quality control and management of education, and develop and implement adapted options; make analysis and proposals related to the quality of education and others.

Some SAMQE contain lists of quality indicators. In general, the indicators mark the input (of the learning process) and output characteristics of the evaluated objects/ processes without specifying rules and formulas for setting specific estimates or a range of allowable values for the indicators.

The main processes which are traditionally observed, self-assessed and assessed are:

educational activity – the structure and content of curricula and programs, teaching methods and methods for assessing the achievements of the learners, the qualification of the teachers, etc.;

research activity – the research and counseling activity of teachers, the participation of students and PhD students in the development of research and applied projects;

management – the organization and management of the learning process and research;

results – the acquired professional knowledge, skills and competences, and the professional realization of students.

The data needed for self-assessment and assessment of the quality of education and the educational product at the University of Plovdiv are collected by means of: expert assessment cards, review with internal and external reviewers, surveys, analyzes, assessments, studying the opinion of students, lecturers, etc., results of attestations, information of departments, etc.

Some higher education institutions use information assurance software for quality management systems, which partially solve the problems associated with collecting, storing, processing and distributing information on the quality of education.

The common model of quality systems incl. the quality in higher education requires compliance with customer requirements and an assessment of their satisfaction (Kuzmanov & Hadjieva, 2011). A common model of quality management in universities is shown in Figure 2.

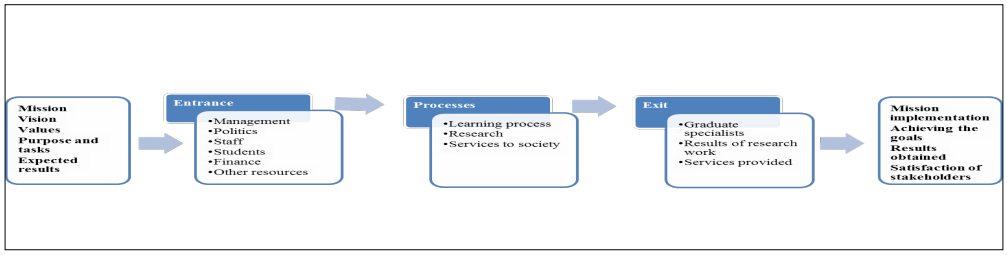

Figure 2. A Common Model of Quality Management in Universities

All individuals in the education process (candidate students, students, parents, employers, country) are interested in providing high quality education. In Fig. 3 is shown a pyramid of users of educational services in universities:

candidate students, students, PhD students, postgraduates and their parents with the desired level of quality of education at the entrance and a degree of satisfaction with the resulting education at the exit;

employers with their requirements to the quality level of the graduates in the labor market, outlining the development trends, which should define the structure and specialties in the educational programs of the higher education institutions;

the country whose main criterion for assessing the quality of education is the correspondence between the activities of the universities and the requirements and standards of the country, the assessment of the contribution of the respective university in the socio-economic development of the country, etc. (Dancheva, 2016).

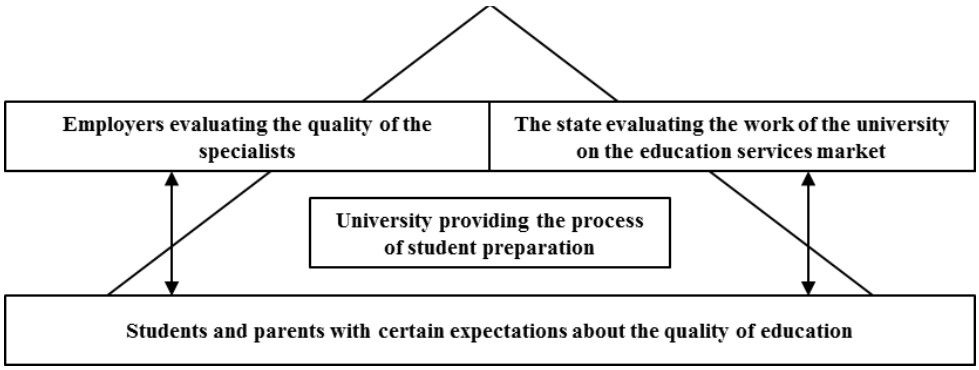

Figure 3. A pyramid of Users of Educational Services in Universities

The efficiency of the quality systems is assessed through customer satisfaction by meeting its requirements (BDS EN ISO 9000: 2007). The requirements are formulated as conscious and systematized objective needs and interests and/or desires and expectations (declared mandatory or commonly implied necessity). They can be purely pragmatic, but the emotional and conjectural elements should not be overlooked. The satisfaction is assessed by meeting the requirements (Kyuchukov, et al., 2005; Pencheva & Beloev, 2009).

On 23 September 2015 the new edition of ISO 9001:2015 entered into force, introducing new requirements for quality management systems. The main change in ISO 9001:2015 is related to the alignment to the Annex SL of ISO Directive for to the ISO for unification the structure of all ISO standards for management systems.

For a smooth transition to the new edition and a successful preparation for recertification under ISO 9001:2015, the necessary measures must be taken in order to update and recast the available ISO 9001:2008 documentation. The changes will be significant – some time will be needed to understand and implement them, and to adapt the implemented quality management system.

Rating Systems for Higher Education Institutions

Rating is a tool for assessing higher education institutions building a national higher education system. With the active processes of expansion of higher education and especially with the unfolding processes of globalization there is a need for a common comparative assessment of higher education institutions in all countries.

With the emergence of the rating system two types or two approaches for the assessment of higher education institutions – *institutional* and *market* – are formed. It is necessary to emphasize the differences in their objectives, purposes and specifics between the two approaches. Institutional assessment aims to ensure the quality of higher education based on the implementation and adherence to educational standards – an object and subject of regular development, monitoring and control. The rating system is a market valuation instrument. Through objective indicators and/or subjective views, it measures the quality of higher education among its users. The rating systems, to a great extent, shape the choice of both a profession and a higher education institution. That is why the deep meaning and purpose of rating systems is to direct private investment to higher education institutions that offer good quality higher education.

While the institutional assessment focuses on the process of creating the educational product, respectively on the education institutions that create it, the rating system assesses the behavior and attitude of the market participants using the human resources capitalized in the educational system. That is why the imposition of institutional assessment is a matter of state policy, and the development and implementation of educational standards is a commitment and responsibility of state institutions. For their part, assessments through rating systems are subject to market interest or initiative of market-based organizations – chambers, associations, business editions, business centers, etc.

The development of the rating system is based on the understanding that the quality of an activity depends on its overall structure and organization. Therefore, the actual and noticeable improvement of the quality of higher education is possible only by

changing the overall way of its management, organization and financing. That is why the establishment of inter-university systems for assessment and maintenance of the quality and the functioning of the National Evaluation and Accreditation Agency should be considered as important but not sufficient enough steps to solve the problem (Boyadzhieva & Dimitrov, 2005).

General Features of Rating Charts

All rating charts claim to rank higher education institutions by quality, but none of them defines this term. There is no common shared understanding of the term "quality of higher education" – ranging from quality assessment by students through expert communities to employers taking into account a variety of objective and subjective indicators (university budgets, material and information provision, assessments of the realization in scientific and labor practice).

Separate attempts to review the global activity in this area, which we do not have any reason to consider exhaustive, cover nearly 50 rankings of different universities. The total number of world rankings exceeds 100. In developed European countries there are about 5 known university rankings, while in the United States there are over 10. Many indicators are used.

Looking at how the used indicators relate to the concept of "quality of education", we find a certain gradation:

The rating charts abound by indicators related to conditions, prerequisites or consequences of possible quality education. Such are: the area of the auditorium, the number of graduates in term, the number of students per teacher, the material base for teaching activities, the living conditions, the volume of scientific activity, the awards, foreign students, etc., in order to arrive at indicators such as "contribution to society", "reputation", "presence of international lecturers". Very often indicators are used to measure the scientific activity and its results, although a very small percentage of the students participate in it.

Rarely included are indicators related to educational achievements at the entrance and to the learning process itself.

Exception are the indicators which directly reflect the quality of the outcome of education no matter how we understand it – as an external and independent assessment of the knowledge and skills of the graduates or as a professional realization. No test, exam or other form of unified measurement of the knowledge and skills of graduates is used in any of the rating systems which are under review. The salary/earnings component after graduation is rare, mostly for individual business, medical and law professions in the United States and the UK.

The Rating System of the Higher Education Institutions in Bulgaria

The rating system of the higher education institutions in Bulgaria assists the users in choosing a higher education institution. The updated version of the system for 2015 contains information about 51 accredited higher education institutions in Bulgaria offering education in specialties, distributed in 52 professional fields. The rating system also collected data on more than 74 indicators that measure different aspects of higher education activities. These indicators are based on statistics collected from various sources, including surveys.

Indicators in the Rating System

The basic information in the rating system is represented by *indicators*. These indicators were formed as a result of collected statistical information from centralized registers and surveys conducted among students, teachers and administrators from different professional fields in the higher education institutions as well as among employers employing graduates with higher education. The indicators are divided into 6 thematic groups according to the main categories in which the higher education institutions are assessed. These groups are learning process, research, learning environment, social-household and administrative services, prestige, realization and connection with the labor market.

The rating system has two main types of indicators – rating and informational. Rating indicators are those that can be used to form higher education rankings in each professional field. Informational indicators provide information about a higher education institution and its professional fields but are not used to make rating charts.

Standardized Charts

These are rankings of the higher education institutions in Bulgaria in a chosen professional field made by an expert team based on previously selected indicators. In standardized charts the number of indicators and their importance in determining the assessment of higher education institutions are fixed in advance and users cannot change them. Prior to making this type of rating, the experts examine the significance of the individual indicators for the different user groups and take into account the quality of the collected information, the number and the correlation between the selected indicators.

Impressive support is given to the idea of creating a rating for the Bulgarian higher education institutions. As “extremely necessary” or “rather needed” is determined by 82% of lecturers, 80% of bachelors, 79% of employers, 78% of graduates, 70% of public opinion and 57% of masters.

The problem of what quality in higher education means and how it can be valued is

fundamental to any higher education system and its policies, which predetermines its key importance in developing the methodology of each rating. A number of publications point out that the very concept of "quality in higher education" is "elusive", "value-laden", and that there is a lack of convincing theory on the issue (Newton, 2007; Stensaker et al, 2011).

It is important to emphasize that the rating system is only one of the mechanisms for assessing the quality of higher education.

National Evaluation and Accreditation Agency (NEAA)

All European countries have organizations for quality assessment and assurance of the higher education structured in regional networks such as the Central and Eastern European CEENQA with 29 agencies from 20 countries (including Bulgaria), the Northern NOQA comprising the agencies of 5 countries (Norway, Sweden, Denmark, Finland and Iceland) and others. The European Association for Quality Assurance in Higher Education (ENQA) is one of the main drivers of the Bologna process and includes 51 agencies from 26 countries, organized at different levels (full members, candidate and associated members) [26].

Four basic types of external evaluation procedures are used in practice:

Audit of the quality of the internal quality assurance system of basic units or of programs of a given higher education institution (auditing);

Comparing the quality of different higher education institutions in each field of study (benchmarking);

Ensuring that a few predefined criteria are met (institutional or program evaluation and accreditation);

Recognition of higher quality (excellence).

Objects subject to external evaluation and accreditation are as follows: higher education institutions – institutional accreditation; professional fields/specialties – program accreditation; programs – program accreditation; projects – for opening and transformation of higher education institutions, branches and/or basic units; projects – for opening of professional fields and specialties; others.

In Bulgaria the organization for quality assurance and accreditation is the National Evaluation and Accreditation Agency (NEAA) which is an independent, specialized state body with its own history and achievements, ensuring the accountability and transparency of the academic and research activities of the autonomous institutions of higher education.

NEAA was established on the grounds of article 11, paragraph 1 of the Higher Education Act, adopted by the National Assembly on December 27, 1995. The new agency's regulation was created by Decree № 189/01.08.1996 on the adoption of NEAA Rules of Procedure and determination of the number of staff in the Agency. The first Accreditation Council started working at the end of 1996.

With the entry into force of the amendments to the Higher Education Act in 2004 a number of changes were made in the assessment and accreditation procedures of higher education institutions, which entrusted NEAA with the functions of a specialized state body for assessment, accreditation and quality control of the higher education institutions' activities and with the ability to carry out post-accreditation monitoring and control – a new activity for NEAA.

NEAA aims to optimally cooperate with stakeholders and to update its activities, seeking the best methods and approaches to improve the quality of higher education. For the Bulgarian higher education institutions membership in ENQA and cooperation with organizations from the European education area is a priority. The efforts of the NEAA for the application of national and European standards in higher education supported by the Council of Rectors, by the National Union of Student Councils, professional associations and research institutes.

Conclusion

The unity of the educational space and the need to develop educational variability require the application of control mechanisms that would allow the quality of education to be influenced not only by the state but also by other groups of users of educational services individuals, professional associations and society as a whole.

The quality of education is a set of learning process properties that determine its ability to meet the needs of citizens, society and the state.

Improving the efficiency of quality control and management requires a received on time reliable and accurate information about the state of the education system and the real quality of the educational processes.

The quality of education is a current topic, revealing many challenges and opportunities for development.

Acknowledgments

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References

Antonov, P., Antonova, V. (2009). Indicators for assessing the quality of curricula in higher education. *Proceedings: Second National Scientific Conference with International Participation Quality of Higher Education in Bulgaria - Problems and Prospects*, 1, 57-62.

Bethard, S., et al. (2009, June). Automatically Assessing Resource Quality for Educational Digital Libraries. *Conference: Proceedings of the 2009 Joint International Conference on Digital Libraries, JCDL* Austin, TX, USA.

Boyadzhieva, P., Dimitrov, G. (2005). Strategy for development of higher education in Bulgaria. *Ed. East West.* In: *(anti) Education / (anti) Corruption,* Sofia: pp. 254–269.

Dancheva, M. (2016). Marketing approach to ensure the competitiveness of higher education. *Abstract of a dissertation for the award of PhD "Doctor"*. VTU "Todor Kableshkov" Sofia.

Dawes, M., et al. (2005). Sicily statement on evidence-based practice. *BMC Medical Education*, 5(1), 1.

Dragusheva, S., Petleshkova, P., Bakova, D. (2017). Improving the quality of practical training of nurses-modern priorities. *Scientific works of the Union of Scientists in Bulgaria - Plovdiv; Series D. Medicine, Pharmacy and Dentistry*, 21: 59-62.

Eskenasi, A., Vassileva, J., Boyadjieva, T. (1999, May 20-23). Management of the Computer-assisted Testing Process, *International Conference "Children in the Information Age",* pp. 188–99.

Kuzmanov, G., Hadjieva, V. (2011). Joint quality management systems in the supply chain. *In M. Dimitrov, P, Rakovska (Ed.), Present and Future. Sofia: Ed. IBIS*, pp. 108–117.

Kyuchukov, R., Stanchev, D., Stancheva, N., Fartunova, M. (2005). Status and problems of university quality systems in higher education. *Proceedings, Jubilee Scientific Session "60 Years of the University of Ruse" Angel Kanchev".*

Newton, J. (2007). What is quality? *In: Embedding Quality Culture in Higher Education a Selection of Papers From the 1 St European Forum*, pp. 14–20.

Oztekin, A., Kong, Z. J., Uysal, O. (2010). UseLearn: A novel checklist and usability evaluation method for eLearning systems by criticality metric analysis. *International Journal of Industrial Ergonomics*, 40(4), 455–469.

Panayotov, I. (2009). Assessing the quality of higher education. *Proceedings: Second National Scientific Conference with International Participation The Quality of Higher Education in Bulgaria - Problems and Prospects*, 1, 19–25.

Peeva, K. (2012). Quality of higher education - European vision. *Social Medicine*, 1, 10–12.

Peeva, K. (2013). Quality of medical education. *Ed. SD Contras*, Stara Zagora, Bulgaria.

Pencheva, V., Beloev, H. (2009). Ensuring quality in higher education - a condition for effective presence of Bulgarian universities in the European educational space. *Procesing: Second National Scientific Conference with International Participation - Quality of Higher Education in Bulgaria - Problems and Perspectives*, 2, 71–77.

Stensaker, B., et al. (2011). An in-depth study on the impact of external quality assurance. *Assessment & Evaluation in Higher Education*, 36 (4), 465–478.

Tuzharov, H. (2009). Quality management in higher education. Retrieved from http://tuj.asenevtsi.com/EL09/EL41.htm

Vroeijenstijn, A. (1995). Quality assurance in medical-education. *Academic Medicine*, 70(7), 59–67.

Teacher Knowledge from Mathematics Education Perspective

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Introduction

With the development of science and technology, the form of education changes day by day. These changes were especially felt during the pandemic caused by COVID-19.The formal changes of education over time show the importance of the teacher's competence to perform an effective teaching.

Shulman (1987) links his teacher competence to his knowledge and explains this knowledge accumulation according to the "knowledge base / base" theory from the perspective of "knowing and teaching". According to Shulman (1987, s.8), a teacher should have subject matter knowledge, general pedagogical knowledge and pedagogical content knowledge categories.

Shulman (1986) defines the amount and organization of knowledge in a teacher's mind as subject matter knowledge. This category of knowledge requires beyond the knowledge of facts and concepts about the content. General pedagogical knowledge; It is a category of knowledge that covers the principles and strategies of lesson planning process, assessment and classroom management.

Pedagogical content knowledge was first introduced as a knowledge category by Shulman (1986, 1987). Shulman (1986) states that subject matter knowledge will not be sufficient to teach a subject so he refers to "pedagogical content knowledge" (PCK), which is a synthesis of subject matter knowledge and pedagogical knowledge. PCK is "a blend of content and pedagogy that shapes how topics and problems in the teaching offered will be organized, represented and adapted to the interests and abilities of the students."

In Shulman's (1986) explanations for pedagogical content knowledge mentions about ways of shaping and organizing content such as representations, analogies / anaologies, drawings, examples, explanations, demonstration experiments for ideas, understanding the factors that make the content easier or difficult to learn, the readiness of the students, their pre- understanding, and their mistakes and strategies to eliminate the errors in their foresight.

Learning changes depending on the form and quality of presented teaching. A teacher who knows about the readiness, misconceptions and interests of her/his students; How to avoid these mistakes during teaching, predict which method and strategy can be used

to provide conceptual understanding in the best practice, and can shape his teaching accordingly. Used representations, explanations, examples, similes are formal factors that make it easier to understand the presented content. These two subcategories pointed out by Shulman (1986) actually determine the line between "knowing very well" and "being able to teach well". Because, according to Shulman (1987), the capacity of a teacher is about transforming his / her content knowledge into strong forms pedagogically.

International Student Assessment Program administered by the Organization for Economic Cooperation and Development(OECD) every three years to fifteen-year-old students (PISA) and Trends in International Mathematics and Science Study (TIMSS), which is applied by the International Association for the Evaluation of Educational Achievement (IEA) to 4th and 8th grade students every four years are carried out in order to determine the place of countries at the international level, the differences in education systems and the trend in student achievement. Results of PISA and TIMSS tests analyze the current state of their educational research, change in the curriculum to increase student success, lead to studies on teacher competencies. In these tests, student achievement and tendencies in mathematics, which are considered important for the development of countries, are not at the desired level. Since student achievement and tendencies in mathematics, which are considered important for the development of countries in these tests, are not at the desired level, many studies are carried out to determine the teacher competencies in mathematics education. As Shulman (1986, 1987) stated, studies on teacher knowledge that reveal a teacher's capacity or competence reveal the inadequacy of teacher candidates and teachers in effective mathematics teaching (Bahar, 2019; Gökce, 2019; Gökkurt, Şahin, Soylu & Doğan, 2015; Kutlu, 2018; Kutluk, 2011; Murtafiah & Lukitasari, 2019; Yeşildere & Akkoç, 2010; Türnüklü & Yeşildere, 2007).

Considering that mathematics is an important discipline in the development of countries, it is necessary to have an idea to evaluate the knowledge of mathematics teachers who are the implementers of the mathematics curriculum. In this study, theoretical studies which aim to identify, explain and develop the categories of teacher knowledge from the perspective of mathematics education are evaluated.

Teacher Knowledge in Mathematics Education

Shulman's (1986, 1987) studies on teacher knowledge based on "knowing and teaching" perspective directed teacher education researchers to study the categories and sub-categories of this knowledge that are necessary for effective teaching. One of the studies conducted for this purpose was carried out by Ball, Thames and Phelps (2008) in the framework of mathematics education.

Ball, Thames and Phelps (2008) categorized the fields of knowledge which is required

to teach mathematics as subject content knowledge and pedagogical content knowledge as shown in Figure 1.

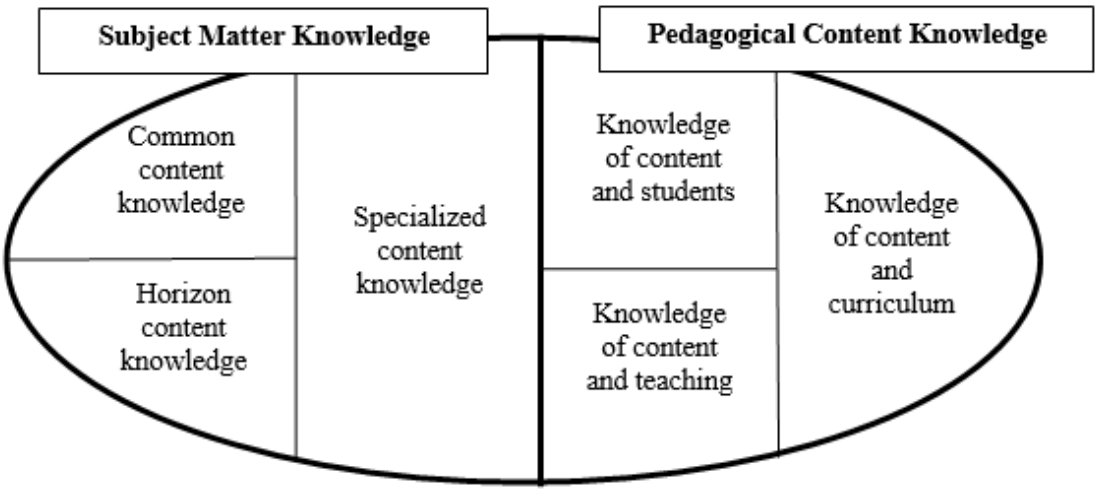

Figure 1. Comparison of Shulman's (1986) and Ball, Thames and Phelps (2008) Knowledge Categories (Ball, Thames & Phelps, 2008, p.403)

Subject matter knowledge is defined as the mathematical knowledge to teach needed mathematics content. It is divided into sub-categories such as general content knowledge, specialized content knowledge and horizon content knowledge.

It is the mathematical knowledge and skills that all well-educated adult should have. For example, the knowledge and skills required to be done in the correct form of the243x15 transaction are included in the general content knowledge category.This information dimension is to be able to identify the mistakes students make, to be able to recognize inappropriate definitions; It provides speaking and writing by using correct terms and notations.

Horizon content knowledge covers the knowledge and awareness of how the mathematics subjects in the curriculum are interconnected. For example; the information about which topics a mathematical concept, transaction or subject is basic or preliminary information are within the scope of this knowledge dimension. Private content knowledge is the knowledge required to teach mathematics beyond what is expected of well-educated adults. Special content knowledge is the knowledge which is necessary to teach mathematics beyond what is expected of well-educated adults. For example; the type of information required to make instructional explanations in accordance with the algorithm behind the $5\ \frac{1}{2}$ transaction is included in this scope.

Unlike pedagogical content knowledge, Mathematical special content knowledge covers the mathematical knowledge required to teach mathematics. This type of knowledge required for the teaching of a mathematical task is generally based on information such as making appropriate mathematical explanations, using representations, justifying and relating.

This type of knowledge, which is necessary to teach a mathematical task, is generally based on information such as making appropriate mathematical explanations, using representations, justifying and relating. Presentation and representation of mathematical ideas, with the mathematical ideas underlying the representations or other representations, providing mathematical examples suitable for critical points, making explanations for reasons, relating a topic to learned topics or topics to be learned, choosing and developing useful mathematical definitions, adapting and organizing the content, using the mathematical language and notation appropriately are seen as knowledge and skills within the scope of special content knowledge. (Ball, Thames&Phelps, 2008).It can be said that Ball, Thames and Phelps require a strong general content knowledge and support pedagogical content knowledge when it comes to the definition of special content knowledge and the skills it contains. In addition, defining specific content knowledge skills related to mathematical tasks can help mathematics teachers question their own actions and strategies and develop course content.

Ball, Thames, and Phelps (2008) categorize the subcomponents of pedagogical content knowledge, which is another dimension of teacher knowledge, as student knowledge related to the content, content teaching knowledge and curriculum knowledge. This categorization differs according to the PAB categories of Shulman (1987).

While Shulman (1987) considers curriculum knowledge as a different dimension of knowledge from pedagogical content knowledge; Ball, Thames, and Phelps (2008) consider curriculum knowledge as a subcomponent of pedagogical content knowledge. The curriculum affects the scope and presentation of the presented content. Considering that pedagogical content knowledge is related to a specific form of content knowledge (Shulman, 1986) that represents the teachable aspects of content, it is clear that curriculum knowledge will also affect pedagogical content knowledge. For this reason, it can be said that Ball, Thames and Phelps(2008), who dealt with curriculum knowledge as a sub-component of pedagogical content knowledge, made an appropriate determination.

In the literature, there are also different categorization of mathematics-specific content knowledge, which Shulman (1986) and Ball, Thames and Phelps (2008) express as subject matter knowledge. For example, Skemp (1976) embraces the subcomponents of mathematics content knowledge as conceptual and operational knowledge. Conceptual knowledge; It is the knowledge of mathematical concepts and the mutual transitions and relations between concepts (Skemp, 1976). Moreover conceptual knowledge covers the mathematical meaning behind rules, relationships, generalizations and operations. Operational knowledge is the knowledge of mathematical methods, rules, and algorithms (Skemp, 1976).

Another categorization of the content knowledge was made by Ball, Lubienski, and

Mewborn (2001). According to Ball, Lubienski and Mewborn, mathematics content knowledge has two sub-components. These are mathematics knowledge and mathematics-related knowledge. According to this categorization mathematics knowledge covers operations and core mathematical meanings. The knowledge based on mathematics covers mathematical presentations and knowledge about how mathematics has developed and changed as a discipline (Ball and others., 2001).

In the teacher education literature, pedagogical content knowledge was first introduced as a category of knowledge by Shulman (1986). Shulman's studies (1986, 1987) accelerated the studies about pedagogical content knowledge. The number of studies on what this knowledge is and its subcategories has increased (Ball et al., 2008; Rowland, Huckstep, & Thwaites, 2003; Rowland, 2005; Rowland, 2013).There have also been studies examining pedagogical content knowledge in terms of mathematics education. Baki (2010) carried out one of these researches and embraces with pedagogical content knowledge as teaching knowledge. According to Baki (2010), the skills required by the mathematics teacher knowledge dimension are expressed as follows (p.24)

- Knowing what to teach in the curriculum
- Knowing and relating the learning areas of the curriculum
- Knowing the achievements of sub-learning areas
- Knowing how the learner comprehend
- Know the student's current operational and conceptual knowledge specific to the subject
- Knowing subject-specific special teaching methods
- To be able to design subject-specific material
- To be able to organize subject-specific learning activities
- Assessment and evaluating student's learning

It is seen that the knowing the curriculum to be taught from these expressed skills, knowing and relating to the learning areas of the curriculum, and the skills of determining the acquisitions of sub-learning areas are related to the curriculum knowledge from the PCK components. (Ball et al, 2008; Shulman, 1986, 1987). The ability to know how the student understands and the subject-specific operational and conceptual knowledge points to the students' understanding knowledge, one of the PCK components expressed in the literature (Ball et al., 2008; Shulman 1986). Skills about knowing how the student understands and current subject-specific operational and conceptual knowledge

points to the students' understanding knowledge, which is one of the PCK components expressed in the literature. (Ball et all., 2008; Shulman 1986). Knowing subject-specific teaching methods, designing materials, organizing learning activities, and assessment and evaluating student learning are the knowledge about teaching knowledge from the components of PCK (Ball et al., 2008; Shulman, 1986). Baki (2010) tried to explain the components of mathematics teaching knowledge with a diagram as in Figure 2 with the help of this framework. When Figure 2 is examined, Shulman's (1986, 1987) student knowledge is considered as Ball, Thames and Phelps' (2008) the knowledge of content and students, whereas Baki (2010) considers it as student's current mathematics knowledge. Knowledge of teaching strategies revealed by Shulman (1986, 1987), is embraced in the form of presentation of the subject and special teaching methods and strategies by Baki (2010). The component that Baki (2010) discussed as "the place of the subject in the mathematics curriculum and its relation with other subjects"; it is discussed as a separate category of knowledge by Shulman (1987), and curriculum information as a sub-knowledge category of PAB by Ball, Thames and Phelps (2008). The last component put forward by Baki (2020) can be associated with Shulman's (1987) category of knowledge about educational purposes and values.

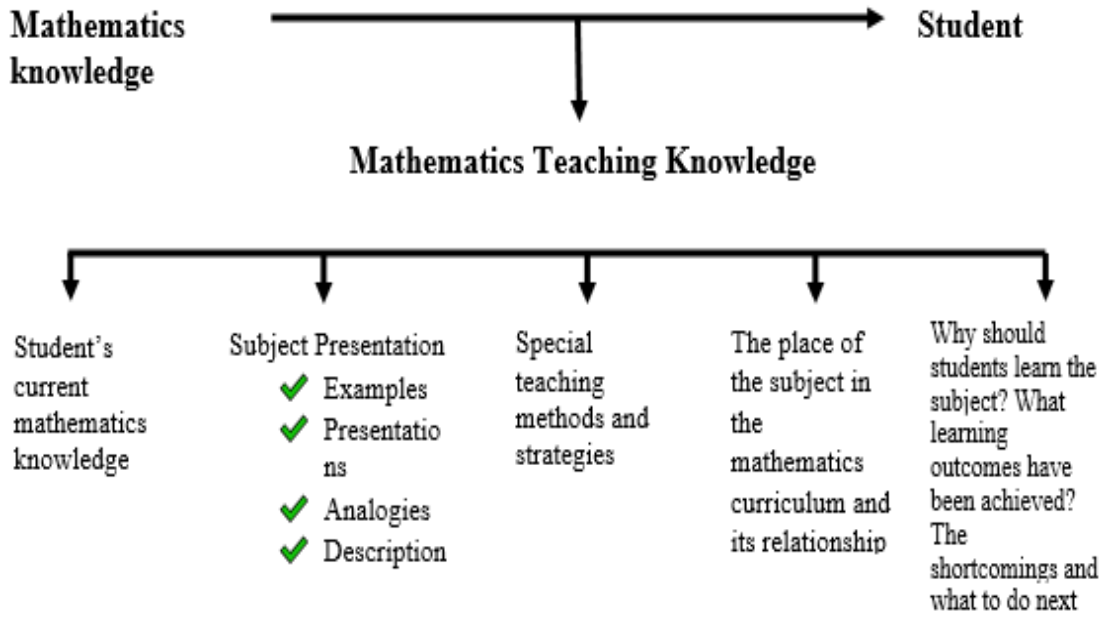

Figure 2. Components of Mathematics Teaching Knowledge (Baki, 2010, p.25)

Evaluation of Teacher Knowledge in Mathematics Education

While categorizing teacher knowledge in the literature of mathematics education, it is known that evaluation studies have been conducted. (Kinach, 2002; Rowland, Huckstep ve Thwaites, 2003; Rowland, 2005; Rowland, 2013). Studies on teacher knowledge emphasize that strong pedagogical content knowledge requires deep field knowledge. (Shulman, 1986; Ball, Thames&Phelps, 2008). Kinach (2002) stated that instructional explanations, which are an indicator of pedagogical content knowledge, reveal teachers'

understanding of the content knowledge they have and tried to define the levels of this understanding. Kinach (2002) has developed a framework based on evaluating the instructional explanations made by the teachers from the perspective of mathematical content and pedagogical content knowledge, based on Skemp (1976) and Perkins and Simmon's (1987) categorization for mathematical content knowledge. The framework that Kinach (2002) put forward to evaluate the knowledge of mathematics teachers is shown in Table 1.

Table 1: Understanding Levels Developed by Kinach (2002)

Instrumental understanding	Content-levelunderstanding
Relational understanding	Theconceptlevel of disciplinaryunderstanding
	Problem-solvinglevelunderstanding
	Epistemic-levelunderstanding
	Inquiry-levelunderstanding

According to Kinach (2002), the indicator of operational understanding is called content level understanding.Content level understanding of mathematics includes rules, operations and basic methods specific to mathematics. On the other hand, relational understanding is observed at four levels. The first of these levels is the concept level of disciplinary understanding which covers defining patterns and relationships, knowledge and experiences based on its classification and generalization. Problem-solving level understanding covers schemes based on the use of analytical tools and methods in solving problems specific to mathematics. Epistemic-level understanding is based on verifying and proving mathematical thoughts and justifying explanations. The framework put forward by Kinach (2002) focuses on evaluating the teacher knowledge on the basis of the quality of the instructional explanations

In the literature, it has been seen that there are studies which aim to evaluate the teacher knowledge according to the characteristics shown in the whole teaching process. (Rowland, Huckstep&Thwaites, 2003; Rowland, 2005; Rowland, 2013). According to Rowland (2005), who conducts studies aimed at defining and developing a theoretical framework to describe and analyze prospective teachers' mathematical knowledge thoroughly, such characteristics of teachers can be evaluated in the best way while teaching, in other words, in practice. This theory, called "The Knowledge Quartet", was first developed at Cambridge University between 2002-2004 (Rowland, 2013). According to this understanding shaped by a series of researches and studies, there are four dimensions of knowledge that a teacher should have (Rowland, Huckstep& Thwaites, 2003).

- Foundation

- Transformation
- Connection
- Contingency

The basic knowledge category consists of the knowledge, beliefs and understandings that prospective mathematics teachers have gained in academy and prepare them for their future roles. Mathematics knowledge and understanding, understanding and beliefs based on thoughts resulting with questioning in learning and teaching mathematics are classified as key components of this theoretical background (Rowland, Huckstep&Thwaites, 2003; Rowland, 2013).

Action knowledge represented by planning for teaching and instruction itself constitute the transformation category which is the second category.There is the ability to transform content knowledge into strong pedagogical forms which was expressed by Shulman (1987) at the center of this category. From this perspective; the choices and examples used in the teaching of the course are important in terms of creating a conceptual background in mathematics teaching, helping to show the language acquisition and mathematical processes. (Rowland, Huckstep & Thwaites, 2003; Rowland, 2005; Rowland, 2013)

Establishing connection knowledge category; it is about consistency in planning and teaching the lesson parts and a set of lessons. The consistency here is the choices that reflect knowledge of their structural connections in mathematics and covers the ordering of the lesson parts with the directions, as well as the awareness of the cognitive demands of different mathematical topics and tasks (Rowland, Huckstep & Thwaites, 2003; Rowland, 2005; Rowland, 2013).

In the last category, the ability to “think for someone else” is at the forefront. And It is about events that are almost impossible to plan, and means being prepared for student ideas and being able to direct them appropriately Rowland, Huckstep & Thwaites, 2003; Rowland, 2005; Rowland, 2013). In the constructivist approach, it is taken into account that the student’s contributions in the course constitute an important perspective in teaching. In this respect, the last category is very important as it includes students’ possible questions and thoughts in the planning and teaching of the lesson.Rowland (2013) classified the indicators about these categories of information as in Table 2.

It handles the mathematics knowledge and mathematics teaching knowledge of the Knowledge Quartet Modeltogether. This indicates that both types of knowledge are important. Considering that pedagogical content knowledge covers blended aspects of content and pedagogical knowledge; a good mathematics pedagogical content knowledge requires a strong mathematics subject matter knowledge. Although good math subject

knowledge is a must for pedagogical content knowledge, it does not guarantee that good. In this respect, Category codes of the Knowledge Quartet Modelshows that it can be said that it is a good synthesis of mathematics subject knowledge and pedagogical content knowledge. In addition, it emphasizes that a teacher's mathematics subject knowledge and pedagogical content knowledge can be observed in practice in the best way. The fact that the category codes are application-oriented also shows the usefulness of the Knowledge Quartet Model.

Table 2. The Knowledge Quartet's Dimensions

Knowledge Dimension	
Foundation	Adherence to text book Awareness of purpose Concentration on procedures Identifying pupil errors Overt display of subject knowledge Theoretical under pinning of pedagogy Use of mathematical terminology
Transformation	Choice of examples Choice of representations Teacher demonstration Use of instructional materials
Connection	Anticipation of complexity Decisions about sequencing Making connections between concepts Making connections between procedures Recognition of conceptual appropriateness
Contingency	Deviation from lesson agenda Responding to students' ideas Responding to the (un)availability of tools and resources Teacher in sight

Conclusion

In this study, it is aimed to present a perspective based on the researches on defining, classifying and evaluating teacher knowledge from the mathematics education point of view. It is seen that the studies conducted try to determine the dimensions of teacher knowledge and the interaction among these dimensions of knowledge. Among these dimensions of knowledge, mostly content knowledge and pedagogical content knowledge, the subcategories of these dimensions of knowledge and the interaction among them were emphasized. (Baki, 2010; Ball, Lubienski & Mewborn, 2001; Ball, Thames & Phelps, 2008; Kinach, 2002; Rowland, Huckstep & Thwaites, 2003; Rowland, 2005; Rowland, 2013; Shulman 1986, 1987; Skemp, 1976)

More relational knowledge types in the dimension of mathematics-specific content knowledge of teacher knowledge is seen as the necessity of a conceptual and deep mathematical knowledge (Skemp, 1976; Kinach, 2002). Strong content knowledge is a prerequisite for an effective teaching process; but it is not enough. The knowledge and skills that can transform the content knowledge into pedagogically strong forms should be possessed (Shulman, 1987).

Student knowledge and instructional strategy information come to the fore in the sub-dimensions of pedagogical content knowledge (Baki, 2010; Ball, Thames & Phelps, 2008; Shulman 1986, 1987). Besides the categorization of teacher knowledge related to mathematics, studies aimed at analyzing and evaluating teacher knowledge also shed light on teaching skills that need to be developed and set application-based evaluation criteria (Kinach, 2002; Rowland, Huckstep, & Thwaites, 2003; Rowland, 2005; Rowland, 2013). The contingency dimension in The Quartet Knowledge model is an important detail among these application-based frameworks. It is emphasiezed that being prepared for problems that may occur in the classroom and the capacity to turn these into an educational opportunity is a necessary teacher competence.

It is important to define and elaborate the knowledge and skills of teachers who are implementers of teaching programs in advancing mathematics education, and to create evaluation frameworks, in terms of shedding light on teacher training programs. Accordingly, teacher training programs and in-service training programs for teachers working currently are required to improve instructional knowledge and skills.

References

Akkoç, H.,& Yeşildere, S. (2010). Investigating development of pre-service elementary mathematics teachers' pedagogical content knowledge through a school practicum course. *Procedia-Social and Behavioral Sciences*, *2*(2), 1410-1415.

Bahar, G., (2019). *Measuring pre-service teachers' mathematics content knowledge and mathematics pedagogical content knowledge on ratio and proportion.* Unpublished master thesis, Boğaziçi University, Institute for Graduate Studies in Science and Engineering, İstanbul

Baki, M. (2010). An evaluation of teacher training from undergraduate and postgraduate dimensions. *Journal of Inonu University Faculty of Education, 11*(3), 15-31.

Ball, D. L., Lubienski, S. T., & Mewborn, D. S. (2001). Research on teaching mathematics: The unsolved problem of teachers' mathematical knowledge. *Handbook of research on teaching,* 4, 433-456.

Ball, D. L., Thames, M. H. & Phelps, G. (2008). Content knowledge for teaching what

makes it special?. *Journal of Teacher Education*, *59*(5), 389-407.

Gökce, R., (2019). *Examining middle school mathematics teachers' content and pedagogical content knowledge of statistical reasoning.* Unpublished doctoral dissertation, Pamukkale University, Institute of Educational Sciences, Denizli

Gökkurt, B., Şahin, Ö., Soylu, Y. ve Doğan, Y. (2015). Pre-service teachers' pedagogical content knowledge regarding student mistakes on the subject of geometric shapes. *Elementary Education Online, 14*(1). Retrieved fromhttp://ilkogretim-online.org.tr/

Kinach, B. M., (2002). Understanding and learning-to-explain by representing mathematics: Epistemological dilemmas facing teacher educators in the Secondary mathematics "methods" course. *Journal of Mathematics Teacher Education, 5*, 153–186.

Kutlu, D. (2018). *Examination of the Pedagogical Content Knowledge Levels of Novice Secondary School Mathematics Teachers.* Unpublished master degree thesis, Karadeniz Technical University, Institute of Educational Sciences, Trabzon.

Kutluk, B. (2011). *The investigation of elementary mathematics teachers knowledge of student difficulties related to pattern concept.* Unpublished master degree thesis, Dokuz Eylul University, Institute of Educational Sciences, İzmir

Murtafiah, W.,& Lukitasari, M. (2019). Developing Pedagogical Content Knowledge of Mathematics Pre-Service Teacher through Microteaching Lesson Study. *Online Submission*, *13*(2), 201-218.

Perkins, D.N. & Simmons, R. (1988). Patterns of misunderstanding: An integrative modelfor science, math, and programming. *Review of Educational Research*, 58(3), 303–326.

Rowland, T., Huckstep, P., & Thwaites, A. (2003). The knowledge quartet. *Proceedings of the British Society for Research into Learning Mathematics*,*23*(3), 97-102.

Rowland, T. (2005). The knowledge quartet: A tool for developing mathematics teaching. In A. Gagatsis (Ed), *Proceedings of the Fourth Mediterranean Conference on Mathematics Education* (1st ed., pp. 69-81) Nicosia, Cyprus: Cyprus Mathematical Society.

Rowland, T. (2013). The knowledge quartet: The genesis and application of a framework for analysing mathematics teaching and deepening teachers' mathematics knowledge. *Sisyphus-Journal of Education*, *1*(3), 15-43.

Shulman, L. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher, 15*(2), 4-14.

Shulman, L. (1987). Knowledge and teaching: Foundations of the new reform. *Harvard Educational Review, 57*(1), 1-22.

Skemp, R.R (1976) Relational Understanding and Instrumental Understanding, *Mathematics Teaching, 77*, 20-26.

Türnüklü, E. ve Yesildere, S. (2007). The pedagogical content knowledge in mathematics: Preservice primary mathematics teachers' perspectives in Turkey. *Issues in the Undergraduate Mathematics Preparation of School Teachers, 1* (October). Retrieved fromhttp://www.k-12prep.math.ttu.edu

21st Century Skills and Teacher Training

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Canakkale Bilim ve Sanat Merkezi

Introduction

The human profile in societies has changed with the dizzying development of technology and access to knowledge and information becoming an important force. The qualities and skills that people should have have inevitably changed, and how education will be affected by this change has also been a subject of great investigation. Changes in the quality and content of education are among the most discussed topics in our country as well as all over the world. The education system consists of the students, teachers, educational programs, administrators, physical and financial resources. In this respect, it can be said that the teacher is the most fundamental element of the education system and the quality of education is directly proportional to the quality of teachers (Şişman, 2005). Considering the fact that the human profile needed today should have characteristics such as being able to think critically, be creative, open to communication and cooperation, it can be said that teachers should have these characteristics in order to raise individuals with these characteristics.

It is an accepted fact that the most important factor determining the quality of educational services in a country is the quality of the teacher (Mahiroğlu, 2007). In a study conducted by Organization for Economic Cooperation and Development (OECD), it is stated that the quality of education in a country is proportional to the quality of teachers, that students' learning process is affected by many factors, and that teacher and teaching-related factors have important effects on student learning. In particular, "teacher quality" is shown as the most important factor affecting the student success (OECD, 2018).

The necessity of teachers to have characteristics that can affect the quality of education makes it necessary to improve the quality of the programs applied in teacher education. However, studies show that there are still problems in the current teacher training programs in our country. In this respect, elimination and improvement of the deficiencies in teacher training programs is important in terms of contributing to the development of teacher qualifications (Erden, 1998).

Teacher training is divided into two periods as pre-service and in-service trainings (Şişman & Acat, 2003). In pre-service education, it is aimed that teacher candidates gain the knowledge, skills and attitudes required by their profession. Pre-service training has 3 aspects. First aspect aims to improve the general cultural skills. The second aspects is the cultural field that gives knowledge and skills related to the content of the field of

education while the third is the professional aspect in which the theoretical and practical sides of educational sciences and the behaviors required by the teaching profession are achieved (Küçükahmet, 1993). In this process, thanks to teaching practices, prospective teachers have the opportunity to examine the information they have obtained in theoretical studies and to turn the knowledge into action. This opportunity is a real chance for prospective teachers to experience the learning process in a real environment (Hamaidi et al., 2014). Regardless of the quality of pre-service training, teachers must be supported by in-service training in order to continue their development after starting their profession.

The changes and developments in the society also direct the education programs, and the education programs are directly affected by this process (Belet- Boyacı & Güner- Özer, 2019). For this reason, the answer to what kind of teacher should be in education varies according to the societies and time, causing new searches in teacher training systems (Celep, 2004). However, in order to talk about the quality of education in a society, the process should be started primarily with teacher education and teacher education should be supported continuously. Studies reveal that teacher training systems should also be reviewed (Yılmaz et al., 2019). Dorczak (2018) states that current approaches in pre-service teacher training focus solely on the teacher's teaching competencies in his / her field and aim to train teachers in specific areas instead of teachers that support the comprehensive development of students. Mizerek (2018) states that current teacher training systems, especially pre-service teacher training systems, should be reviewed. It is inevitable to do this especially in these days when we are going through extraordinary periods.

Different practices have been made in the field of teacher training in the world and in our country and the new developments have been followed in order to train more equipped and more qualified teachers, and as a result, many changes have been made (Altınok & Eskimen, 2011). In recent years, it is seen that many countries associate the inadequacy of their education systems with teacher training and carry out continuous reforms on this issue, and as a result, there are many different practices in teacher training in the world (Topkaya et al., 2012; Aksoy, 2013). Practices in teacher training programs, especially in countries that are successful in education, are followed by other countries. Teacher education policies in Turkey are also affected by these studies.

As a result of the education policies that have been followed in our country since the 1960s, many changes have been experienced in our teacher training system (Okçabol, 2005). In consequence of the teacher training system transferred from the Ministry of National Education (MEB) to universities with the law about the Council of Higher Education (YÖK) enacted in 1982, the education faculties that did not have sufficient experience in training teachers got into a very difficult situation. As a result, an effective

coordination between Higher Education Institution and the Ministry of National Education in teacher education could not be achieved for a long time (Ayas, 2009). The first formal studies aiming to determine the teacher competencies in Turkey began in 1998 and teacher training standards was set in cooperation with YÖK and the World Bank. Teacher competencies within the scope of "YÖK / World Bank National Education Development Project Initial Teacher Training" was determined as "competencies related to subject area and field education", "competencies related to teaching-learning process", "monitoring, evaluating and recording students' learning" and "complementary professional competencies" (MEB, 2017). As a result of this study, the names of the departments and programs, the names of the courses, their duration and contents were changed, and a balance was tried to be established between theory and practice. Thus, in this process called faculty-school cooperation, it is aimed to strengthen the cooperation between the university (faculty) and the ministry (school) (Şişman & Acat, 2003; Tok, 2011).

With this cooperation model, it is aimed that prospective teachers will be able to apply in educational environments the theoretical infrastructure acquired in the faculty and required by the profession, and adopt a positive attitude regarding the teaching profession, so that they are able to carry out the theoretical and practical education together effectively (Yapıcı & Yapıcı, 2004). Thus, teacher candidates will have the opportunity to reach a more successful pre-service education. However, today there are still deficiencies and glitches in both the theoretical and practical part of pre-service training (Taşcı, 2016). In brief, improvements need to be made in many areas, from the process of selecting teacher candidates to the training process. In recent years, countries that stand out with their success have developed mechanisms that will enable teachers to be innovative and creative in their education policies, as well as giving more importance to the selection of teacher candidates and teacher training (Durman, 2017). Education is a set of systems; the quality and success of the teaching system depends on the existence of a successful pre-service education system. In the report prepared by OECD (2005); it is stated that teacher quality is very important in student achievement, therefore, more attention should be paid to pre-service teacher education as a basic component in increasing teacher qualifications and continuous development of teachers within the profession.

There are common elements in teacher professional development policies of successful countries in education. These; the quality of pre-service teacher training is pre-service or as part of the start-up period, long-term teaching practice activities, a structure that focuses on the continuous improvement of teachers and well-established teacher evaluation mechanisms in school practices (OECD, 2018). The way to improve educational outcomes in a country is through improving teacher qualifications (MEB, 2017). It is obvious that teacher quality can be achieved by increasing the quality of

pre-service and in-service teacher education. For this reason, it should be ensured that teachers are qualified to meet the educational needs of students through both pre-service training and in-service training. In order to increase the quality of the education system, it is very important to develop existing teachers, as well as attract successful students to the teaching profession (OECD, 2015).

Since the beginning of the century, serious changes have been taking place in education. Turkish society has also been affected by the economic, technological and cultural transformations that have occurred at the international level since the last quarter of the twentieth century. It is possible to see the effects of this change on social, cultural and economic structures as well as schools, students, teachers and administrators in the education system (MEB, 2011). Especially in recent years, technological developments and changes reveal the necessity of education systems that can improve themselves in this direction (Abualrob, 2019). The ultimate purpose of education systems is to be able to raise free individuals who are beneficial to society, who take care of social values, who have acquired effective communication skills, who can adapt to change, who have gained the skills to access and benefit from learning resources effectively, who can use information communication technologies efficiently, who are at peace with themselves and society, who take initiative, research, question and have critical thinking skills. The most important task in the construction of a society consisting of individuals with these qualities falls to the teachers (MEB, 2017). Nowadays, students' unlimited and free access to information have changed the roles of teachers in the process. In this regard, educators need to redesign their teaching processes, create an innovative learning experience for students and use technology actively. In addition, teachers are expected to help students develop 21st century skills such as problem solving, critical thinking, creativity, teamwork, metacognition, effective communication and social skills (Mitsou, 2019).

Changes in information and communication technologies as a result of globalization and internationalization concepts also change learning styles and skills. Common points of the researches conducted on these skills, which are generally referred to as 21st century skills; cooperation, communication, digital literacy, citizenship, problem solving, critical thinking, creativity, productivity. Problem solving and critical thinking skills have long been on the agenda of education systems. With the addition of creativity and digital literacy to this process, the knowledge and skills required in education have become quite different from the 19th and 20th century education systems. Especially developments in information and technology have made education more global and international (Suto & Eccles, 2014). One of the primary roles of education is to prepare students to cope with future challenges. Therefore, it can be thought that education has become the key to economic survival in the 21st century (Trilling & Fadel, 2009). Today, students need

more competencies such as high-level thinking skills, multi-literacy, technological literacy (Snape & Fox- Turnbull, 2011).

It is inevitable to make changes in teacher training as a result of the changes happened in the traditionally known duties and characteristics of teachers. The research conducted by Abualrob (2019) reveals that many of the teachers still use traditional methods. In the same study, it is stated that very few teachers use critical thinking, effective communication, cooperation, negotiation and problem solving skills. One of the reasons teachers cannot do that is their lack of skills of that kind and their inability to keep up with rapid technological progress. In this respect, it is important to educate teachers who adopt the 21st century skills and take an interest in using them (Yavuz et al., 2015).

21st Century Skills

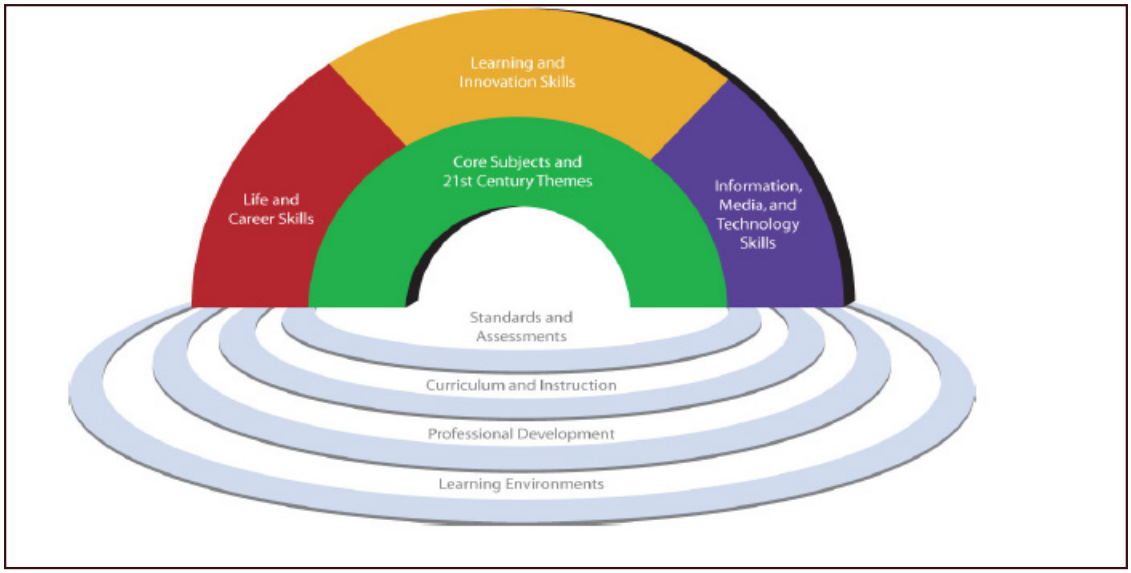
Although there are many studies on the determination of 21st century skills, there is no single widely accepted definition. Considering the differences in the structures of societies, educators, politicians, employers and higher education institutions, it can be said that this is an expected situation (Suto & Eccles, 2014). Studies have been conducted by various institutions and organizations regarding the modeling of these skills, and frameworks have been put forward. 21st century skills have been defined by many institutions such as P21 (Partnership for 21st Century Learning), Microsoft, EnGauge (The Metiri Group and The Learning Point Associates), ATC21S (Assesment and Teaching of 21st Century Skills).

According to Assessment and Teaching of 21st Century Skills (ATC21S), 21st century skills are (Binkley et al., 2010):

- Ways of thinking (creativity and innovation, critical thinking, problem solving, decision making, learnig to learn, metacognition)
- Ways of working (communication, collaboration)
- Tools for working (information literacy, information and communication technology literacy)
- Living in the World (citizenship, life and career, personal and social responsibility)
- According to EnGauge, 21st century skills are (NCREL, 2003):
- Digital- Age Literacy (basic, scientific, economic and tehnolgical literacies, visual and information literacies, multicultural literacy and global awareness)
- Intentive Thinking (aadaptability, managing complexity and self direction, curiosity, creativity and risk taking, higher- order thinking and sound reasoning)

- Effective communication (teaming, collaboration and interpersonal skills, personal, social and civic responsibility, interactive communication)
- High productivity (prioritizing, planning and managing for results, effective use of real- World tools, sbility to produce relevant, high- quality products)
- According to P21, 21st century skills are (AACTE, 2010):
- Core subjects (native language/ reading, World languages, arts, geography, history, mathematics, science, government/ civics)
- 21st Century Themes (Global Awareness, financial, economic, business and entreproneurial literacy, civic literacy, health literacy)
- Learning& Innovation skills (critical thinking & problem solving, creativity & innovation, communication & collaboration)
- Information, media & technology skills (information literacymedia literacy, ICT literacy)
- Life & career skills (flexibility & adaptability, initiative & self- direction, social & cross- cultural skills, productivity & accountability, leadership & responsibility)
- According to Microsoft, 21st century skills are (Microsfot, 2017):
- Thinking and learning to learn
- Cultural competence, interaction and self- expression
- Self- care and managing everyday life
- Multiliteracy
- Information and communication technology (ICT) competence
- Working life skills and entrepreneurship
- Participating, influencing and building a sustainable future

When the studies on 21st century skills are compared, it is seen that the skills are grouped under different titles: In the framework developed by Assessment and Teaching of 21st Century Skills (ATC21S), 21st century skills are gathered under 4 headings; in the framework developed by Microsoft, 21st century skills are gathered under 7 headings ; in the framework program prepared by the US National Research Council, 21st Century skills are collected under 3 headings; in the framework, which is one of the most important of these studies prepared by The US Partnership for 21st Century Learning



Şekil 1. 21st Century Student Outcomes and Support Systems (P21)

In our country, MEB (2011) conducted the study of "21st Century's Student Profile" so as to examine the student profile in the 21st century. In this study prepared by MEB 21st century skills are discussed in 4 themes as ways of thinking, ways of working, working tools and world citizenship. Ways of thinking consist of creativity, innovative thinking, receptiveness, problem solving, decision making and using learning strategies; and the ways of working include in communication skills and teamwork while working tools consist of information literacy and communication literacy and finally world citizenship is made up of the awareness of local and universal citizenship, awareness and skills related to life and career, cultural awareness and competences; so that it can be created a personal and social responsibility awareness.

One of the main roles of education is to prepare individuals to cope with the future challenges (Trilling & Fadel, 2009). One of the most important issues of today's education is how 21st century skills can be acquired and developed through education systems. This makes it inevitable to make changes and innovations in education policies. 21st century skills must be included in the school curriculum, teaching and evaluation process (NCREL, 2003). It can be said that technological development, educational environments, applied education, interactive distance education, orientation, access to information-information source, globalization-international education, learning thinking skills will be decisive concepts for education in the 21th century (Gelen, 2017). Studies show that it is possible to gain these skills by integrating them through lessons. It is very important for teachers to have these skills which are aimed to be acquired also by the students (Cansoy, 2018).

Considering the relationship between students' ability to use 21st century skills and the level of teachers' use of these skills, teachers should be trained to have these skills, as well as teacher candidates (Dağhan et al., 2017). In other words, there is a need for

teachers who adopt 21st century skills and strive to transmit these skills to the students. This requires to determine some of the skills and attitudes that teachers should have (Yavuz et al., 2015).

The attitudes and skills that teachers should have are called teacher competencies. Studies are carried out to determine teacher competencies in the world. In this direction, there is a number of studies carried out by the Ministry of National Education in our country. In order to reorganize teacher competencies in line with European Union countries, the Ministry of National Education determined the "General Competencies for the Teaching Profession" in 2006 as a result of studies made by national and international experts, academicians and teachers. These competencies were revised in time and took their final form in 2017. According to that, the general competencies of the teaching profession were grouped under three headings: professional knowledge, professional skills, attitude and values.

The teaching profession competencies in our country are expressed as the teaching profession standards in many countries and even states. There are different approaches in grouping of the competences in the world. For instance, teaching standards in New York State are gathered under 7 headings: knowledge of students and student learning, knowledge of content and instructional planning, instructional practice, learning practice, learning environment, assesment for student learning, professional responsibilities and collaboration, professional growth (NYSED, 2011) . In Australia, the standards are grouped in 3 areas as professional knowledge, professional practice and professional participation, and a total of 7 standards have been determined by detailing each area (Australian Institute for Teaching and School Leadership, 2011).

The American Association of Teacher Training Colleges (AACTE) and the Partnership for 21st Century Skills Strategic Council state that 21st century knowledge and skills should be integrated into education and both teachers and administrators should have these skills (AACTE, 2010). In the 2023 Education Vision prepared by MEB (2018), it is stated that studies will be carried out to provide teachers with 21st century skills.

Significant changes are being made in education systems around the world in order to gain skills such as problem solving, critical thinking, innovative production, effective communication which are called 21st century skills. It was impossible for the education system in our country not to be affected by these developments. As a result, the qualifications that the teacher should have along with the curriculum were redefined. Because the success of reaching the goals designed in the field of education is proportional to the qualifications and competencies of the teachers who direct this process (MEB, 2017). There are studies conducted by the Ministry of National Education to provide teachers with 21st century skills through in-service training. However, teacher

candidates who have not started yet their profession should gain these skills and teacher training programs should be reviewed in this direction. In the studies about the 21st century skills of teachers and teacher candidates different results have been reached. When the studies conducted with pre-service teachers are examined, it is seen that undergraduate programs are sufficient to acquire 21st century skills, and that the teacher candidates consider themselves sufficient regarding these skills (Göksün & Kurt, 2017; Gömleksiz et al., 2019; Bozkurt, 2020; Erdoğan & Eker, 2020). Similarly, when studies on teachers are examined, it is seen that teachers have high perceptions of competence regarding these skills and they use them in their teaching processes (Cemaloğlu et al., 2019; Eğmir & Çengelci, 2020; Gürültü et al., 2020).

It can be said that 21st century skills and technology are highly interrelated. Effective use of knowledge, media and technology skills, which is one of the 21st century skills, supports the learning of other skills such as critical thinking and problem solving, communication and collaboration, creativity and innovation (Lamb et al., 2017). In this respect, technological competence is very important for students to acquire 21st century skills. In this regard, it is necessary to improve teachers' ability to use technology effectively in order for students to use technology effectively (AACTE, 2010).

Technological Competence

Today, technology has become an important element of our life as a result of the use of technology everywhere, its accessibility and its facilities, and hereat, our social life has acclimatized to that. Educational environments also have been affected by these technological developments that have made the society change, and as a result, innovations and changes have been made in learning processes and environments (Usta & Korkmaz, 2010; Menzi et al., 2012). Traditional teaching approach have been leaving its place to the technology-based teaching methods, and both students and teachers benefit more from technology (Erbil & Kocabaş, 2019).

In consequence of the rapid change experienced with the development of science and technology, access to the information has become easier, so that people are able to reach the information from anywhere at any time. As a result of such a rapid change, all the knowledge and experience people need in the 21st century have been put at the service of humanity with the help of digital media (Kozikoğlu & Altınova, 2018). Benefiting from these opportunities at the highest level is one of the priorities of education systems in all societies. In our country, it is aimed that students use information technologies as a means of "production", "developing solutions to problems" and "realizing their dreams" in online and offline environments. For this purpose, digital content will be prepared for students as well as improving the technological infrastructure. With the help of these contents, it is aimed that students reach more easily the information they need.

Thus teachers all over Turkey with the use of digital learning technologies and students are expected to reach equal learning opportunities (MEB, 2018). As a matter of fact, countries in the world have been applying digital learning technology to educate their citizens to be successful in the 21st century. The success of future education systems will be evaluated according to how well the system prepares students for the 21st century's world and Industry 4.0 (Ally, 2019).

Education systems have to prepare students for developing technologies and jobs which is convenient for the human profile required by Industry 4.0 (Ally, 2019). This means raising individuals who use technology more effectively. With the widespread usage of mobile phones and the internet, students are more open to communication. In terms of using technology, 21st century's students who are more successful than their parents and teachers need the guidance of their teachers to use these skills in the field of education (Trilling & Fadel, 2009). In the 21st century's education, teachers should be able to use technology effectively in the learning process (Riandi et al.,2018). In this respect, teachers need support in understanding when and how to use information technologies so as to deal with students' experiences and enrich their educational environments (UNESCO, 2011).

Developments in information and communication technology play an important role in the daily life of most people around the world, and it is natural for the school system to integrate technology into the education process (Malinina, 2015). A wide range of people from all over the world, from educators to politicians, agree that technology is an essential component of education. For that reason, countries have been working significantly to improve the technological infrastructure of schools. In addition, efforts to integrate technology into education programs have been also continuing (Lamb et al., 2017).

Students' learning is also positively affected by the effective use of technology and their integration into the teaching environment by teachers (Menzi et al., 2012). In this respect, it is possible to say that the most important task and responsibility in integrating technology into different lessons belongs to schools and teachers (Şad & Nalçacı, 2015). The most important factor in the development of technology in education is not only the teachers and their attitudes and competencies towards including technology in teaching processes but also their desire to receive more education in this field (Malinina, 2015). As a matter of fact, the implementation of technology-based innovations in schools can be possible with the adoption of it by educators. Therefore, teachers who believe that the use of information and communication technologies (ICT) works will adopt these technology-based approaches. With the integration of ICT into education and harmonization of it with the curriculum, they will contribute to the spread of ICT usage (UNESCO, 2011).

The use of information and communication technologies in education has many benefits for teachers and students. Affecting more than one aspect of education, ICT not only provides students with the opportunity to learn outside of school, but can also change the pedagogical approach of teachers. Therefore, education systems integrate digital competencies more into the education systems and curriculum (OECD, 2019). Efficient integration of technology is possible with the preparation of teachers who encourage and use digital learning (Raob et al., 2012). The successful integration of information and communication technologies in education not only increases the usability and flexibility of education for students, but also helps students to collaborate and use information effectively (Malinina, 2015). On the other hand, it contributes to teachers' structuring the learning environment in unconventional ways, combining technology with the new pedagogy and thus building a more active and collaborative process (UNESCO, 2008).

Important studies are carried out to improve the technological infrastructure in schools in our country as well as all over the world. One of them is FATIH Project (Increasing Opportunities and Improving Technology Project) project. With FATIH Project, it is aimed to equip all classes with ICT tools and to implement ICT-supported education in all classes. In the project, online and face-to-face professional development activities are planned in order to support the training of teachers in the use of ICT in the classroom (UNESCO, 2011). In the face of the 21st century, developing the technological skills of teachers is of great importance in order to improve the quality of learning (Riandi et al.,2018).

The inadequacy of schools in terms of physical and technological equipments prevents the information technologies from its integration into learning and teaching processes (Atalay & Anagün, 2014). Besides, increasing the technological competence of schools is not enough to use new methods and techniques in the teaching process. For this reason, the competence of the people who will be affected by this change should also be taken into account. Because the self-efficacy of the teachers regarding the use of technology directly affects the use of these technologies (Ursavaş, 2014).

Studies are conducted on teachers' ICT competencies in the world and in our country. In the ICT Competence Standards for Teachers project carried out by UNESCO (2008); It is emphasized that it is necessary to develop teachers' ICT skills and contribute to their professional development, to provide teachers with qualifications to integrate their ICT skills into their teaching processes, and to organize teacher training programs in this direction.

There are studies that have reached different results on the technological competencies of teacher candidates. When the researches on the technological competencies of teacher candidates are examined, it's seen that in addition to researches that pre-service teachers

consider themselves to be sufficient (Usta & Korkmaz, 2010; Menzi et al.; Gömleksiz et al., 2019; Kartal, 2019; Erdoğan & Eker, 2020), there are also studies showing that pre-service teachers do not have basic knowledge and skills in effective technology use (Pamuk et al., 2012). When the studies on the technological competencies of teachers are examined; it can be said that there are also studies that teachers consider themselves competent (Güneş et al., 2010; Atalay & Anagün, 2014; Malinina, 2015; Yılmaz, 2016; Gürültü et al., 2020) and studies that teachers think they are not competent to meet the needs of students (Hamlı et al.,2020). In-service trainings are of great importance in developing the technological competencies of teachers. In the study conducted by Erbil & Kocabaş (2019), teachers stated that they benefited from technology in the teaching process, but also emphasized the insufficiency of in-service training. The results show that there are serious differences between the technological competencies expected from teachers and the competencies they actually have. Researches show that teacher candidates cannot gain the use of technology sufficiently during their teacher education process. For this reason, teachers should be supported with in-service trainings, and teacher candidates should be trained with an effective training on this subject (Menzi et al., 2012).

Active use of technology in the educational process contributes to increase the motivation of students, as well as increasing the general information and communication technology competence of both teachers and students (Malinina, 2015). Teachers, who play an active role in helping students acquire these skills, are responsible for creating the appropriate classroom environment and for preparing the learning opportunities that make it easier for students to use the technology. In addition to using technology effectively, teachers should know how to support students in this process and prepare favorable learning environments (UNESCO, 2008). To achive that, it is so important to develop and support teachers professionally.

The integration of technology into learning processes affects students' learning processes inside and outside the school. As a matter of fact, teachers use more technology in many areas such as classroom management, teaching practices and communication. In this respect, information and communication technology proficiency is considered as an important skill that students must acquire (OECD, 2019). In conclusion, when all these are taken into consideration, it is possible to say that the most important task in raising individuals with 21st century skills and technological competence is teachers's. Although studies show that teachers have 21st century skills and technological competence, reflection of these competencies in learning-teaching processes requires a separate competency. In other words, the integration of ICT into the curriculum and technology-supported teaching activities require teachers to have certain skills and knowledge about the learning process with digital tools, preparation of course materials and classroom

management (OECD, 2019). In the teacher training process, skills should also be acquired about how to use this technology in the integration of technology into learning environments and what it means pedagogically (Şad & Nalçacı, 2015). The training of teachers to have these knowledge and skills can also be provided by effective pre-service and in-service training. In this respect, it is very important to review the existing teacher training systems and develop it to gain 21st century skills.

Conclusion

In these days when Industry 4.0 is experienced, great changes are taking place in all areas of life. The rapid change and development of technology, the ease of access to information and the fact that information becomes the greatest power change the lives of societies. Along with the concepts of globalization and internationalization, the characteristics that individuals should own also have changed over time. In the 21st century, the knowledge and skills that people should have also have changed. Education system is one of the systems that is most affected by these changes. The greatest function of education is to prepare individuals for the future and the challenges they may face in the future.

Societies are affected in different ways by these changes and these changes are reflected in educational policies and processes differently. These skills sought in individuals today are called 21st century skills. Although some studies say that these skills were important in education in the past centuries and even have existed since Socrates, some concepts are quite new in our lives. In today's world, where skills such as problem solving, critical thinking, innovative production, and information literacy are referred to as 21st century skills, it is stated that the task of education systems is very important for students to gain these skills. It is obvious that teachers have the most important role in raising students with these skills. In this respect, it is an indisputable fact that teachers should have these skills themselves. Today, where traditional teaching methods are frequently used, researches show that teachers should be supported both before and in service in order to gain 21st century skills.

21st century skills and technology are two important inseparable components and are highly interrelated. In particular, the changes in technology in recent years have pushed education systems to change in this direction, education programs have been affected by this process, and efforts have been made to integrate technology into the curriculum. Integrating technology into the curriculum and teachers' competencies in this regard have gained particular importance, especially in today's very extraordinary times. In the "General Competencies for Teaching Profession" prepared by the Ministry of National Education (2017), the vocational skills that teachers should have are included. One of these skills is expressed as managing the teaching and learning process and is included in this

section as one of the sufficiencies that "effectively uses information and communication technologies in the teaching and learning process." Today, the concept of technological competence has also changed. The ability of teachers to be technologically competent also affects their effective use of technology in learning-teaching processes. In this respect, it is inevitable for teachers to have these competencies and develop themselves in this direction in today's education system, where concepts such as technological development, interactive distance education, access to information, and digitalization are highly involved.

References

AACTE (2010, November 11). 21st Century Knowledge and Skills in Educator Preparation. Retrieved from https://files.eric.ed.gov/fulltext/ED519336.pdf

Abualrob, M. M. (2019). The role of science teachers in developing the 21st century skills fort he elementary school students. *Interdisciplinary Journal of Environmental and Science Education,* 15 (1), e02206.

Aksoy, E. (2013). *Transformation in teacher education in USA (New York), Finland, Singapore and Turkey (2000- 2010).* (Unpublished doctoral dissertation). Ankara University Institute of Educational Sciences, Ankara.

Ally, M. (2019). Competency profile of the digital and online teacher in future education. *International Review of Research in Open and Distributed Learning Volume*, 20 (2), 302- 318.

Altınok, Ş. & Eskimen, A.D. (2011). Türk Dili ve Edebiyatı öğretmen adaylarının okul deneyimi-I dersine yönelik görüşleri [Turkish Language and Literature Teachers' opinions towards School Experince-1 Course]. *2nd International Conference on New Trends in Education and Their Implications (ICONTE),* 27-29 Nisan, Antalya.

Atalay, N. & Anagün, Ş. S. (2014). The views of classroom teachers working in rural areas about using information and communication technologies. *Journal of Qualitative Research in Education,* 2 (3), 9- 27 (Online).

Australian Institute for Teaching and School Leadership (2011). *Australian professional standards for teachers*. Retrieved from https://www.aitsl.edu.au/docs/default-source/national-policy-framework/australian-professional-standards-for-teachers.pdf

Belet- Boyacı, Ş. D. & Güner- Özer, M. (2019). The future of learning: Turkish language course curricula from the perspective of 21st century skills. *AJESI - Anadolu Journal of Educational Sciences International*, 2019; 9(2): 708-738.

Binkley, M., Erstad, O., Herman, J., Raizen, S., Ripley, M. & Rumble, M. (2010). *Draft white paper 1 defining 21st century skills.* Retrieved from https://www.intel.com.tr/content/dam/www/public/emea/tr/tr/pdf/education/tools-and-resources/century21-skills-report.pdf

Bozkurt, F. (2020). Evaluation of social studies teacher training program in terms of 21st century skills. *Pamukkale university Journal of Education,* 1-30.

Cansoy, R. (2018). 21st century skills according to international frameworks and building them in the education system. *Journal of the Human and Social Science Researches*, 7 (4), 3112- 3134.

Celep, C. (2004). *Meslek olarak öğretmenlik.* Ankara: Anı Yayıncılık.

Cemaloğlu, N., Arslangilay, A. S., Üstündağ, M. T. & Bilasa, P. (2019). 21st century skills self- efficacy perceptions of vocational high school teachers. *Journal of Kırşehir Education Faculty*, 20 (2), 845- 874.

Dağhan, G., Nuhoğlu- Kibar, P., Menzi- Çetin, N., Telli, E. & Akkoyunlu, B. (2017). 21st century learners' and teachers' characteristics from ICT preservice teachers' perspectives. *Educational Technology Theory and Practice*, 7 (2), 215- 235.

Dorczak, R. (2018). The importance of teacher leadership in educational leadership. In J. Madalinska- Michalak (Ed.), *Teacher Leadership* (pp. 40- 51). Warszawa: FRSE Publications.

Durman, Ö. (2017). *Sustainable economic growth and skilled labour: An assessment of PISA exams*. (Unpublished master's dissertation). Ağrı İbrahim Çeçen Institute of Social Sciences, Ağrı.

Erbil, D. G. & Kocabaş, A. (2019). Primary teachers' views on using technology in education, flipped classroom and cooperative learning. *Elemantary Education Online*, 18 (1), 31- 51.

Erden, M. (1998). *Eğitimde program değerlendirme*. Ankara: Anı Yayıncılık.

Erdoğan, D. & Eker, C. (2020). Investigation of the relationship between Turkish pre-service teachers' 21st century skills and lifelong learning life tendencies. *Karaelmas Journal of Educational Sciences*, 8, 118- 147.

Eğmir, E. & Çengelci, S. (2020). The predictive power of teachers' 21st century teaching skills on applying reflective thinking skills. *Journal of History School*, 45, 1045-1077.

Gelen, İ. (2017). P21- 21st century skill frameworks in curriculum and instruction (USA practices). *International Journal of Interdisciplinary Educational Studies*, 1 (2), 15- 29.

Göksün, D. O. & Kurt, A. A. (2017). The relationship between pre-service teachers' use of 21st century learner skills and 21st century teacher skills. *Education and Science*, 42 (190), 107-130.

Gömleksiz, M. N., Sinan, A. T. & Doğan, F. D. (2019). Perceptions of prospective teachers of Turkish, Turkish Language and Literature and Contemporary Turkis Dialects of the 21st century skills ande competences. *Avrasya Uluslararası Araştırmalar Dergisi*, 7 (19), 163- 185.

Güneş, G., Gökçek, T. & Bacanak, A. (2010). How do teachers evaluate themselves in terms of technological competencies? *Procedia Social and Behavioral Sciences*, 9, 1266- 1271.

Gürültü, E., Aslan, M. & Alcı, B. (2020). Secondary schools teachers' competencies in the use of 21st century skills. *Hacettepe University Journal of Education*, 35 (4), 780- 798.

Hamaidi, D., Al- Shara, İ., Arouri, Y. & Awwad, F. A. (2014). Student- teachers's perspectives of practicum practices and challenges. *European Scientific Journal*, 10 (13), 191- 214.

Hamarat, E. (2019). *21.yüzyıl becerileri odağında Türkiye'nin eğitim politikaları.* İstanbul: Seta Yayıncılık.

Hamlı, D., Hamlı, S. & Taneri, P. O. (2020). Temel eğitimde 21.yüzyıl becerilerinin sınıf öğretmenlerinin görüşlerine göre incelenmesi. Current Debates on Social Sciences 4 Mul (Ed: Alpaslan Ceylan, İlhami Durmuş ve Salih Çeçen). Ankara: Bilgin Kültür Sanat Yayınları.

Kartal, B. (2019). Examining pre-service teachers' attitudes beliefs, and intentions related to using educational technologies. *YYÜ Journal of Education Faculty*, 16 (1), 436- 463.

Kozikoğlu, İ. & Altunova, N. (2018). The predictive of prospective teachers' self-efficacy perceptions of 21st century skills for their lifelong learning tendencies. *Journal of Higher Education and Science,* 8 (3), 522- 531.

Küçükahmet, L. (1993). Öğretmen yetiştir*me (programları ve uygulamaları.* Ankara: Gazi Üniversitesi İletişim Fakültesi Matbaası.

Lamb, S., Maire, Q. & Doecke, E. (2017). *Key skills for the 21st century: an evidence-based review. education future frontiers report. nsw department of education.* Retrieved from http://vuir.vu.edu.au/35865/1/Key-Skills-for-the-21st-Century-Analytical-Report.pdf

Mahiroğlu, A. (2007). Öğretmenlik mesleği ve öğretmen yetiştirmede gelişmeler ve yenilikler. In Ö. Demirel, Z. Kaya (Ed.), *Eğitim Bilimine Giriş*. Ankara: Pegem A Yayıncılık.

Malinina, I. (2015). ICT competencies of foreign languages teachers. *Procedia- Social and Behavioral Sciences*, 182, 75- 80.

MEB (2011). The Characteristics of a 21st Century Student. Retrieved from http://www.meb.gov.tr/earged/earged/21.%20yy_og_pro.pdf

MEB (2017). Öğretmen Strateji Belgesi 2017- 2023. Retrieved from http://oygm.meb.gov.tr/meb_iys_dosyalar/2017_06/09140719_Strateji_Belgesi_Resmi_Gazete_sonrasY_ilan.pdf

MEB (2018). 2023 Eğitim Vizyonu. Retrieved from https://www.gmka.gov.tr/dokumanlar/yayinlar/2023_E%C4%9Fitim%20Vizyonu.pdf

Menzi, N., Çalışkan, E. & Çetin, O. (2012). Examination of the competencies of pre-service teachers in terms of some variables. *Anadolu Journal of Educational Sciences International*, 2 (1), 1- 18.

Microsoft (2017). *Road to 21st century competence.* Retrieved from https://kirstilonka.files.wordpress.com/2018/08/evaluation_framework_microsoft_final.pdf

Mitsiou, D. (2019). The flipped classroom learning model as a means for acquiring 21st century skills. *Journal of Contemporary Education, Theory & Research,* 2, 16- 23.

Mizerek, H. (2018). What kind of evaluation do we need inside a school?. In R. Dorczak (Ed.), *Leading and Managing for Development*, (pp. 15- 24). Krakow: Jagiellonian University Institute of Public Affairs.

NCREL (2003). enGauge 21st Century Skills for 21st century learners. Retrieved from file:///C:/Users/asus-pc/Desktop/kitap_b%C3%B6l%C3%BCm%C3%BC/21.yy/engauge21st-2.pdf

NYSED (2011). *New York State teaching standards.* Retrieved from http://www.highered.nysed.gov/tcert/pdf/teachingstandards9122011.pdf

OECD (2015), *Education Policy Outlook: Poland.* Retrieved from www.oecd.org/education/policyoutlook.htm

OECD (2018), Effective Teacher Policies: insights from PISA. Retrieved from https://www.oecd-ilibrary.org/docserver/9789264301603-5 en.pdf?expires=1600547811&id=id&accname=guest&checksum=C562806CB5D6103C31FC2EC5DE34CCF

OECD (2019). PISA 2021 ICT framework. Retrieved from November 11, 2020, https://www.oecd.org/pisa/sitedocument/PISA-2021-ICT-Framework.pdf

Okçabol, R. (2005). Öğretmen yetiştirme sistemimiz. Ankara: Ütopya Yayınevi.

Pamuk, S., Ülken, A. & Dilek, N. Ş. (2012). The investigation of preservice teachers' technolgy integration competencies from technological pedagogical content knowledge framework. Mustafa Kemal University of Social Sciences Institute, 9 (7), 415- 438.

Raob, I., Al-Oshaibat, H. & Ong, S. L. (2012). A factor analysis of teacher competency in technolgy. New Horizons in Education, 60 (1), 13- 22.

Riandi, R., Apriliana, V. & Purwianingsih, W. (Eds.). (2018). The analysis of 21st century teachers' ability in technological pedagogical content knowledge from: 2nd International Conference on Education Innovation (ICEI 2018), Atlantis Press.

Snape, P. & Fox- Turnbull, W. (2011). Twenty- first century learning and technology eduction nexus. Problems of Education in The 21st Century, 34, 149- 161.

Suto, I. (2013). 21st century skills: ancient, ubiquitous, enigmatic? Research Matters, 15, 2-8.

Suto, I. & Eccles, H. (2014). The Cambridge approach to 21st century skills: definitions, development and dilemmas for assesment. IAEA Conference, Singapore.

Şad, S. N. & N. Ö. İ (2015). Prospective teachers' perceived competencies about integrating information and communication technologies into education. Mersin University Journal of the Faculty of Education, 11 (1), 177- 197.

Şişman, M. (2005). Öğretmenliğe giriş. Ankara: Pegem A Yayıncılık.

Şişman, M. & Acat, M. B. (2003). A study of school experinces practices and its effeect on the perception of teaching profession. Fırat University Journal of Social Science, 13 (1), 235- 250.

Taşcı, S. (2016). Evaluation of the cooperation process between faculty of education-practice school in terms of managerial effectiveness (Unpublished doctoral dissertation). Çanakkale Onsekiz Mart University Institute of Educational Sciences, Çanakkale.

Tok, H. (2011). Clinical practice in teacher training. Gaziantep Üniversitesi Sosyal Bilimler Dergisi, 10 (4), 1363- 1375.

Topkaya, Y., Tokcan, H. & Kara, C. (2012). Opinions of prospective social studies teachers' views about teacher practice course. The Journal of Academic Social Science Studies, 5 (7), 663- 678.

Trilling, B. & Fadel, C. (2009). 21st century skills: Learning for life in our times. Francisco: Jossey-Bass.

UNESCO (2008). ICT competency standards for teachers policy framework. Retrieved November 26, 2020, https://unesdoc.unesco.org/ark:/48223/pf0000156210.

UNESCO (2011). ICTs and teacher competencies. Retrieved from https://iite.unesco.org/pics/publications/en/files/3214694.pdf

Ursavaş, Ö. F. (2014). Modeling and examining teachers' ICT acceptance (Unpublished doctoral dissertation). Gazi University Institute of Educational Sciences, Ankara

Usta, E. & Korkmaz, Ö. (2010). Pre-service teachers' computer competencies, perception of technology use and attitudes toward teaching career. *International Journal of Human Sciences,* 7 (1), 1335- 1349.

Yapıcı, Ş. & Yapıcı, M. (2004). Pre-service teachers' opinions about school experince 1 course. *İlköğretim- Online*, 3 (2), 54- 59.

Yavuz, M., Özkaral, T. & Yıldız, D. (2015). The teacher competencies and teacher education in international reports. *SDU International Journal of Educational Studies,* 2 (2), 60- 71.

Yılmaz, M. (2016). *The evaluation of primary school teachers' computer competency and attitudes toward technology concerning the use of technology in education* (Unpublished master's dissertation). Mersin University Institute of Educational Sciences, Mersin.

Yılmaz, R. B., Erden, E. G., Sarıca, B. Ö., Akın, M. Yılmaz, Ö. & Berat, G. (2019). Teachers' development and assignment systems of PISA successful countries. *Academic Platform Journal of Education and Change,* 2 (2), 217- 236.

SECTION 2
EDUCATIONAL TECHNOLOGY

Distance Education in Turkey During the Pandemic

Melike Cetinkaya
Mone

Introduction

Covid-19, which broke out in December 2019 in Wuhan, has spread throughout the world in a short time and changed the usual course of life (Zhao, 2020). The fact that Covid-19, which has been proven to transmit from person to person quickly, has fatal effects permeating throughout the large section of communities, has resulted in regulating precautions to decrease human contact all around the world. (OECD, 2020). As one of the foremost precautions, reducing the contact among the studentswho are educated in crowded classrooms and switching to online education instead of face-to-face education have necessitated (Gupta & Goplani, 2020). At the beginning of this process, whereas some countries chose to shut down the schools right away, some of them insisted on continuing face-to-face education; however, the spread of the virus has forced most of the countries to shut down the schools and go on with distance education again (Ozer, 2020; Reimers, 2020). At this very point, online infrastructure of countries has played a vital role in devising their plans and strategies for Covid-19 (Moreno & Gortazar, 2020). The maintenance of education by keeping the social distance has only been possible through the effective functioning of distance education. Therefore, this paper was written to describe what distance education is, its improvements both in the world and Turkey, and education activities organized in Turkey during the Covid-19 process for having a better grasp of distance education activities in Turkey.

Process

What is Distance Education?

Education is a non-stop process for all people throughout their lives. People have understood the importance of this process and developed alternative solutions for improving the quality of education. We can state that these alternatives have emerged from the opinion that traditional education carried out in schools has lost its quality of being the best method providing formal education in theoretical and universal terms (Ekici, 2003). Schools are educational institutions; yet, they were established in a time when people had quite different understanding of learning and learners, knowledge and ability, teaching and teachers. (Zhao, 2020). In this context, the most considered and significant alternative method to advance the quality of education is “distance education” (Ekici, 2003).

Distance learning, whose first use was carried out by post in 1728, appears to have improved considerably thanks to the advanced information technologies and it is now usable in the forms of teleconference and internet applications (İşman, 2008). Distance education, which is performed through the students' contact with educational sources (CDLP, 2004), has different definitions in literature. Some of these definitions are given below;

Distance education is the transmission of education to distant students by means of satellite, video, voice, graphic, computer and multimedia technology (USDLA, 2004).

Distance education is an education pattern that has emerged due to some reasons such as (a) when distance limits education and people living in rural regions are destitute of sufficient amount of sources and teachers, (b) the education requirement of people who are laid up with physical disabilities, (c) the education requirement of youth who could not go on formal education and the adults who want to improve themselves (Newby, Stepich, Lehman & Russell, 2006).

Distance education is a multidisciplinary field that tries to remove the restrictions between learners, teachers and learning sources, and applies available technologies with a pragmatist approach for achieving its purpose (Bozkurt, 2017).

Distance education is an education system in which teachers and learners are in different environments and they can continue their teaching and learning activities efficiently by adjusting the education based on their own pace and capacity and benefiting from education technologies (Balaban, 2012).

Distance education is an education model removing all the limitations and enabling a practical learning opportunity regardless of peoples' age and place, which therefore procures course materials and interaction by applying communication technologies to protect the unity of education without time and place limitations of teacher and learner (Adıyaman, 2002).

Distance education has many advantages compared to face-to-face education. Distance education is a philosophy and more of an education pattern. Students can access education everywhere (home, work and learning center) and every time without talking face to face with teachers. Technology is a key factor of distance education (Bates, Pearson & Pulimood, 2020). Teachers and students who are distant for miles can communicate with each other audibly and visually by means of distance education tools (İşman, 2008).

Improvement of Distance Education in the World

With the invention of the printing press, education technology gained acceleration more than it had ever gained and with the help of books, many people from miles away were

able to educate themselves without even knowing the people arranging the content of books. Therefore, we can say that the underlying process for distance education is the conversion of written sources in printed ones which entailed written sources to be easily reproduced, distributed and reached (Al & Madran, 2004).

In the performed classifications aimed at distance education, it is observed that technology plays a determinant role (Bozkurt, 2017) and these classifications are not apart but rather involve each of previous stages by overlapping with each other (Bozkurt, 2017; Moore & Kearsley, 2011; Rodriguez, 2012). In addition to that, when the improvement of distance education is analyzed, it is noteworthy that there is a tendency in education toward learning and principles of openness and flexibility.

The improvement of distance education is summed up with 5 stages by Taylor (1999):

1. Correspondence training;
2. The integrated use of one-way and multiple media such as printing, broadcast, videotapes or saved media;
3. mutual and simultaneous tele-learning by means of vocal or videoconferencing;
4. flexible learning based on online learning by means of online interactive multimedia and connected asynchronous learning.
5. a high automatization for asynchronous online learning and interactive multimedia and finally smart, flexible learning adding student check.

Simonson and his friends (2003) suggest that there are three turning points and periods that have changed how distance education is perceived all around the world:

1. correspondence courses in 1700s
2. the beginning of learning with electronic lesson materials after the emergence of electronic technologies in 1920s
3. the foundation of distance education universities in 1960s

One of the earliest examples of correspondence courses dates back to March 20, 1728, when it was announced in *Boston Gazette* that "steno" lessons would be taught through letters (Holmberg, 1995). In 1833, moreover, it was announced in one of the Swedish newspapers that a "written expression" lesson would be taught. However, the method for interaction and grading the lessons were not accentuated in the newspapers. Furthermore, these lessons, only announcements of which are known, could not be certified whether they were really taught or not. Therefore, distant education is accepted to have been

started by Isaac Pitman in 1840 in England. Pitman, who was a stenographer in England, began to teach steno lessons by letter.

Pitman taught his students how to write small parts of Bible with steno and graded students' success (Mshvidobadze & Gogoladze, 2012).

Bozkurt (2016), on the other hand, discussed the improvement of distance education in more detail and classified its change, periods and stages as it is seen below.

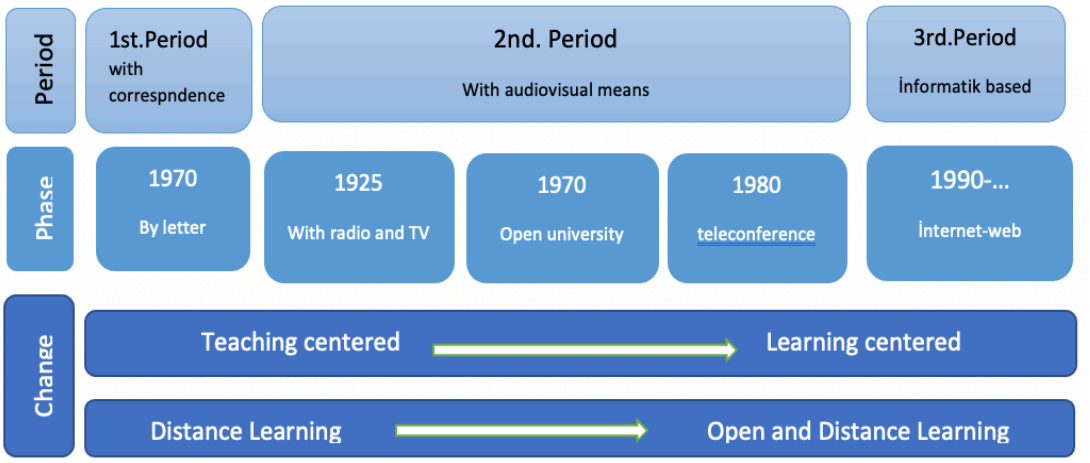


Figure 1. Periods and stages of distance education in a global context (Bozkurt, 2016).

Having analyzed the history of distance education activities, it is seen that it is generally adults in the universities on whom distance education has been concentrated. In today's world, even though distance education is designed for and implemented at all age groups and education levels, the vast majority of the distance education courses is still concentrated on higher education (Özbay, 2015).

Improvement of Distance Education in Turkey

Considering common technologies and important events affecting the field while determining the periods and stages of distance education in Turkey, Bozkurt (2017) underlined that there are four main periods in the development of distance education in Turkey.

- First Period–Discussions and Suggestions: Conceptional (1923-1955)
- Second Period–Correspondence: Letters (1956–1975)
- Third Period–Audio-visual aids: Radio–Television (1976–1995)
- Fourth Period–Informatics-based: Internet–Web (1996-…)

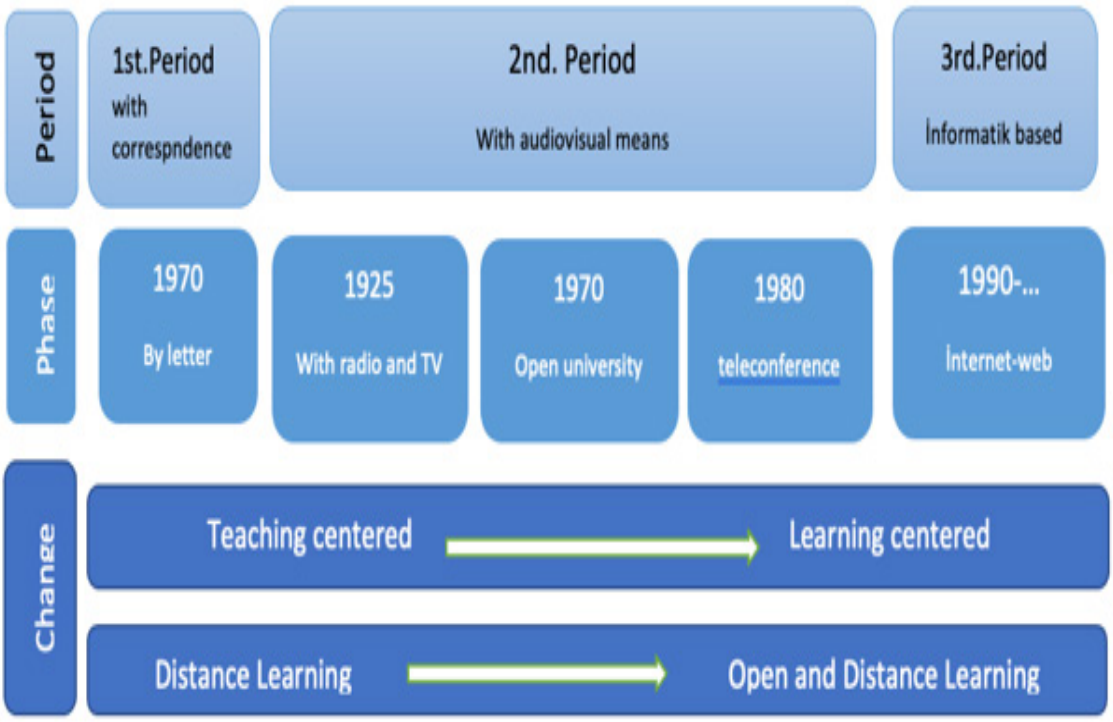


Figure 2. Periods and Phases of Distance Education in the Context of Turkey(Bozkurt, 2017).

Distance learning practices whose conceptualization dates back to 1700s began through letters (Ozbay, 2015), and had just been introduced around two centuries later in Turkey (Bozkurt, 2017). The statement "All kinds of schooling are liberated" in the Turkish Constitution of 1924 is a statement enabling the application of distance education as well as face-to-face education. Moreover, John Dewey, who was invited to Turkey by Atatürk in 1924 for analyzing the Turkish education system and making suggestions for its improvement, recommended distance education and teacher training in his report named "Report and Recommendation upon Turkish Education" (Bozkurt, 2017; Dewey, Boydston & Ross, 1983; Akdemir, 2011). One of the most striking suggestions made by Dewey was also to build traveling libraries and keep them open not only for students but for everyone. This suggestion made by Dewey in 1924 is alike to one of the fundamental principles of distance education, which is openness. Dewey's studies have had profound effects on the process of forming pedagogics and its practical understanding in Turkey (Bal, 1989, 1991; Bozkurt, 2017; Büyükdüvenci, 1995; Ergun, 1987; Kırby, 2010). After Dewey's report, distance education came to the fore for the first time in 1927 in the meeting where the problems in the field of education were brought to the table in an attempt to teach the illiterate part of society how to read and write. Yet, this attempt, which was planned to be carried out by correspondence, could not be put into practice since approximately %90 of the people were illiterate and the project was considered to fail if started (Özbay, 2015).

The first state-run practice of distance education dates back to 1956 (Kaya & Odabasi, 1996; Bozkurt, 2017). The first attempts for distance education were carried out after

1956 and a committee called “a center for learning by letter” was founded in 1960 in Directorate of Statistics and Publishing (Ozarslan & Ozan, 2014). With the legal regulation committed in 1964, a legal duty of “aiding to education” was given to Turkish Radio and Television Association (TRT) (Aziz, 1975). With the improvement of technology, educational television programs were broadcasted in 1968 by TRT. In 1973, educational programs for elementary, secondary and high schools were broadcasted by Center of Training by Film, Radio and Television (FRTEM) (Özbay, 2015).

In 1966, distance education activities were started to be executed in an organized and systematic manner at the level of General Directorate and The General Directorate of Correspondence and Technical Publishing was founded on February 2, 1966. (Alkan, 1981; Irmak, 1974). Moreover, Common-Public Higher Education Institution (YAYKUR) which was founded in 1975, planned to broadcast educational programs in many needed fields (Isman, 2005). In 1978, it was recommended by The Ministry of National Education to establish an “Open University” for improving the distance education in higher education. Yet, it was not until 1981 that the suggestion made by MEB in 1978 was actualized and The Faculty of Open Education was launched at Anadolu University in accordance with the law numbered 2547 (Gelisli, 2015).

In the years between 1980s and 1990s, The School Radio and Television School, which was affiliated to the Ministry of National Education, not only supported formal education, but it also provided common education opportunities for everyone (Bozkurt, 2017). With the establishment of the Faculty of Open Education in accordance with the law numbered 2547 and the first matriculation in 1982-83, distance education found its place in higher education (Akdemir, 2011). Open Education High Schools, on the other hand, were founded in accordance with the law 12633 on June 2, 1992 by the Ministry of National Education. Thus, people who were not able to finish their secondary schools were given the opportunity to complete their education and receive their diplomas (Bozkurt, 2017).

The advancements in information technologies have made great contributions to the improvement of distance education practices and global communication network (Isman, 2008). The web-based distance education practices have been available since 1996. Bilkent University attempted to carry out some of its lessons from the USA through video conference; likewise, Middle East Technical University (ODTU), led by Informatics Institute, started distance education practices through internet (Bozkurt, 2017). A little while later, distance education has become an alternative to elementary schools as well. The open elementary school was founded in 1997 by the Ministry of National Education. Therefore, a great contribution has been made to spread basic education across the country, which has been intended ever since the beginning of republic. (Bozkurt, 2017).

Authorities established "open" universities fifty years ago to create equal opportunities by means of distance education by extending the access to higher education (Daniel, 2020). Distance education in higher education was legitimated in 2011 by decree dated 25.02.2011. In the same year, "distance education" was identified as one of the education models in higher education along with formal, evening and open education with the introduction of new law 6111 (Ozarslan & Ozan, 2014). Although most of the legal regulations were executed, one of the problems observed in this period was the contradictions between the needs in real practice and distance education practices previously identified by legal regulation. Diversity and substantiality in the practice of distance education were procured with the use of printed, audio-visual contents along with equipment and content based on information technologies and most importantly the learning environments (Bozkurt, 2017). However, until the emergence of Covid-19, distance learning practices were not welcome in formal education, particularly in the public schools, and program development and enrichment studies were mainly confined to face-to-face education.

Distance Education in Turkey during the Process of Covid-19 Pandemic

Novel coronavirus (SARS-CoV-2)-related Covid-19 infection broke out in the late of December 2019 in Wuhan, China. The contagious virus spread throughout the world in a short span of time and was declared as pandemic on March 11, 2020 by the World Health Organization (World Health Organization–WHO, 2019; WHO, 2020a; WHO 2020b). Pandemic is defined as "seeing one disease epidemically in one continent or several countries at the same time", or as "great outbreak" (Turkish Language Society [TDK], 2020).

The suggestions proposed on the closure of educational institutions to stop the permeation of virus have been taken into consideration (Wheeler, Erhart, & Jehn, 2010; Kawano & Kakehashi, 2015; De luca, 2018; Bakioglu & Cevik, 2020). With the appearance of first person to test positive on March 11, 2020, formal education was temporarily suspended as of March 12 by the decree of the Ministry of National Education (San & San, 2020) and higher education was also suspended by the Higher Education Institution as of March 25 (YOK, 2020). Although the duration of the suspension in formal education was first announced as three weeks, after the situation assessment by the Ministry, it was announced that face-to-face education was suspended until the end of 2019-2020 fall term (Kaysi, 2020).

The legislative arrangements were held with regard to use of distance education and switching to a flexible academic calendar due to the ambiguity and possible extension of the process following compulsory suspension decisions made by the Ministry of National Education and the Higher Education Institution (YOK, 2020). Along with all

regulations for creating social distance and cutting down the spread of virus, distance education has been considered as the best alternative in the field of education to perform the precautions, particularly by densely affected countries suffering from the spread of virus, becoming the most-preferred channel by administrators and education specialists (Telli & Altun, 2020).

Covid-19 has shown that education systems in other countries and Turkey are not prepared to ensure the consistency of education and learners are physically separated from their schools, teachers and other learners (Bozkurt & Sharma, 2020). The web-based Education Information Network (EBA) founded between the years of 2011-2012 and TRT EBA TV broadcasting educational programs on television have been used by public schools as of March 23, while private schools have maintained distance education using their own systems during the process of compulsory suspension, which was put into practice on March 12, 2020 (Zan & Zan, 2020). With the closure of schools and switching to distance education, 18 million students from elementary, secondary and high schools have been attending the lessons through the Education Information Network (EBA) and TRT EBA TV (Sezgin & Fırat, 2020). The various lesson materials included in curriculum and also videos, documents, e-books, worksheets and activities are shared on EBA for all education stakeholders ranging from pre-school education to high school level. The Ministry initially announced that internet infrastructure of EBA would be strengthened and education would be maintained through EBA with all media organs to be able to meet the increased demands during the pandemic process. Therefore, EBA was visited more than 1 billion times between 12 March and 12 April, making it one of the biggest education platforms in the world. Moreover, The Ministry of National Education provided students with the free internet up to 8GB data by cooperating with the leading GSM operators in the country to allow students to keep up with their lessons (Ozer, 2020).

MoNE/MEB prepared 17 programs focused on various topics and presented these to teachers for improving their professional abilities in cooperation with UNESCO. MEB also established a hotline service for to support students and parents psychosocially. Psychological counseling service provided by the Ministry answered the calls and mentored them both on the phone as well as in counseling and research centers and also preparing guidelines for them so that they would not be exposed to adverse effects of the virus. In this process, vocational and technical high schools played a major role and their production capacities were augmented. These schools worked as the production centers of mask, sanitizer, and medical scrubs at the beginning of the pandemic. In this context, 10 million medical masks, 1 million disposable lab coats and the dysinfectant material requirement of 54 thousand public institutions were met by in these schools (Ozer, 2020). Having completed the second semester of 2019-2020 with distance education,

the Ministry pursued a different strategy in the first semester of 2020-2021 and applied a hybrid education model in certain classes. The Minister of National Education announced on September 8, 2020 that schools that had been shut down since March due to Covid-19 would be re-opened on Monday 21st September, 2020 for kindergartens and first graders of elementary schools with "gradual and reduced" model of face-to-face education. The new education term was started as distance education on August 31 through online lessons by TRT EBA and EBA. The adjustment program that would start on 21-25 September which was the first week of school was planned and applied as "face-to-face education for 1 day" in pre-school institutions and first graders of elementary schools. In the announcement with regard to the issue, the Ministry stated that students would not be obliged to participate in face-to-face education and parents could choose distance education for their students without written permission. The Ministry also underlined that schools could choose the day of adjustment program with their own teachers. While it would be planned as 5 activity classes each of which was 30 minutes in a day for pre-school institutions, the adjustment program in elementary schools would be planned as 5 lesson periods each of which was 30 minutes with 10minute breaks in a day.

Furthermore, it was made clear by the Ministry that classroom size would be divided as two parts in accordance with the social distancing rules as much as possible and both of these groups would have their adjustment programs in different days. The instructions to make students follow the social distancing rules during the break time were also among the precautions announced by the Ministry. The details of the hybrid education to be be used by the Ministry are explained as "The week covering the days between 28 September- 2 October after the adjustment program and onwards, 6 classes of Turkish lesson will be taught in two halves in two days per week ;2 classes of Maths lesson will be taught in two halves in two days per week; and 2 classes of Life Sciences lesson will be taught in two halves in two days per week as face-to-face education. The lesson contents of these subjects that cannot be taught as face-to-face and other subjects in the curriculum of the first graders in elementary schools will be taught through distance education by means of online lesson programs on EBA TV and EBA portal. The lessons can be taught online at any time from 08.30 in the morning to 20.20 in the evening."

It was announced by the Ministry that during the week covering the days between 28 September – 2 October which was the week after the adjustment program and its following,

5 lessons each of which was 30 minutes would be taught at the same class levels as face-to-face education 2 days per week with 10-minutes breaks. The Ministry also stated that necessary precautions including the assignments of hall monitors would be taken by school managements to keep the social distance between students during the break times. During this process, no visitors would be let in (the school) unless it is necessary;

yet, in case of necessity, they would be registered and accepted in line with the measures . In this context, a hybrid system in which both face-to-face and distance education are used has been put into practice for preschool and first graders. However, the Ministry announced new decrees as a result of the acceleration of the virus in the country.

In this context, the Minister of National Education declared that:

- Formal, private and non-formal (common-public) education will be maintained as distance education as of 20 November until 4 January,
- There will be no face-to-face or online exam until 31 December and new regulations will be planned in accordance with the progress of the virus,
- Students will be responsible for all the school subjects in the curriculum taught through both face-to-face and distance education,
- In the meantime, there will be no face-to-face education in refresher and training courses either,
- The individualized programs in the special teaching and rehabilitation centers that are included in Special Teaching Code can be carried out as face-to-face education,
- The schedule of gradual transition to face-to-face education will be made public in accordance with the latest situation in the last week of December.

In spite of these recent measures and adaptation attempts that have been put in practice, it is utterly challenging to come up with fast and accurate solutions for such an immediate threat. All of the academicians, teachers, students and parents have made an abrupt effort to adapt to "the education system of the changing world" with which they have never been acquainted before. Yet, this compulsory process has brought about new problems (Zan & Zan, 2020). According to Daniel (2020), Covid-19 is the biggest threat that national education systems have ever faced. The regulations arranged with inaccurate concepts for saving the day are bound to trigger bigger problems in the long run (Daniel, 2020). Educational institutions' being caught unprepared by the virus has either led many countries to suspend their assessment and evaluation systems based on passing and failing (Bozkurt et al., 2020) or suddenly urged/required them to organize online exams without sufficient validity and reliability practices rather than traditional exams or evaluations (d'Orville, 2020). The interruption in the lessons and the postponement of exams etc. might lead to time constraints in the next academic year (Gupta & Goblani, 2020). Reimers lay special emphasis on the fact that in case students' education is interrupted due to ill-structured distance education curriculum, students might easily forget what they have learnt in the lessons and end up learning less information than they

are supposed to know (2020).

In this context, conceptual discussions are believed to be important to prevent possible negative perceptions that might be directed towards distance education and bad experiences that can be experienced by teachers and students who are not acquainted with distance education (Bozkurt, 2020). In a way, the pandemic process can be said to be a blessing in disguise to reshape our thinking about education; however, this re-thinking should be focused on what, how and where to learn rather than the improvement of school education (Zhao, 2020). Covid-19 has changed we see and interpret the education (Bozkurt & Sharma, 2020).

Covid-19 has not only turned upside down the levels and effectiveness of students' learning but also affected students' lives in different ways depending on their education levels. The students who are at the end of an education level and those passing to the next level such as those passing from secondary school to higher education or those in transition from student to professional life are faced with several problems. They will not be able to finish their curriculum and evaluation process in a normal way and they will be kept away from their social groups almost overnight (Daniel, 2020). According to a report conducted by UNESCO, more than 1.5 billion students and 63 million educators in 188 countries have been affected by the closing-down process of schools as of March 27, 2020 (UNESCO, 2020; UNESCO, 2020a, UNESCO, 2020b). The number of students affected by the interruption of education has reached 25 million in Turkey (UNICEF, 2020).

The differences in individuals' socioeconomic levels also lead to differences in the accessibility and use of information and communication technologies (Sezgin & Fırat, 2020). Although distance education and digital solutions are the best ways to cope with Covid-19, these solutions also bring about increased inequality in education (Moreno & Gortazar, 2020). Half of the students kept out of schools because of Covid-19, which is 826 million, cannot access computers and 43% of all the students, which is 706 million, have no internet connection in their house. Digital-based distance education is used to ensure the consistency of education by most of the countries. Inequalities are especially severe in low-income countries. For instance, 89% of the students in Africa cannot access computers and 82% of them have no access to internet connection at all. Audrey Azoulay, who is the Director-General of UNESCO, states on this issue that "we know that while it is necessary to maximize the efforts ensuring the connections for everyone, maintenance of education will not only be limited to online tools. Thus, we should support community radio, television broadcasts and all other possible and creative alternatives to decrease the inequalities at present." (UNESCO, 2020b). According to the latest research, this situation called "digital gap" is rising because of the social economic differences (Sezgin & Fırat, 2020). Access to the internet, speed of access, speed of bandwidth,

the possession of computers or mobile phones and television services differ from place to place and as the digital gap is rising, the distance education is being affected in a negative way. According to the data provided by the Turkish Statistical Institute, 49,1% of the houses in Turkey have access to the internet through fixed broadband internet such as ADSL, cable internet, fiber etc. whereas 86.9% of the houses have access to internet through mobile broadband. Central East Anatolia (25,6%), Northeast Anatolia (25,8%) and Southeastern Anatolia (27,2%) are the regions where the rate of houses having fixed broadband connection is the lowest. The rate of houses having desktop computers is 17,6%, having luggable computers is 37,9%, having tablet computers is 26,7% and having mobile phones is 98,7% (Tokyay, 2020). The people out of the data such as the romany, children of the seasonal agricultural workers and the refugee children who have no opportunities for education make the digital gap apparent and therefore the big differences emerge between the students accessing information and communication technologies and those not having the same opportunities. Some studies show that students having internet connection in their house cannot make the most of the distance education as much as those not having internet connection, and socioeconomic levels play a vital role for the conscious and accurate use of distance education tools (Sezgin & Fırat, 2020). Therefore, if the digital gap rises when the schools are closed, inequality in education and "learning hardship" will inevitably increase as well. At the end of the process, continuity of learning will be ensured for some students and it may end for others (Moreno & Gortazar, 2020).

Conclusion

According to the meta-analysis conducted by Russel (1999), when the education technologies and distance education are well-structured, there is not any difference between face-to-face and distance education. In their studies in which the connection between web-based learning and some concepts such as used tools, interaction, time-environment flexibility was analyzed, Anderson and Dron (2010) indicated that the not only the effectiveness of distance education draws near to the potential of the interaction in the face-to-face education depending on the tools used in the process, but it also comes with some advantages in terms of time and environment flexibility. Although there are many research showing the effective practicality of distance education, there are some adverse outcomes caused by the canalization of all society in distance education. In many countries, public schools were built such a long time ago that few of the living people remember how life was without schools. One of the functions of these schools is to make the playground equal for the students born in different conditions. Schools help students socialize (Bozkurt et al. 2020). The curriculum is not the only loss of children who have lost their learning opportunities due to the pandemic. The students in the lower socioeconomic group, who will also be away from the social environment, may come to

the fore due to their limited opportunities (Daniel, 2020). If the necessary measures are not taken, the educational disadvantage caused by these losses will eventually result in more educational, economic and social disadvantages. This situation is the cruel reality of how Covid-19 will shape the education and the decades in the years to come (Reimers, 2020). If equal opportunities can be ensured in the countries, distance education is of great chance to overcome this process less harmedand to to reach and educate all the students in the society.

Suggestions:

During the pandemic, distance education practices that can allow meaningful and effective learning should be applied. To do so, it is necessary to take into account the digital competencies and opportunities that teachers, students and parents have in distance education process. Due to the principle of welfare state, governments should focus on practices that can provide students with equal opportunities; in addition, it is necessary to make the trainings that can increase the digital competencies of teachers, students and parents a part of the planned process.

It is of great importance to determine the short-term goals of distance education focusing on the development of the education programs that may be sustainable even after this process rather than short-term goals and to expand the circle of the distance education and finally to maintain the education process in line with these long-term goals. Covid-19 should not be treated as a short-term crisis, nor should it be planned as ad hoc activities to help prolong learning while schools are closed. The old approach to education should not be returned as soon as the schools are reopened. Instead, it would be more accurate to perceive Covid-19 as an opportunity to redesign the education system (Zhao, 2020).

Considering that the students who benefit from distance education system face many problems such as having to continue their education on their own, loneliness, incoordination, lack of motivation, inadequate communication and interaction, having no access to teachers, the characteristics of students' learning styles should be seen as a key factor and used in the planning of distance education to keep students active and more successful in this system. With this purpose in mind, students' learning styles should be determined and they should be entitled to choose appropriate learning environments (Ekici, 2003).

Institutions should increase their distance teaching capabilities while taking steps to communicate, secure and maintain communication with students and parents. The best regulation for those who are accustomed to learning in real time in classes is to benefit from asynchronous learning so that there will be no need for participants to interact at the same time. Asynchronous teaching/learning method can provide flexibility for teachers to prepare learning materials. Teachers are not obliged to submit materials at a specific

time; it can be posted online for on-demand access, and students can interact with it using wikis, blogs, and email to follow their schedule. Teachers can follow students' attendance periodically and set up online meetings for students having certain needs or questions. Creating an asynchronous digital class provides more opportunities both for teachers and students to make them feel at ease (Daniel, 2020).

One of the problems encountered during distance education has been the assessment and evaluation processes. In this context, result-oriented examination systems should be replaced with process-oriented evaluation criteria, in which students' academic progress is monitored. Another point that should be taken into consideration is how to conduct the assessment and evaluation processes in digital environment, how to ensure data privacy in the meantime, and how to use this data within the scope of ethical frameworks in order to use online applications safely in distance education (Bozkurt, 2020).

This process we have been going through has made it clear that teachers must be highly qualified with regard to distance education. For this reason, it has become obligatory for teachers to be have been taught about the use of online education and digital materials. Therefore, the curriculums of education faculties and compulsory courses that teachers have to take at the level of bachelor degree should be analyzed in this context and the necessary arrangements should be made in these programs.

With the teaching of the courses in distance education using digital platforms, change has become mandatory in the fundamental training tools. Producing e-materials and contents for the students using digital platforms in distance education is also an emerging requirement.

References

Adıyaman, Z. (2002). Uzaktan Egitim Yoluyla Yabanci Dil Ögretimi. *TOJET: The Turkish Online Journal of Educational Technology*, *1*(1).

Adıyaman, Z., & Müdürlüğü, M. E. T. G. (2001). Uzaktan eğitim yoluyla yabancı dil öğretimi. *The Turkish Online Journal of Educational Technology TOJET*, *1*(11), 92-97.

Anderson, T., & Dron, J. (2010). Three generations of distance education pedagogy. The International Review of Research in Open and Distributed Learning, 12(3), 80-97.

AkdemİR, Ö. (2011). Yükseköğretimimizde uzaktan eğitim. *Yükseköğretim ve Bilim Dergisi*, *1*(2), 69-71.

Al, U., & Madran, O. (2004). Web tabanlı uzaktan eğitim sistemleri: Sahip olması gereken özellikler ve standartlar.

Alkan, C. (1981). Açıköğretim: Uzaktan eğitim sistemlerinin karşılaştırmalı olarak incelenmesi. Ankara: Ankara Üniversitesi Eğitim Bilimleri Fakültesi Yayınları.

Aziz, A. (1975). Televizyonun yetişkin eğitimindeki yeri ve önemi. Türkiye ve Orta Doğu Amme İdaresi Enstitüsü yayınları. Ankara: Sevinç Matbaası.

Bal, H. (1989). John Dewey – M. Necati ve Türkiye'de öğretmen yetiştirme sorunu. *Çağdaş Eğitim, 14*(142), 29-33.

Bal, H. (1991). John Dewey'in eğitim felsefesi. İstanbul: Kor Yayıncılık.

Balaban, E. (2012). Dünyada ve Türkiye'de uzaktan eğitim ve bir proje önerisi. *İstanbul: Işık Üniversitesi*.

Bakioğlu, B., & Çevik, M. (2020). COVID-19 Pandemisi Sürecinde Fen Bilimleri Öğretmenlerinin Uzaktan Eğitime İlişkin Görüşleri. *Electronic Turkish Studies*, *15*(4).

Bates, D. C., King, J., Pearson, K., & Pulimood, S. M. (2020). Interdisciplinary and Community Collaboration through the Transition to Distance Learning caused by the COVID-19 Pandemic. *Teaching through COVID-19*, 9.

Bozkurt, A. (2016). Bağlantıcı kitlesel açık çevrimiçi derslerde etkileşim örüntüleri ve öğretenöğrenen rollerinin belirlenmesi. Doktora Tezi. Anadolu Üniversitesi, Sosyal Bilimler Enstitüsü, Uzaktan Eğitim Anabilim Dalı. Eskişehir.

Bozkurt, A. (2017). Türkiye'de uzaktan eğitimin dünü, bugünü ve yarını. *Açıköğretim Uygulamaları ve Araştırmaları Dergisi*, *3*(2), 85-124.

Bozkurt, A., & Sharma, R. C. (2020). Emergency remote teaching in a time of global crisis due to CoronaVirus pandemic. Asian Journal of Distance Education, 15(1), i-vi. https://doi.org/10.5281/zenodo.3778083

Büyükdüvenci, S. (1995). John Dewey's impact on Turkish education. In J. Garrison (Ed.), The new scholarship on Dewey (pp. 393-400). Norwell, MA: Kluwer Academic Publishers.

CDLP. (2004). Adult learning activities: What is distance learning? 16 Temmuz 2004 tarihinde http://www.cdlponline.org/index.cfm?fuseaction =whatis adresinden eriflildi.

d'Orville, H. (2020). COVID-19 causes unprecedented educational disruption: Is there a road towards a new normal?. Prospects, 1-5. https://doi.org/10.1007/s11125-020-09475-0

De Luca, G., Van Kerckhove, K., Coletti, P., Poletto, C., Bossuyt, N., Hens, N., et al. (2018). The impact of regular school closure on seasonal influenza epidemics: a data-driven spatial transmission model for Belgium. BMC infectious diseases, 18(1), 29.

Dewey, J., Boydston, J. A., & Ross, R. G. (1983). The middle works, 1899-1924: 1921-1922 (Vol. 13). Southern Illinois University Press.

Drennan, J., Kennedy, J. ve Pisarski, A. (2005). Factors Affecting Student Attitudes Toward Flexible Online Learning in Management Education. *Journal of Educational Research, 98* (6), 331-338.

Ekici, G. (2003). Uzaktan eğitim ortamlarının seçiminde öğrencilerin öğrenme stillerinin önemi. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi*, *24*(24).

Ergun, D. (1987). Sosyoloji ve eğitim. Ankara: V Yayınları.

Gelişli, Y. (2015). "Uzaktan Eğitimde Öğretmen Yetiştirme Uygulamaları: Tarihçe ve Gelişim", Journal of Research in Education and Teaching, Cilt:4 Sayı:3 Makale No: 34.

Gupta, A., & Goplani, M. (2020). Impact of Covid-19 on Educational Institutions in India. UGC Care Journal, 661-671. https://doi.org/10.13140/RG.2.2.32141.36321

Holmberg, B. (1995). "Theory And Practice of Distance Education", London: Routtedge.

Horzum, B. (2003). Öğretim Elemanlarının İnternet Destekli Eğitime Yönelik Düşünceleri (Sakarya Üniversitesi Örneği). Yayımlanmamış Yüksek Lisans Tezi, Sakarya Üniversitesi.

Irmak, M. (1974). Türkiye'de mektupla öğretim çalışmaları. Halk eğitim Bülteni, VIII(47).

İşman, A. (2005). "Uzaktan Eğitim Ankara", Pegem A Yayıncılık.

İşman, A. (2008). *Uzaktan eğitim*. Pegem Akademi.

Kawano, S., & Kakehashi, M. (2015). Substantial impact of school closure on the transmission dynamics during the pandemic flu H1N1-2009 in Oita, Japan. PloS one, 10(12).

Kaya, Z. ve Odabaşı, F. (1996). "Türkiye'de Uzaktan Eğitimin Gelişimi", *Anadolu Üniversitesi Eğitim Fakültesi Dergisi,* Sayı 1.

Kaysi, F. (2020). 5th International Scientific Research Congress (IBAD - 2020) Bildiriler September 1-2.

Kırby, F. (2010). Türkiye'de köy enstitüleri (Çeviren: Niyazi Berkes). Ankara: Güldikeni Yayınları.

Moore, M. G., & Kearsley, G. (2011). Distance education: A systems view of online learning. (3rd ed.). Belmont, CA: Wadsworth Cengage Learning.

Moreno, J. M., & Gortazar, L. (2020). Schools' readiness for digital learning in the eyes of principals. An analysis from PISA 2018 and its implications for the COVID19 (Coronavirus) crisis response. World Bank Blogs. Retrieved from https://blogs.worldbank.org/education/schoolsreadiness-digital-learning-eyes-principals-analysis-pisa-2018-and-its?CID=WBW_AL_BlogNotification_EN_EXT

Mshvidobadze, T. & Gogoladze, T. (2012). "About Web-Based Distance Learning", International Journal of Distributed and Parallel Systems (IJDPS) Vol.3, No.3, Georgia.

Newby,T.J., Stepich, D.A., Lehman, J.D. ve Russell, J.D. (2006). Educational Technology for Teaching and Learning. Upper Saddle River, New Jersey: Pearson Merrill Prentice Hall.

OECD (2020). A framework to guide an education response to the COVID-19 Pandemic of 2020. Paris: OECD Publishing.

Özarslan, Y., & Ozan, Ö. (2014). Yükseköğretimde uzaktan eğitim programı açma sorunsalı. XIX. Türkiye'de İnternet Konferansı, 27-29 Kasım 2014, Yaşar Üniversitesi, İzmir. http://inet-tr.org.tr/inetconf19/bildiri/84.pdf

Özarslan, Y. ve Ozan, Ö. (2014). "Yükseköğretimde Uzaktan Eğitim Programı Açma Sorunsalı", XIX. Türkiye'de İnternet Konferansı, Yaşar Üniversitesi, İzmir.

ÖZBAY, Ö. (2015). Dünyada ve Türkiye'de Uzaktan Eğitimin Güncel Durumu. *Uluslararası Eğitim Bilimleri Dergisi*, (5), 376-394.

Özer, M., (2020). Türkiye›de COVID-19 Salgını Zamanında Milli Eğitim Bakanlığı›nın Eğitim Politikası Eylemleri. *Kastamonu Eğitim Dergisi* , *28* (3), 1124-1129.

Reimers, F. M. (2020). What the Covid-19 Pandemic will change in education depends on the thoughtfulness of education responses today. Worlds of Education. Retrieved from https://www.worldsofeducation.org/en/woe_homepage/woe_detail/16727/%E2%80%9Cwhat-the-covid19-pandemic-will-change-in-education-depends-on-the-thoughtfulness-of-education-responses-today%E2%80%9D-by-fernando-mreimers

Rodriguez, C. O. (2012). MOOCs and the AI-Stanford Like Courses: Two Successful

and Distinct Course Formats for Massive Open Online Courses. European Journal of Open, Distance and E-Learning. http://www.eurodl.org/materials/contrib/2012/Rodriguez.pdf

Russel, T. L.(1999). The No significant difference phenomenon as reported in 355 research reports, summaries and papers. USA: North Carolina State University.

SEZGİN, S., & FIRAT, M. Covid-19 pandemisinde uzaktan eğitime geçiş ve dijital uçurum tehlikesi. *Açıköğretim Uygulamaları ve Araştırmaları Dergisi*, *6*(4), 37-54.

Simonson, M., Smaldino, S., Albright, M., and Zvacek, S. (2003). "Teaching And Learning At A Distance", Upper Saddle River, NJ: Pearson Education.

Taylor, JC (1999). Uzaktan eğitim: 19. ICDE Dünya Açık Öğretim ve Uzaktan Eğitim Konferansı Beşinci Nesil Bildirileri , Viyana, Avusturya.

Telli, S. G., & Altun, D. (2020). Coronavirüs ve çevrimiçi (online) eğitimin önlenemeyen yükselişi.

Tokyay, M. (2020). Uzaktan eğitim dijital uçurumu derinleştiriyor mu? İnterneti olmayan öğrenci nasıl eğitim alacak?. https://tr.euronews.com/2020/04/17/uzaktan-egitim-dijitalucurumu-derinlestiriyor-mu-interneti-olmayan-ogrenci-nas-l-egitim-a. (Erişim Tarihi: 17.04.2020).

UNESCO (2020, March 27). Teacher Task Force calls to support 63 million teachers touched by the COVID-19 crisis. UNESCO. Retrieved from https://en.unesco.org/news/teacher-task-force-calls-support-63-million-teachers-touched-covid-19-crisis

UNESCO. (2020a). School closures caused by Coronavirus (Covid-19). UNESCO. https://en.unesco.org/covid19/educationresponse UNESCO. (2020b). Startling digital divides in distance learning emerge.

UNESCO. (2020b). Startling digital divides in distance learning emerge. UNESCO. https://en.unesco.org/news/startling-digital-divides-distance-learning-emerge

UNICEF. (2020). UNICEF and Microsoft launch global learning platform to help address COVID-19 education crisis. UNICEF. https://www.unicef.org/press-releases/unicefand-microsoft-launch-global-learning-platform-help-address-covid-19-education

USDLA. (2004). United States Distance Learning Association: Definition of distance learning. 16 Temmuz 2004 tarihinde http://www.usdla.org adresinden eriflildi.

Wheeler, C. C., Erhart, L. M., & Jehn, M. L. (2010). Effect of school closure on the incidence of influenza among school-age children in Arizona. Public health reports, 125(6), 851-859.

WHO. (2020a). Coronavirus disease (COVID-19) Pandemic. World health Organization. https://www.who.int/emergencies/diseases/novel-coronavirus-2019

WHO. (2020b). WHO Coronavirus Disease (COVID-19) Dashboard. World health Organization. https://covid19.who.int/

World Health Organization (WHO). Q&As on COVID-19 and related health topics, Retrieved May 12, 2020, from https://www.who. int/emergencies/diseases/novel-coronavirus-2019/question-andanswers-hub

Yükseköğretim Kurulu (YÖK) (2020a). Basın açıklaması, https://www.yok. gov.tr/Sayfalar/Haberler/2020/, Erişim tarihi: 26.03.2020.

Zan, N., & Zan, B. U. (2020). Koronavirüsile Acil Durumda Eğitim: Türkiye'nin Farklı Bölgelerinden Uzaktan Eğitim Sistemine Dahil Olan Edebiyat Fakültesi Öğrencilerine Genel Bakış. *Electronic Turkish Studies*, *15*(4).

Zhao, Y. (2020). COVID-19 as a catalyst for educational change. Prospects, 1-5. https://doi.org/10.1007/s11125-020-09477-y

Flipped Clasroom Model in the Context of Distant Training

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Introduction

In recent years, technical and theoretical innovations in educational science have unlocked new paths entirely. The pressure of rising tuition rates and delivering free, online classes opens up debates and catalyzes the reform in the physical classroom. In the middle of this debate flipping classroom is the useful one that is mostly prominent (Bishop and Verleger, 2013). Moreover, many of the steps taken by countries that respond the crisis in the field of education due to COVID-19 pandemic, contributed to the termination of face-to-face classes for each level. The pandemic has transformed the contexts in which curricula are implemented since certain qualifications and competencies are more applicable in the current situation1. The impact of this epidemic on schools sharply stressed the importance of the connection and accessibility to digital media in service of all the education levels. Hence flipping classroom model come to fore again because schools and other educational centres. In many cases without any guidance and instruction for educators, these institutions had to transfer their education online in the process of the COVID-19 pandemic. In marked contrast to a paradigm of teacher-centered learning in which the students are treated as hollow containers which can consume knowledge passively, flipped classrooms provide student-centered peer-assisted instruction. Students are presented with pre-class knowledge through videos, graphical lectures or brief lessons using a “Typical Flipped Classroom Pedagogy”. It follows a class session where the material is reviewed while the teacher conducts small group conversations under the leadership of students (Guraya, 2020). In this respect, it seems that flipped classroom model can be useful for conducting education that depands on distant training. However, it should be kept in mind that neither distant training nor flipped classroom can handle the disruptive effects of the COVID-19 pandemic on education. The several obstacles which prevent students and instructors from engaging continued education during the lock-down of COVID-19 because educational problems with COVID-19 pandemic locks ranged from learning disruption, restricted access to study facilities like labs, job loses in the education sector, raised debts of students, decreased support and funding for education, research constraints, and loss of learning interests among learners (Onyema,et al. 2020). Despite the technological flux that reveals a classroom paradigm

[1] https://repositorio.cepal.org/bitstream/handle/11362/45905/1/S2000509_en.pdf retrived from 29.11.20

consistent with the needs of the 21st century as well as the devastating effects of the COVID-19 pandemic a little study in flipped classrooms has been done in the literature (Abeysekera, Dawson, 2015). Hence, the aim of this part is to run through the literature about the flipped classroom model and grip it through the current context of distant training.

Improvement of Flipped Classroom

Flipped classroom is a recent pedagogic approach which replaces the face-to-face learning with the use of time for individual study to enhance their effectiveness of educational practice (Quint, 2015) such as where teachers have assigned a certain number of materials until the next day to be read about a certain topic or topic (Springen, 2013) so that students can use the material in activities covered in the classroom (Kenna, 2014). In their book Flip Your Classroom: Reach Every Student in Every Class Every Day, Bergmann and Sams (2012:13) defined a flipped classroom as a educational place "which is traditionally done in class is now done at home, and that which is traditionally done as homework is now completed in class" . In other words, students watch or listen to the content of their classes at home in flipped learning and then participate in mental tasks under the supervision of teachers in various assignments during school hours (Goodwin & Miller 2013). Altough there isn't any unique definition of Flipped Classroom, Abeysekera and Dawson (2015) (cited by Yurdagül, 2018: 27) described the characteristics of the Flipped method and summarized as follows:

- a change in use of classroom time;
- a change in use of out-of-class time;
- doing activities traditionally considered ―homework‖ in class;
- doing activities traditionally considered as in-class work out of class;
- in-class activities that emphasize active learning, peer learning, problemsolving;
- pre-class activities;
- post-class activities, and;
- use of technology, especially video.

Just as Bergmann and Sams (2012: 6) clarified that no one has invented 'flipped classroom model, only that they were 'early adopters and outspoken proponents' of the screen casting tool. In the past there has been tremendous attention to the flipped classroom that reverse the conventional lecture-homework pattern. The notin of the flipped classroom can be traced back to the article entitled as "From Sage on the Stage to Guide on the

Side" of King (1993) focusing on the changing role of the educator as either a facilitator or a guide but not a simple lecturer. It was nonetheless in the 1990s that the professors of physics, Eric Mazur from Harvard, proposed a transition from 'teaching' to 'helping students learn.' The "Peer Instruction" from Mazur can be regarded as of these steps in the creation of the flipped-in classroom concept (Brame, 2013). He saw education as a two-step process: 'transferring information,' and then 'recognizing and assimilating this information'. Then, Mazur (2009) revised his instruction by recording his lectures through videos making students able to prepare for the class in advance so that Mazur reverse passive studying outside the classroom as an updated concept of a flipped classroom, thus bringing active learning inside the classroom (Crouch and Mazur, 2001). In 2000, J. Wesley Baker introduced the concept of "flipping the classroom using web-based learning management tools" in his paper presented in the 11th International Conference on College Teaching and Learning, in Florida. In this presentation, Baker's (2000) emphasized the signifcance of adopting qualified programs and materials to invert, reverse or flip their classes. At the same time, Lage et al. (2000) similarly translated the concept of "The Classrom Flip" as "Inverted Classroom" and similarly defined it as watching the lectures before coming to the classroom and working with a group in the classroom in a collaborative way. Khan and Khan academy took the next step in making flipped classroom material common when Khan began documenting videos in mathematics for her younger cousin having trouble at math in 2004 (Khan, 2012). The doctoral dissertation of Strayer (2007) suggested the common point in the majority of flipped classroom activities as a means of creating an active learning environment as another contributor to the development of this model. This research can be regarded as one of the first research on flipped classroom, investigating how students perceived the learning environment and activity in the flipped and traditional classroom. However, the people who are credited with the application of the concept of the flipped classroom at secondary level are Jonathan Bergmann and Aaron Sams, two chemistry teachers from North America. For the first time, Bergmann and Sams named the approach the pre-vodcasting model: "pre" to address the idea of the video occurred prior to class and "vodcasting" as an acronym for video podcast. They also produced and developed other teachers' professional skills and adapted the name to reverse instruction to address the anxiety teachers showed in the name of the technology (Bates , Almekdash , and Gilchrest-Dunnam, 2017: 5). In 2006, they started recording their live classes and making lesson videos with screen casting apps and slides for the students who missed their classes. Later, the format of their instruction was entirely changed. They posted pre-recorded lessons for pre-class views and used class time for hands-on learning (Kömeç, 2018: 23).

Blended learning environments allow learning both in conventional face-to-face and digital workplaces (Singh, 2003). The flipped classroom model is basically based on blended learning and active learning (Hung, 2015). Within this respect, in order to

encourage student readiness by even more engaging learning interactions for classroom learners, it covers a wide group of active face-to-face problems and inquiry-based learning opportunities inside the classroom followed by educational films (İyitoğlu, 2018: 27).Actually, according to Staker & Horn (2012) flipped classroom model can be categorized under the title of blended learning which is a recent learning model that encompasses face-to-face instructional methods with supportive online instructions (Bonk & Graham, 2006).

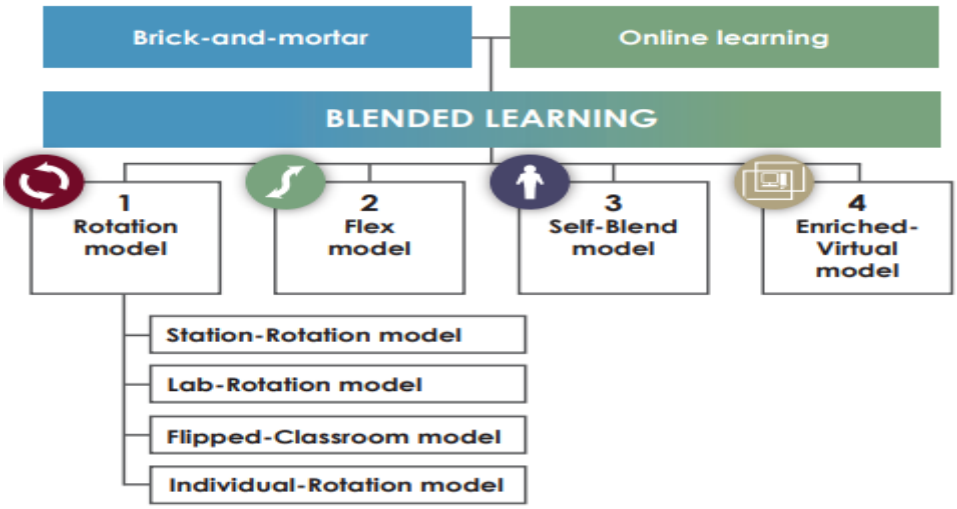

Figure 1. Types of Blended Learning Model (Staker & Horn, 2012).

According to Staker & Horn (2012) Filipped Classroom is a sub-category of rotation model where students rotate between modalities of learning within a given course or theme (e.g. math), at a fixed timeframe or at the teacher's discretion between learning modalities, at least one of which is online learning. Other forms of doing that could include small-group or full-class instruction, group projects, individual tutoring, and pencil-and paper tasks. Students rotate on a fixed schedule between face-to-face teacher-guided practice (or projects) on campus during the standard school day and online delivery of content and instruction of the same subject from a remote location (often home) after school. The central aspect of content and instruction is that it occurs in an online space, which separates a Flipped Classroom from students who just only do homework or given tasks online at night. The model of Flipped Classroom accords with the idea that blended learning includes some element of student autonomy over time, place, path, and/or pace, since the model enables students to choose the location at which their content and instruction are obtained online and to control their interactions through the online elements.

"F" of F-L-I-P TM stands for flexible environment where the flipped classroom teachers build flexible ecosystems having small individual and group work areas so that the most of their class time is allocated to expand skills through more problem-based learning

exercises . "L" of F-L-I-P TM stands for a changing tendency in the learning where students are actively engaged with the knowledge construction process. "I" of F-L-I-P TM refers to intentional content where the content is supposed to be intentionally tailored to support the curriculum in a collaborative and active learning atmosphere. "P" of F-L-I-P TM stands for professional educators as the implementers of the approach in order to make sure the students acquire and use their own learning materials. (Hamdan, et al., 2013; İyitoğlu, 2018: 27-30). The reason why it is called a flipped classroom is that it is an approach that proposes to move what is achieved beyond the school in the traditional classroom management to outside of the classroom and vice versa. As for traditional approaches, homeworks are supposed to be assigned for outside the classroom in order to consolidate what has been taught in the classroom. This can lead to challenges for students since these activities are usually harder than those learned in the classroom (Yurdagül, 2018: 27). The guiding principle is the thought that just listening to the lessons is a passive process, and the student will be able to view the lecture videos and content individually. As for the homework and related exercises which are the practice of what is learned during the lesson, the student may need more fort he guidance of the teacher, and the more effective learning is provided by the guidance of a teacher in the classroom. It is basically a contemporary research application of study at home, the current application is not that simple and its benefits are much higher (Göksu, 2018; Kara, 2015).

Flipped Classroom Model versus Traditional Instruction

Flipped Learning Network (2014:1) recognizes the FCM as a 'pedagogical method in which explicit instruction is moving from the group to the individualized learning domain, where it turns the resultant group space into a complex, collaborative learning environment, where the instructor facilitates the students through their development of concepts and an innovative approach to the course topic'. The theory of student engagement (Astin 1999) forms the basis of flipped learning, which notes that the more work a student brings into his or her learning process, the greater its personal and collective progression (Roehling, 2018:3). When compared to the traditional learning approaches, students demonstrate impressive results in flipped learning (Schultz et al., 2014). First of al, FCM supports the learner-centered pedagogy. Students become active learners and teachers are more able to promote higher-level instruction and learningn. This learning model takes into account the characteristics of learners such as individual differences, levels of learning readiness such as motivational levels, learning rates and cognitive ability (Nederveld and Berge; 2015). Teachers present themselves more effectively as a professional who encourages students to participe in the learning process. Teachers offer activities that lead students to make successful use of their learning to improve their abilities to find solutions to complex problems (Milman 2012).

In a large lecture course, the conventional teaching/learning pattern starts with an

instructor presenting each class with new materials and subsequently reviewing the content, and then a summative evaluation to test student comprehension (Moravec, et al. 2010). Therefore, traditional classrooms are usually based on teacher-centred group instruction, where knowledge flows only in one direction from teacher to learner while in flipped classrooms the role of a teacher changes from information giver to that of a facilitator who designs a student-centred environment that encourages students to be more active in their learning and uses class time for more engaging activities (Cheng-lin & Jian-wei, 2016). Secondly, educational knowledge transmits from teacher to student in a conventional approach, while flipped teaching models allow students greater autonomy and responsibility and collaboration for learning (Zownorega, 2013) since the flipped-class designs provide an environment for learners to control their own learning by setting their own objectives and preparing their time to study (Wiginton, 2013). Classical education methods, learning is bounded with time and location. For example, the duration in the classroom is limited in a sense that the student is provied with minimum assistance and must use his/her lowest level cognitive skills (Arslan & Özpınar, 2008). Bergmann and Sams (2012: 15) properly describe how the time is completely restructured as follows:

Students still need to ask questions about the content that has been delivered via video, so we generally answer these questions during the first few minutes of class. This allows us to clear up misconceptions before they are practiced and applied incorrectly. The remainder of the time is used for more extensive hands-on activities and/or directed problem-solving time.

Table 1. Comparison of Class Time in Traditional versus Flipped Classrooms (Bergmann and Sams, 2012:15)

Traditional Classroom		Flipped Classroom	
Activity	Time	Activity	Time
Warm-up activity	5 min	Warm-up activity	5 min.
Go over previous night's homework	20 min.	Q&A time on video	10 min.
Lecture new content	30-45 min.	Guided and independent practice and/or activity	75 min.
Guided and independent practice and/or lab activity	20-35 min.		

Additionally, students need teacher assistance in homework activities that are given for the outside the classroom activities (Talbert, 2012). However, in the flipped classroom model, students have more broader time for handling complex task and they can more easily reach teacher guidance since FCM enables teachers to spend their limited class time with students (Obradovich et al 2015). The following figure illustrates the application differences between the traditional model and FCM (Şık, 2019: 41).

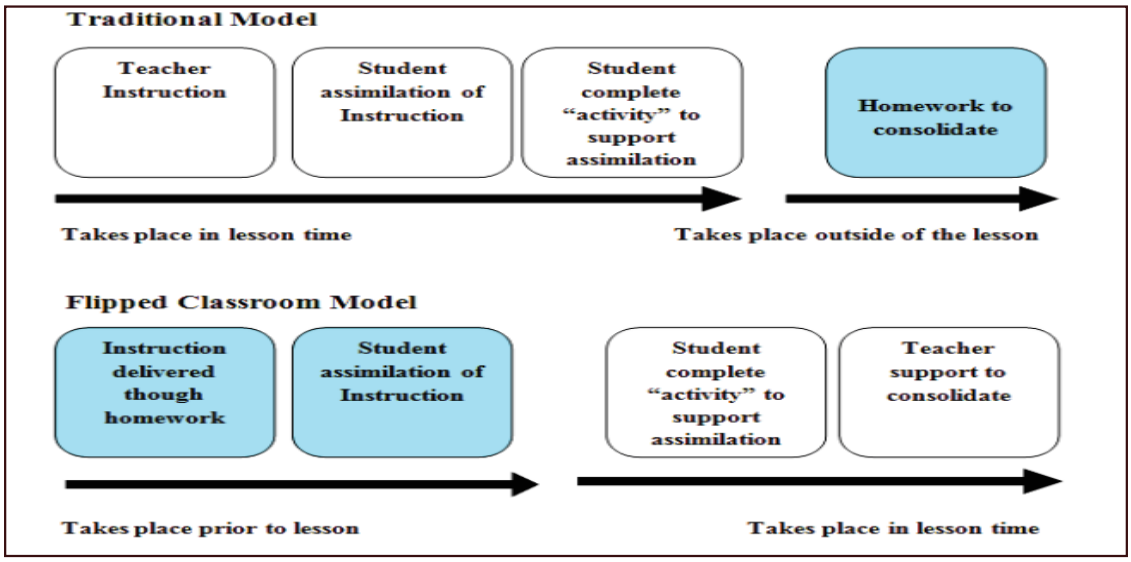

Figure 2. A Comparison Between Traditional Classroom and FCM (Moravec, et al. 2010 from Şık, 2019: 42)

FC offers another advantage in developing higher-quality skills in the learning process. Bloom's revised teaching taxonomy (Anderson, Krathwohl and Bloom, 2001) which orders cognitive thinking skills from simple to complex. Figure below demonstrates the order of skills when engaged in the learning process in traditional and flipped classrooms. Therefore, pupils are exposed to traditionally educated schools. Thereby, students are subject to direct instruction in class rooms that have typically learned fewer low level skills such as recall and understanding, whereas in homework assignments they need **a** higher order cognitive skills such as applying, analyzing, evaluating and design for the tasks given. In comparison, FC Strategy inverts these steps because of their complexity in order, under the supervision of teachers in the schools, to promote activities that involve higher order cognitive skills while providing simple information that can be handled by less organized thinking skills using video lectures at home (Göksu Yüreğilli, 2018; Bulut, 2018).

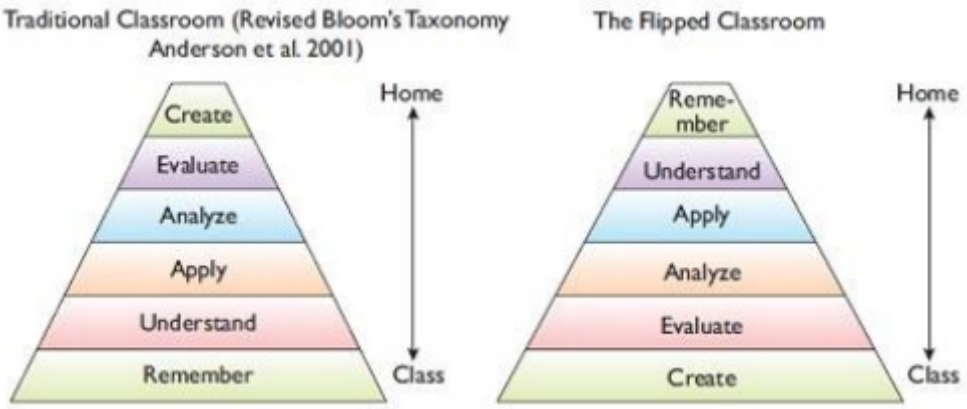

Figure 3. Revised Bloom's Taxonomy of Educational Objectives in the Context of Flipped Classroom Model (Bulut, 2018:16).

Another advantage of the flipped classroom model is that learners are encouraged to transfer their new knowledge to real-life contexts (Horn, 2013). Students engage actively

in the process of knowledge formation in active learning settings (Adams & Burns 1999).The flipped classroom puts together constructive learning techniques. Therefore it encourages students to devote their time to finding solutions to problems, develop, evaluate and synthesize in a comprehensive and logical manner (Gürlüyer, 2019). Finally, the goal of the flipped classroom approach is to give students direct access to and use of digital technologies (Richter & McPherson, 2012; Yaşar, 2020) so that teachers put together multimedia and video lectures in online mode. This enables students, through mobile phones, tablets and other devices, to enter and attend lectures at home and later to pay more attention to the work of seeking solutions to complicated or complex problems during classroom hours (Martin, 2012). Enfield (2013) highlighted the advantages of employing Flipped classroom model in the context of technology as follows;

(a) When the students are absent, the videos provided a good source of information,

(b) Most students find educational videos useful and stimulating, and students moving their own way through the exercise.

(c) Daily quizzes were found to be a significant incentive for most students to keep up the videos.

(d) More students their who want to to learn a new technology without attending a structured course reported that they were more confident.

Therefore, students have the chance to develop their learning across a variety of experiences in an educational environments **in** which they play an active involvement (Seaman & Gaines, 2013). Chilingaryan and Zvereva (2017) emphasized the advantages of FC as;

(a) it increases the contact time between the teacher and the student

(b)it is a kind of personalized approach to each student

(c) it gives an opportunity for the teacher to create authentic mini-lectures

(d) it increases the responsibility and autonomy of the learner

(e) it gives the absent students chance to catch up with the missing subject

(f) each student can work on his/her own pace

(g) it gives the ability to concentrate more on the subject in a free environment

(h) it increases the motivation of the student

(i) it improves the atmosphere in the classroom, making it more welcoming and

comfortable

(j) it increases and creativity and critical thinking of students

(k) the possibility for continual archiving of the material enable the students to access the online material continuously

(l) it turns the teacher into a kind of counselor, helper, guide, helping to orient student themselves to find their way in a sea of information.

However it should be emphasized that Flipped Classrooms may have disadvantages just as every educational model. Correa (2015) listed some potential problems about Flipped Classroom model, these are;

(a) boring/not engaging lessons,

(b) deeming teachers non-necessary,

(c) students not watching the videos,

(d) not everything can be taught online,

(e) the approach is passive

(f) insufficient technological resources

(g) insufficient time to produce the material and lastly

(h) using other teacher's videos would be unethical

We can propose some drawbacks of flipped classrooms in this respect. For instance, if some students who especially live in low-income areas,or come from poor families cannot watch the video lectures because of problems in accessing the Internet and gadgets, then the effectivenes of the flipped classroom will be meaningless for those students. Despite these socio-economic access issues for teachers, it is the duty of teachers to list those who do not have the appropriate technical requirements and who use the form of survey they use until the model has been applied (November, Mull, 2015). Another drawback may be related to the content of the video lectures are supposed to be assigned to students in a clear, informative, and pedagogic way (Mirriahi, Alonzo, McIntyre, Kligyte, &Fox, 2015). Otherwise, the flipped classroom won't be effective in this respect. Additionally, the student reluctance to a new approach is also an issue with respect to flipped classrooms. Some students see video lectures as an extra burden and they don't have instant access to ask the questions to the teachers immediately (Defour, 2013; Öztürk, 2018). Herreid and Schiller (2013) found that students thought like they did more work than in a classroom in the flipped calssroom model. Students who did not watch the outside videos did not

readily understand the content during the class. It was also challenging for teachers to make professional videos and regarded as time consuming in many respects. However, most studies show that educators and students appreciate this transition, but only usually afterwards. It should be emphasized that several years of deeper habits and beliefs must be overcome," and teachers and students must be convinced that this transition is positive for both sides before the filipped classroom begins (Rotellar & Cain, 2016: 5). Talley and Scherer (2013) proposed that flipping the classroom may not be enough to enhance teaching and learning only by itself but that students have become more involved and have better learning when combined with proper activities and self-practice. Again teachers should be careful about the characteristics of the class and students if they want to use flipped classroom model. Therefore, Zappe and Litzinger (2017) propose the variables to measure when evaluating flipped classrooms as student characteristics, out-of-class activities, and in-class activities given in Table 2.

Table 2. Considerations for Variables to Measure when Evaluating Flipped Classrooms Relating to Student Characteristics, Out-of-Class Activities, and in-Class Activities (Zappe and Litzinger, 2017)

Student characteristics	Out-of-class activities	In-class activities
- Gender - Auditory, visual, learning, and other disabilities - Socioeconomic status - Cultural expectations - Previous relevant experiences - Concerns regarding new instructional strategy - Concerns regarding technology requirements - Prior knowledge of course material	- Alignment to course learning objectives - Alignment with related in-class activities - Clarity of materials - Accessibility - Technical issues - Appropriate amount of material assigned - Students' actual or estimated usage of online material (if applicable) - Students' level of preparation for related in-class activities - Student learning gains	- Alignment to course learning objectives - Alignment with related out-of-class activities - Clarity of instructions/ materials - Level of engagement - Targeted time vs. actual time required - Generation of discussion/ questions - Perceptions of class environment - Perceptions of activity effectiveness - Student learning gains

However we can still argue why flipped classroom is needed today if it is applied appropriately by referring the ideas of Bergmann and Sams (2012:15) as follows:

1- Flipping speaks the language of today's students: Today's students grew up with Internet access, YouTube, Facebook, MySpace, and a host of other digital resources. Therefore teachers should infiltrate the video/digital culture instead of fighting it. They should embrace digital learning and used it to help the students to learn, instead of telling them they can't learn with today's tools?

2- Flipping helps busy students: Students today are busy. Many are overprogrammed,

going from one event to the next so that they need the flexibility of the flipped classroom.

3- Flipping helps struggling students: Teachers can spend most of their class walking around helping the students who struggle most.

4- Flipping helps students of all abilities to excel: All the direct instruction is recorded, students with special needs can watch the videos as many times as they need to learn the material.

5- Flipping allows students to pause and rewind their teacher: Flipped the classroom, give the students control of courses so that students appreciate the pause function for different reasons such as slow or fast learning.

6- Flipping increases student–teacher interaction: Flipping allows teachers to leverage technology to increase interaction with students.

7- Flipping allows teachers to know their students better: Flipping allows teachers to build better relationships with our students due to the increased teacher–student interaction.

8- Flipping increases student–student interaction: Teachers can purposely try to make their classes places where students carry out meaningful activities instead of completing busywork so that they can create a culture of learning.

9- Flipping allows for real differentiation: Flipping the class can show how needy many students were since teachers can personalize the learning of all.

10- Flipping changes classroom management: Since teachers not just to stand up and spoke to students, all of the issues of school administration evaporated.

11- Flipping changes the way teachers talk to parents: Flipped classrooms are shifting the emphasis to a place where parents can consider how their students can enhance learning.

12- Flipping educates parents: Many of parents were watching right alongside their children and learning science.

13- Flipping makes the class transparent: Flipping opens the doors to our classrooms and allows the public in.

The Relationship between Technology and The Flipped Classroom

Two important aspects of learning are lectures and active learning in the FCM. The lessons are flipped to home activities so that students can gain expertise and spend more time developing and improving knowledge they have acquired out of class.. The students thus invest their time in class on productive learning and use digital tools for content mastery the activities that are out of class (Martin, 2012). Clark (2015) defined flipped classroom method as a new teaching approach that aims to make lectures outside the classroom through technology, and to do homework and exercises in the classroom with planned learning activities, thus increasing students' participation and performance. In this respect technology has an important role in flipped classroom activities. The flipped classroom technology means such an arrangement for the teaching process, which also has theoretical understanding and an understanding of the problem to be addressed as students attend face to face courses in the classroom. It makes interaction more productive and successful as students are relaxed and more assured as they ask questions and speak to teachers and their peers about the problems. In addition, students take part in realistic exercises, but not in repetitive taking notes of the lecture. Therefore, homeworks becomes different as well (Evseeva & Solozhenko, 2015: 207).The development of technology will facilitate «a new way of intellectual expression and creativity» and offer «previously unbelievable» opportunities for learning (McGrath et al, 2017: 38). The teachers and students realized the need of flexibility and realized the flexibility of the technique itself in the use of technology at home rather than at school (Shaffer, 2017:19). The technologies used in the flipped learning model records lessons for students, enabling them to experience the material at their own speed and allowing them to see the contents themselves (Horn, 2013). Therefore, we need to consider the role of technology and which tools to use when flipping. The first technological concept that can be more frequently used in flipped classrooms are online resources. However, those sources should be educationally fit, credibility and availabile (Crawford and Senecal,2017: 37-41). The mindful use of technology can also provide (McGrath et al, 2017: 39):

• *new ways to:*

- *interact in and out of class (e.g. discussion forums, chat rooms, polls);*
- *collaborate, share, and create (e.g. wikis, social bookmarking, collaborative documents);*
- *showcase, feedback, and peer review (e.g. e-portfolios, online rubrics); and*
- *reflect and plan (e.g. journals, shared calendars);*

• increased flexibility in time, place, and pace of study as recorded lectures and other online study resources allow students to access resources at their convenience and to suit their pace of learning;

• extended opportunities for discovery (e.g. 3D immersive environments, interactive role-plays);

• better monitoring of student learning and engagement together with increased ability to identify students "at risk"; and

• increased efficiencies in sourcing, producing, and distributing content

Secondly, effective online presentations that are audio recordings, voiceover presentations, screencasting and videos can be used to transform in-class lectures to pre-class learning activities. However, whatever the presentation type we will chose, teachers consider five logistical factors when choosing the most appropriate presentation type (Crawford and Senecal,2017: 37-41):

• How much time is available to create the presentation?

• How much effort will be needed to use the tools for creating the presentation?

• What is the cost of the tools required to develop the presentation?

• Will the presentation be reused in other courses?

• Will the audio/video production quality level be in alignment to the expected instructional use pattern?

It should be noted that the delivery of technology is not only related to the structure and logistical factors of the course but the current technological condition of the student and schools. Options for delivery of flipped lessons can be varied given in Table 3.

Table 3. Options for Delivery of Flipped Lessons (Shaffer, 2017: 4).

If a student has…	Then…
Computer with Internet capability and service	Lessons can be watched on desktop at home, laptop at home, or outside school.
Computer with no Internet	Lessons can be burned onto a DVD or flash drive and sent home with student
A tablet or a smartphone with Internet access (wireless or 3G/4G)	Lessons can be watched anywhere, anytime when wireless or 3G/4G service is available.
No personal technology, but the school has adequate technology	Laptops or tablets can be loaned to students as needed.
No personal technology and school technology resources are limited	Students can watch lessons in school computer labs, libraries, or classrooms before or after class.

Addtionally, a class shouldn't be inverted merely because of institutional drivers or just for techonological incorporation of new tools. A FC must be defined on the basis of a

need (Kavanagh et al. 2017: 17):

- assist students in mastering a complex idea or information that is difficult and not properly managed using a modern method of delivery;
- Involve students in content which has been considered by previous cohorts to be "boring" or "irrelevant."
- promote professional creation using new knowledge or principles.

The technology that can used in flipped classrooms involves many tools ranging from costly and sophisticated virtual worlds, to free and downloadable mobile softwares to encourage teamwork, connectivity and the community (Bosman and Zagenczyk 2011). First, schools must decide the LMS they are using, ensuring that all students are using the same framework regardless of their grade level or teaching degree. Most Google Classroom schools have also used Google Education software. Second, schools must decide what teachers and students are going to use to store and transfer files. Google Schools of Education used for instance, Google Push. Thirdly, schools must decide if teachers sync video meetings with pupils. Many schools used Zoom or Google Meet. Fourthly, schools must decide what teachers are using to catch asynchronous learning video lessons. Chrome users use Screencastify to screen (when you record what you do on your pc), but even services like Loom and Screencast-O-Matic are very common[2]. However, essential technologies for the flipped classroom can be given as[3]:

1. Screen and video recorder: The development of async learning materials that simulate conventional teaching experience can be encouraged through a screen and video recorder.
2. Video editor with quizzing or polling capabilities: You will customize your presentations and tutorials with a video editor in order to produce on demand content of high enough quality with less time.
3. Video captioning tools: Captioning flipped classroom videos not only helps render asynchronous learning material more available, yet also helps all students, even non-native speakers, grasp and maintain their content.
4. Secure video library: Teachers new to flipping sometimes turn to platforms like YouTube or Google Drive often switch to store and upload course videos. Public sharing platforms not only diminish the rights and control of the intellectual property but also bring ads and sometimes unauthorized images to the virtual learning environment. Video management technology lets you store and share

[2] https://blogs.edweek.org/teachers/classroom_qa_with_larry_ferlazzo/2020/08/blended_learning_in_the_age_of_covid-19.html
[3] https://www.panopto.com/blog/essential-flipped-classroom-technology/ retrieved from 29.11.20

your course videos in a private, searchable video library, without sacrificing any of your creative and intellectual rights.

5. Learning management system: The LMS system of your school will play a key role in building an effective, smart learning environment. In order to facilitate asynchronous conversations and student collaboration in an educational setting, LMS is the core source of content and communication..

Vodcast designing is the important part of the flipped classrooms and the learning objectives for the class period should inform your decision regarding the type of hardware and software you use. Screencast programs generate a multimedia archive of activities on the computer screen. First, screencast programs can be used to deliver lecture-style presentations. Programs may be used to illustrate how a software application should be operated. most popular software programs used by flipped instructors can be given as Camtasia, Adobe Captivate, Screencast-O-Matic, PowerPoint, Snagit, Jing, Screencastify. Additionally, screencasting whiteboard applications record what you illustrate or write on your iPhone or tablet while also capturing your narration. These programs can give as Explain Everything, Educreation, ScreenChomp, ShowMe. Once you have created your vodcast, video hosting services to disseminate the videos. Various hosting services that you can choose can be listed as University In-House Hosting Services, Screencasting-Based Hosting Services, YouTube, Vimeo. Video Hosting Services That also embed quizzes and track student progress can be given as Edpuzzle, Playposit, TED Ed Lessons. It should be noted that the products in the technology world are constantly shifting and changing and therefore you should also follow the current technology (Roehling, 2018). Tools such as Edmodo, YouTube, Google Apps, Dropbox, Educreation, GlogsterEdu, Screncast, Socrative, Teaching Channel, Twitter can also be used to Assessments in transformed education have to be made differently in order to evaluate and assess students success in the flipped classrooms. Due to the COVID-19 pandemic, our education system totally depend on distant trainig.

The Importance of Flipped Classroom Model in Distant Training

Distance learning offers the perfect way to explore the flipped classroom, because students already learn too far from their homes. It builds and enhances the interaction between teachers and students. And inspiration can also help. If you are learning theories in practice, promote student comprehension and peer-to-peer co-operation, this makes an online lesson more dynamic and stimulating. If the aim of the course is the practical application of ideas, this makes an distance learning more dynamic and stimulating. Flipped Learning provides instructors with a means of facilitating and coordinating student activities remotely. Therefore, time spent online together can then be used more

efficiently and a student with personal feedback and support can continue to make successful progress. It is always important to remember that flipped classroom is not a way of technology incorporation into education, but taking a different philosophical approach to education. The flipped classroom approach is basically to encourage constructive learning by providing active learning through interaction between students and teachers. This ensures that you can use your time in communication encouraging the students to use the practice of their new knowledge instead of wasting your time to clarify the fundamentals of a new subject or theory so that it ensures that teachers will concentrate on making the classroom a diverse and distinct learning environment. This transition signals significant cultural changes and aspirations for educators and learners such as (McGrath et al, 2017: 38):

- to require students to be more responsible in their learning;
- presenting students with chances to negotiate with peers and co-creating understanding;
- challenge students by focusing on problems or projects, and research-based learning methods;
- delivering personalized feedback opportunities;
- giving opportunity to transform the lessons according to the responses of the students;
- application of student involvement facilitation techniques;
- improving formative assessment and feedback options

Therefore it brings many disadvantages during the distance learning. First of all it is founded on the belief that our students will prepare for the course. Additionally the instructor must also arrange the content in advance. Therefore teachers also get more time to spend on dealing with students who have little experience, while quicker students may get extra tasks and attempt to clarify the matter in their own words to their peers[4]. Another problem with flipped classroom in Covid-19 pandemic is that our education has became totally depend on the virtual environments so that there is no physical room to flip the classrooms. Maybe this can be compensated by other online options such as livestream coursed or simulations. Therefore out of the class activities refers to asynchronous learning activities such as videos or other multimedia tools and in-class actifities refers to synchronous activities where the difficult and the incomprehensible parts are focused so that discussions, various activities and activities are carried out on the subject, and the subject is reinforced, thus active and meaningful learning is realized. What is learned

[4] https://erasmuscoursescroatia.com/2020/03/26/flipped-classroom-a-perfect-tool-for-distance-learning-or-how-to-use-facebook-in-a-flipped-classroom/ retrieved from 29.11.20

outside of the classroom increases the time to be used in class (Basal, 2015). Firstly, before schooling, the students addressed the output task, the teacher offered feedback, comments and then outlined the typical problems in the production task of the students. Second, the teacher instructed or taught just-in-time, according to the problems, outlined in the internet discussion group or during the delivery of the production task. Thirdly, diverse learning experiences will be conceived for students to provide more resources, such as interviews, discussions, role plays, simulation negotiations, etc. to interact with the teacher and peers, to further digest, absorb and apply what they learned. The instructor will select a student to respond to questions arbitrarily, to engage in a conversation, exchange thoughts, etc in order to retain his interest and also to track his learning process during the online synchronous training period. In synchronous online instruction, the instructor assessed student performances in different aspects. On the postclass level, the extended challenge was created to further illustrate the students' achievements of internalizing information and absorbing it in a synchronous online learning scene to consolidate learning content. The finished completed homework should be reloaded to the platform and the final chapter exam is over. During that process students should also communicate with the instructor and peers as they experience learning difficulties[5].

For instance, in the recent study of Guraya (2020) shows how flipped classroom can be actualized in distance learning education. The face-to-face teaching pedagogy was smarterly turned into a remote teaching module using Blackboard® and MS Teams® interfaces at the College of Medicine in Sharjah, United Arab Emirates. The first stage was to provide the students with a pre-recorded video lecture by the instructor. The key emphasis of this pre-recorded lecture was an instructional, cognitive interpretation of the subject. The lecture will finish with a dynamic, clinical situation that would guide students to learn how to address the issue with the Blackboard® or MS Teams® community discussions. A live, immersive resource session on the same subject was held two to three days after the pre-class lecture. The session begins with a resolution of the same situation in which the pre-class lecture concluded. Finally, after-session activities were offered to students to discuss small groups, which they learned through live chats. It should be noted that transition to a remote distribution format was challenged as follows (Fogg, Maki, 2020):

1- Engaging students with the lecture content: Additional steps required to present the information informatively and interactively without communicating personally with the students and include students in the development of the lecture.

2- Replacing the hands-on learning activities: Since students could no longer reach the lecture room and measurements on living systems required a simulated experiment that matched the lesson objectives.

[5] https://assets.researchsquare.com/files/rs-84578/v1/cccfed35-424c-4dd5-9727-bdd9853cdb40.pdf retrieved from 29.11.2020

3- Creating a sense of community within the class: Since students could no longer communicate in person, extra time needed to be built in to promote peer-to-peer interactions.

4- Promoting collaboration in group projects: As this was no longer an option, additional scaffolding was required to enable students to cooperate.

5- Making all students accessible: For students with restricted internet connectivity, customer service and/or time constraints to make this course accessible, more flexibility required to be integrated into the course.

Finally, it should be bear in mind that due to the COVID-19 pandemic, our education system totally depend on distant trainig, goverments should follow a successful strategy integrating online and offline teaching and learning activities[6]:

- Guarantee access to internet and availability of computers, laptops, or tablets
- Adopt proper Virtual Learning Environments (VLE)
- Rethink the role of broadcasting education
- Improve availability of learning technology for students with Special Educational Needs and /or Disabilities
- Support teachers
- Support parents

References

Abeysekera, L., & Dawson, P. (2015). Motivation and cognitive load in the flipped classroom: definition, rationale and a call for research. *Higher Education Research & Development*, 34(1), 1-14. https://doi.org/10.1080/07294360.2014.934336

Adams, S. & Burns, M. (1999). *Connecting Student Learning and Technology*. R http://www.southcentralrtec.org/products/cslt.html retrieved from 25.11.20

Arslan, S., & Özpınar, İ. (2008). Öğretmen nitelikleri: ilköğretim programlarının beklentileri ve eğitim fakültelerinin kazandırdıkları. *Elektronik Fen ve Matematik Eğitimi Dergisi (EFMED)*. 2(1) 38-63.

Astin, A. W. (1999). Student Involvement: A Developmental Theory for Higher Education. *Journal of College Student Development* 40 (5): 518–529.

6 https://publications.jrc.ec.europa.eu/repository/bitstream/JRC121071/jrc121071.pdf retrieved from 29.11.20

Basal, A. (2015). The Implementation of A Flipped Classroom in Foreign Language Teaching. *Turkish Online Journal of Distance Education-TOJDE*, 16 (4).

Bates , J.E. Almekdash ,H. Gilchrest-Dunnam, M.J.(2017). *The Flipped Classroom: A Brief, Brief History*, Educational Communications and Technology: Issues and Innovations, USA: Springer.

Bergmann, J., & Sams, A. (2012). *Flip Your Classroom : Reach Every Student in Every Class Every Day*. Eugene, Or: International Society for Technology in Education.

Bergmann, J., Overmyer, & Wilie. (2012). *The flipped class: What it is and what it is not*. USA: The Daily Riff.

Bishop, J. Lowell, M. (2013). The Flipped Classroom: A Survey of The Research. *ASEE National Conference Proceedings*. c. 30. s. 9: 1-18.

Bonk, C. J., & Graham, C. R. (Eds.). (2006). *Handbook of blended learning: Global perspectives, local designs.* San Francisco, CA: Pfeiffer Publishing.

Bosman, L., & Zagenczyk, T. (2011). *Revitalize your teaching: creative approaches to applying social media in the classroom.* In Social media tools and platforms in learning environments (pp. 3–15). Springer Berlin Heidelberg.

Brame, C. (2013). *Flipping the Classroom.* https://cft.vanderbilt.edu/guides-sub-pages/flipping-the-classroom/ retrieved from 28.11.20

Brame, C. (2013). *Flipping the classroom*. Retrieved June 18, 2015, from http://cft.vanderbilt.edu/ guides-sub-pages/fl ipping-the-classroom, Educational Communications and Technology: Issues and Innovations, USA: Springer.

Bulut,C.(2018). *Impact of flipped classroom model on EFL learners' grammar achievement: Not only inversion, but also integration*, (Unpublished Master Thesis), https://tez.yok.gov.tr/ retrieved from 25.11.20

Cheng-lin, H., & Jian-wei, C. (2016). A target design of a mobile app providing supportive service for flipped classroom. *Journal of Educational and Social Research*, 6(1), 27.

Chilingaryan, Kamo and Zvereva, Ekaterina (2017), Methodology of Flipped Classroom as a Learning Technology in Foreign Language Teaching, *Procedia-Social and Behavioral Sciences*, 237, 1500-1504.

Clark, K. R. (2015). The Effects of the Flipped Model of Instruction on Student Engagement and Performance in the Secondary Mathematics Classroom. *Journal*

of Educators Online, 12(1), 91-115.

Correa, Maite (2015), Flipping the Foreign Language Classroom and Critical Pedagogies A (New) Old Trend, *Higher Education for the Future*, 2(2), 114-125.

Crawford, S.R. Senecal, J.(2017). Tools of the Trade: What Do You Need to Flip? *Educational Communications and Technology: Issues and Innovations*, USA: Springer.

Crouch, C. Mazur. H.E. (2001). Peer Instruction: Ten Years of Experience and Results. *American Journal of Physics*. c. 69. s. 9: 970-977.

Defour, M. (2013). *Flipped classrooms' spreading in Wisconsin*. Community College Week, 25(16), 10-20.

Enfield, J. (2013). Looking at the Impact of the Flipped Classroom Model of Instruction on Undergraduate Multimedia Students at Csun. *Techtrends Tech Trends* **57,** 14–27 https://doi.org/10.1007/s11528-013-0698-1

Evseeva, A. & Solozhenko, A. (2015). Use of Flipped Classroom Technology in Language Learning. *Procedia - Social and Behavioral Sciences*. 206. 205-209. 10.1016/j.sbspro.2015.10.006.

Goodwin, B. & Miller, K. (2013). Evidence on flipped classrooms is still coming in. *Educational Leadership*, 70 (6), 78-79.

Göksu Yüreğilli, D. (2018). *The effect of the application of flipped classroom approach on the 5th grade students' english academic achievements, learning anxieties and learning attitudes*, (Unpublished Doctoral Dissertation), https://tez.yok.gov.tr/ retrieved from 25.11.20

Guraya S. (2020). Combating the COVID-19 outbreak with a technology-driven e-flipped classroom model of educational transformation. *Journal of Taibah University Medical Sciences*, 15(4), 253–254. https://doi.org/10.1016/j.jtumed.2020.07.006

Hamdan, N.., Mcknight, P. Mcknight, K. & Arfstrom. K.M. (2013). *A Review of Flipped Learning*. Pearson-Research & Innovation Network

Flipped Learning Network (FLN). (2014). *What is flipped learning? The Four Pillars of F-L-I-P.* https://flippedlearning.org/wp-content/uploads/2016/07/FLIP_handout_FNL_Web.pdf retrieved from 23.11.20

Fogg, K.C., Maki, S.J. (2020). *A Remote Flipped Classroom Approach to Teaching Introductory Biomedical Engineering During COVID-19*. Biomed Eng Education

https://doi.org/10.1007/s43683-020-00001-4

Herreid, C. F., & Schiller, N. A. (2013). Case studies and the flipped classroom. *Journal of College Science Teaching*, 42(5), 62–66.

Horn, M. (2013). The transformational potential of flipped classrooms. *Education Next*, 13(3), 78–79.

İyitoğlu, O. (2018). *The impact of flipped classroom model on EFL learners' academic achievement, attitudes and self-efficacy beliefs: A mixed method study,* Unpublished Doctoral Dissertation, https://tez.yok.gov.tr/ retrieved from 28.11.20

Kara, C.O. (2015). Ters yüz sınıf . *Toraks Cerrahisi Bülteni*, 9, 22-48

Kardaş, F. &Yeşilyaprak, B. (2015). Eğitim ve öğretimde güncel bir yaklaşım: teknoloji destekli esnek öğrenme (flipped learning) modeli. *Ankara Üniversitesi Eğitim Bilimleri Fakültesi Dergisi, 48*(2), 103-121.

Kavanagh, L. Reidsema, C. McCredden, J. and Smith,N. (2017). *Design Considerations. The Flipped Classroom*, USA: Springer.

Kenna, D. C. (2014). *A study of the effect the flipped classroom model on student self-efficacy* (Doctoral dissertation, North Dakota State University)

Khan Academy. (2012). https://www.Khanacademy.Org/

King, A. (1993). From Sage on The Stage to Guide on The Side. *College Teaching*. c. 41. s. 1:30-35.

Kömeç, F. (2018). *Efl students' perceptions of the flipped classroom in terms of learner autonomy, language skills, technological attitudes and motivation at secondary level*, (Unpublished Master Thesis), https://tez.yok.gov.tr/ retrieved from 24.11.20

Lage, M. J., Platt, G. J., & Treglia, M. (2000). Inverting the classroom: A gateway to creating an inclusive learning environment. *The Journal of Economic Education*, 31(1), 30- 43.

Lage, M. J., & Platt, G. (2000). The internet and the inverted classroom. *Journal of Economic Education*, 31(1), 11-11.

Martin, F. G. (2012). Will massive open online courses change how we teach? *Communications of the ACM*, 55(8), 26-28. doi: 10.1145/2240236.2240246

Martin, D. J. (2003). *Elementary science Methods: A constructivist Approach 3nd ed.* Boston, MA: Pearson Education, Allyn & Bacon.

McGrath,D. Groessler,A. Fink,E. Reidsema,C. Kavanagh, L. (2017). *Technology in the Flipped Classroom, The Flipped Classroom*, USA: Springer.

Milman, N. B. (2012) The flipped classroom strategy: What is it and how can it best be used? *Distance Learning* 9 (3), 85.

Mirriahi, N., Alonzo, D., McIntyre, S., Kligyte, G., & Fox, B. (2015). Blended learning innovations: Leadership and change in one Australian institution. *International Journal of Education and Development using Information and Communication Technology*, 11(1), 4.

Moravec, M., Williams, A., Aguilar-Roca, N., & O'Dowd, D. K. (2010). Learn before lecture: A strategy that improves learning outcomes in a large introductory biology class. *CBE Life Sciences Education*, 9, 473–481.

November, A., Mull. B. (2015). *Flipped Learning: A Response to Five Common Criticisms, https://novemberlearning.com/article/flipped-learning-a-response-to-five-common-criticisms*-article/ retrieved from 28.11.20

Quint, C. L. (2015). *A study of the efficacy of the flipped classroom model in a university mathematics class* (Doctoral dissertation, Teachers College, Columbia University)

Obradovich, A., Canuel, R. ve Duffy, E. P. (2015). A survey of online library tutorials: guiding instructional video creation to use in flipped classrooms. *The Journal of Academic Librarianship*, 41(6), 751-757.

Onyema, E. & Chika, N. & Obafemi, F. & Shuvro,S. & Atonye, F.G.& Sharma, Aa & Alsayed, A. Oç (2020). Impact of Coronavirus Pandemic on Education. *Journal of Education and Practice*. 11. 108-121. 10.7176/JEP/11-13-12.

Öztürk, S.Y. (2018). *The impact of flipped classroom model on the academic achievement of student teachers of English*, (Unpublished Master Thesis), https://tez.yok.gov.tr/ retrieved from 24.11.20

Richter, T., & McPherson, M. (2012). Open educational resources: education for the world?. *Distance education*, 33(2), 201-219.

Roehling, P.V. (2018). *Flipping the College Classroom*, Switzerland: Palgrave Macmillan.

Rotellar, C., and Cain, J. (2016). Research, perspectives, and recommendations on implementing the flipped classroom. *American Journal of Pharmaceutical Education*, 80(2), 1-9.

Shaffer,S. (2017). *Examining the Potential for Flipped Literature Units: Flipping The*

Great Gatsby, Applying the Flipped Classroom Model to English Language Arts Education, USA: IGI Global

Schultz, D., Duffield, S., Rasmussen, S. C., & Wageman, J. (2014). Effects of the flipped classroom model on student performance for advanced placement high school chemistry students. *Journal of Chemical Education*, 91(9), 1334-1339.

Seaman, G., & Gaines, N. (2013). Leveraging digital learning systems to flip classroom instruction. *Journal of Modern Teacher Quarterly*, 1, 25-27

Singh, H. (2003). Building Effective Blended Learning Programs. *Educational Technology*, 43(6), 51-54.

Springen, K. (2013). Flipped: A revolutionary approach to learning presents pros and cons for educators. *School Library Journal*, 59(4), 23-26.

Staker, H., & Horn, M. B. (2012). *Classifying K – 12 blended learning*. Innosight Institute. Retrieved from https://files.eric.ed.gov/fulltext/ED535180.pdf

Strayer, J., F. (2007). *The Effects of The Classroom Flip On The Learning Environment: A Comparison of Learning Activity in A Traditional Classroom and A Flip Classroom That Used An Intelligent Tutoring System*. Doctoral Dissertation. The Ohio State University

Şık, P. (2019). *The effect of flipped classroom on young learners' vocabulary learning in primary elt classrooms*, Unpublished Master Thesis,

Talbert, R. (2012). Inverted classroom. *The Internet and Higher Education*, 15, 89-95

Nederveld, A., & Berge, Z. L. (2015). Flipped learning in the workplace. *Journal of Workplace Learning*, 27(2), 162-172

Talley, C. P., & Scherer, S. (2013). The enhanced flipped classroom: Increasing academic performance with student-recorded lectures and practice testing in a Flipped STEM course. *The Journal of Negro Education*, 82(3), 339–347. doi:10.7709/jnegroeducation.82.3.0339

Walvoord, B. E., & Anderson, V. J. (1998). *Effective grading: A tool for learning and assessment*. San Francisco, CA: Jossey-Bass

Wiginton, B. (2013). *Flipped instruction: An investigation into the effect of learning environment on student self-efficacy, learning style, and academic achievement in an algebra I classroom* (Doctoral dissertation, University of Alabama Libraries).

Yaşar, M.Ö. (2020). *Integrating a mooc-based flipped classroom model into the ELT*

program: Pre-service English language teachers' experience and perceptions, (Unpublished Master Thesis), https://tez.yok.gov.tr/ retrieved from 24.11.20

Yurdagül, C. (2018). *The effect of flipped classroom as a teaching strategy on undergraduate students' self-efficacy, engagement and attitude in a computer programming course*, (Unpublished Doctoral Dissertation), https://tez.yok.gov.tr/ retrieved from 24.11.20

Zappe, S.E. Litzinger, T.A. (2017). *Considerations When Evaluating the Classroom Flip Instructional Technique, Educational Communications and Technology: Issues and Innovations*, USA: Springer.

Zownorega, S. J. (2013). *Effectiveness of flipping the classroom in a honors level, mechanicsbased physics class*. (MA Thesis), Eastern Illinois University.

The Current State of Digital Learning in the 21st Century

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Introduction

In the report of the Organization for Economic Cooperation and Development (OECD) conducted in 2014 it is stated that Turkey has the highest value in the use of technological tools and equipment after Britain. It is also noted that over 59% of the world average rate of change and renewal in the field of education is in Turkey. According to 2019 data 99% of homes in Turkey, have smartphones. However, it is known that almost 87% of households have access to the internet. Also, it has been determined that 82% of men and 70% of women have access to and can use the internet (Arseven, 2020). Apart from all this, it has been determined that 4.54 billion people can use the internet in 2020 worldwide. 3.80 billion people in the world have social media accounts. It has been determined that more than 5.19 billion people in the world have mobile phones and each internet owner uses the internet for an average of 6 hours and 43 minutes a day (Geçgel, Kana, & Eren, 2020). When we look at Turkey, the technological developments in the world and search the internet for this information, the use of digital technology in the teaching-learning process is understood to be inevitable.

Various activities are carried out due to factors such as easier learning, accessing, and using information faster in the education process. These activities cause the most practical and solution-providing methods to be used to access or structure information (Ling Koh, & Pei Kan, 2020). In choosing these methods; Factors such as students, goals, activities, assessment, and learning environment culture appear as determining factors. Here, the term learning environment can be thought of as the classroom (setting) in which education takes place, although it usually has a traditional connotation as a room consisting of rows and blackboards lined up one after another. As it is known, the education and training process takes place in the classroom environment. In some definitions, even concepts such as "between four walls" are used (Kara, 2020). The insufficiency of this concept has emerged over time. Because it is perceived as being attached to a place or environment by staying between four walls. In the education process, learning can take place in space. However, it was thought that it lacked competence, persistence, speed, or reaching many examples (Taş et al., 2015). It is understood that different physical spaces, environments, and cultures where students perform the learning activities are also required. It has been observed that students can learn outside of school, outdoors, or in similar very different, and diverse environments. So much that in order to facilitate learners' access to information, the effectiveness of learning has been increased by

carrying various tools and equipment within the four walls. By creating laboratories in schools, learning has been made more concrete and appealing to the senses. Also, some subjects or educational practices that were not satisfied with these were carried out, out of school. Changing the learning environment, seeing on the spot, national park trips, zoos, or out-of-school education was made (Okur-Berberoğlu & Uygun, 2013). Apart from all these, with the development of technology and time, the use of technological tools has gained importance in education and training environments. Digital technologies have become important in education, especially with the discovery of the internet and the widespread use of computers.

In the 2010s digitization years in education in Turkey “Industry 4.0", which was put forward with the agenda (Özbek, 2020). The importance of industry 4.0 was emphasized in the 2023 vision document of the Ministry of National Education (MoNE). It is thought that the aim here is that children are expected to be qualified, moral people who are interested in science and culture along with the skills of the age and the future (MoNE, 2020). Also, MoNE emphasized that individuals should be raised with the concept of “digital skills” with their knowledge, skills, and behaviors (Yazıcıoğlu, Yaylak & Genç, 2020).

Digital Transformation

The development and change of web-technology integration into educational processes has been observed from past to present. Especially the use of new web technologies has led to a new perspective (Selwyn, 2007). The development of these technologies provides education independent of time and space and with enriched course contents (Işık, Işık, & Güler, 2010). These developments aim to overcome the restrictions of informal education and increase teacher-student interactions. It is thought that students are familiar with digital technologies today, where technology and digitalization are developing intensively. It was determined that students know how to access, create, and share information using technology (Yazıcıoğlu, Yaylak, & Genç, 2020). With the technological skills of students coming to the forefront, researchers and practitioners have turned to design learning processes appropriate to students' needs, expectations, and learning styles (Blau, Grinberg, & Shamir-Inbal, 2018). Also, students who have placed technology at the center of their lives are in the 21st century. To train them with their skills and to make their learning more effective, they started to turn to different quests where technology is integrated into education (Korucu, 2020). The search for digitalization or the use of digital technologies in many branches of society has also manifested itself in the education sector.

The transformations of societies took place in three waves. Agriculture, industry, and knowledge factors have provided permanent changes in societies (Alp & Levent, 2020).

Apart from these waves, digitization is thought to have a similar effect. In the digital age, it is thought that many societies or individuals are trying to digitize, at least they are willing to use, develop, and renew digital technologies. Also, they aim for a stronger education by differentiating traditional roles with the integration of digital technologies in the education and training processes of individuals.

As the functions of the education and training process were renewed, the roles of teachers have also changed. The teacher, who was seen as the only source of information in the classroom, has gradually become a guide. Rather than a tool that teaches the knowledge, it has a different meaning that directs and mediates access to information. Because today students' opportunities to access information have diversified. It is known that the student can capture information from many branches. In these stages, the teacher guides the student in developing their cooperation, collecting, organizing, evaluating, and using information. Especially the development of digital technologies and the necessity of having skills in this field made it necessary for students to get help. Digital transformation; is the transformation of existing digital tools, processes, and competencies into digital skills in harmony with changes and opportunities (Parsehyan, 2020). The development of this ability of the individual enables him/her to adapt to situations such as realizing the needs of the age in the digital transformation process, mastering digital tools, being aware of the risks in digital environments, observing personal rights in the virtual environment, and being open to changing and developing technological innovations (Manap & Durmuş, 2020).

In digital transformation, first of all, individuals who teach and implement education need to know and realize the digital and educational technologies (Raike, Keune, Lindholm, & Muttilainen, 2013). It is essential to enrich learning activities in the classroom and to create learning environments that arouse interest in students with learning styles, strategies, skills, and approaches. Also, it should support the development of students' success with activities that increase learning and remembering in students. For learning and teaching activities in schools or virtual classrooms to be equipped with the skills of the age and the future, firstly, teachers should be informed about digital technologies and their use. Subsequently, with similar training to be applied to students, it is ensured that all elements of education life can use digital technology and content. Sound, text, animation, 3D interactions are used in these digital contents (Sezgin & Karabacak, 2020).

The first examples of digital transformation in the world date back to the 1960s. Especially studies on computers and their use date back to these periods. It took the 1980s for some universities in the USA and Japan to start preparing networks and using the internet. Not only the USA and Japan but many countries, especially Germany and Russia, have acted with this trend. Institutional and individual studies have been done many times in Turkey, although the formal sense in the digital transformation of the 2019 Higher Education

Institutions in Council of Higher Education (CoHE) has been announced as one of the main goals. First of all, strategies related to digital transformation were determined for target groups through pilot universities. It started with 8 universities in November 2018, and the Digital Transformation Project in Higher Education was implemented with 8 other pilot universities in July 2019. First, the lecturers of 16 pilot universities are taught Digital Literacy, which is applied to undergraduate and then associates' degree programs in the following academic years (Sezgin & Karabacak, 2020). In this course, topics such as internet and portable technologies, social networks, future technologies and information ethics are given (Ataş & Gündüz, 2020).

Digital Literacy

Internet and digital applications that emerged with the big explosion in the world of information provided new developments. Social platforms, which have gained a spatial dimension with their written, visual and auditory features, have created a new literacy phenomenon (Özcan, 2017). Digital literacy is an old concept. It emerged in the 1980s when computer literacy was poorly defined in terms of goals and requirements (Sezgin & Karabacak, 2020). Digital literacy was first defined as Gilster's (1997) ability to understand and use the information provided via computers and received from various sources in digital environments (Pala & Başıbüyük, 2020; Yazıcıoğlu, Yaylak, & Genç, 2020). The purpose of this definition is to emphasize the importance of computer skills and learning with computers.

Digital literacy is the capability of perceiving, evaluating, analyzing, and sending appropriate messages to written and visual messages provided by communication tools (Potter, 2013). Digital literacy is to be able to overcome the virtual environments with information pollution in the developing and widespread technological age and to realize the reliability of "edu" and "gov" extensions (Ataş & Gündüz, 2020; Eroğlu, 2020). It is known that digital literacy is also cultivated in problem-solving, research, skill acquisition, and creating collaborative social interaction areas (Jesson, McNaughton, and Wilson, 2015; Kardeş, 2020). Apart from these data, it is claimed that some employers and educators do not adequately prepare their students for digital literacy in higher education institutions (Webb, 2019; Yazıcıoğlu, Yaylak, & Genç, 2020). It is known that some universities assume that students are at a sufficient level while they need to increase their competence in this subject (Murray & Pérez, 2014). However, it is essential to have and gain literacy in the digital age. Because digital literacy is perceived as the most basic skill that enables individuals to work together with software tools and perform information retrieval tasks.

In terms of digital literacy, it is known that the digital literacy status of male teacher candidates is generally better than female teacher candidates (Yazıcıoğlu, Yaylak & Genç,

2020). When examinations were made based on branches, no significant relationship was found between preschool and classroom teachers. However, it was determined that preschool teachers stated that digital literacy is beneficial and contributes to the development of the child (Kardeş, 2020). A study found that fifth-grade students generally have high scores on digital literacy skills. Also, it is known that children who have a higher frequency of connecting to the internet have better digital literacy than those who have the internet at home. However, digital literacy is not thought to affect gender (Pala & Başıbüyük, 2020). Apart from all these data, “digital literacy” is frequently expressed for virtual information and communication tools in educational environments. The concept of digital is understood with the awareness of "computer-based / supported", "online," “network", "web” or “e” expressions. Today (digital age), many public institutions and organizations are trying to get the title of "digital" (Sezgin & Karabacak, 2020).

Digital Learning

Digital learning is a teaching application that provides effective use of technology with a wide range of tools and applications to strengthen the individual's learning experience (Hover & Wise, 2020). Digital learning, which includes applications developed in the web environment, receives minimal support from computer applications or programs. It generally includes media consisting of texts, sounds, videos, and photographs. It also includes identifiable and definable goals and assessments for teachers and students (Becker, 2010).

In the digital learning environment, there are three elements: (1) communication, (2) resource, and (3) evaluation (Thoma, et al. 2019). These elements require the ability to connect and stay in communication between teachers and students interacting with digital learning environments, or within students. Teachers and students should use reliable sites or blogs as a source of information and make objective evaluations with these tools. Also, Guo, Bussey, and Adachi (2020), suggest four steps to ensure efficiency in digital learning, to be effective in education, and to adapt to students' cultures. (1) cooperation; mutual interaction and communication and sharing of teachers and learners, (2) adoption; especially supporting students in digital messaging, getting help and usage, (3) activation; motivating students in learning and achieving, supported by teachers, (4) competence; In particular, teachers must have knowledge of digital technologies and competence in using them. Thanks to this competence, teachers, and students will not have difficulty in designing digital learning materials in the process. In the digital learning process with digital technologies; They can express detailed learning objectives, design principles derived from theories about learning and teaching, and develop design patterns (Busstra et al., 2008).

Through the use of digital technology in Turkey digital learning environments costing us

the society are available. The largest of these is the Increasing Opportunities, Technology Improvement Movement (FATİH) project carried out by the Ministry of National Education and the Digital transformation and distance education platforms carried out by the Higher Education Institution. The digital transformation project is quite new, as described above. This project, which includes new and digital elements, will lead to the delivery of some of the lessons through this channel in the future. However, distance education, which has been practiced in the country for years, has been adopted by open education universities. Especially in this method used by the Ministry of National Education together with the pandemic process, the integration of both distance education and the FATİH project draws attention. With this integration, students were able to communicate with each other or with their teachers, and a connection with reliable and used resources was provided. However, many teachers within the ministry could not make student evaluations. Especially in the eastern regions, rural and mountainous areas, the evaluation could not be made as an equal opportunity could not be achieved due to the lack of network, internet, and technology (detailed in the conclusion section)..

FATİH Project

Turkey is since 1998 responsible for the integration of education and technology Innovation and Educational Technologies General Directorate at the Ministry of Education site (YEĞİTEK in 2011, has been updated name). MoNE in 1984-2013; By signing protocols and contracts with international institutions and organizations such as Microsoft, the World Bank, Intel, and the European Investment Bank, it found financiers for projects that increase the information technologies infrastructure (Topuz & Göktaş, 2015). Especially in the 2000s, computer classes/laboratories have been established in schools with many donors and funds.

When computers and the internet started to spread, MoNE tried to strengthen the infrastructure of schools. Although information technology classes have been established within the schools, students' curiosity and interest in technology have increased in parallel. While informatics classes increased between 2003 and 2009, after these dates, the focus of attention of students, parents, and even teachers changed with the introduction of phones with interactive (touch) computers. Due to this rapid technological change, the opportunities for students' interest shifted from computers in informatics classes to interactive mobile phones. This indifference in schools has manifested itself. As a matter of fact, after a few years, informatics classes in schools completely lost interest and their doors were locked. The Ministry of National Education has developed the FATİH project both to integrate technological developments into education and to change the direction of students' interests.

Within the scope of the Fatih project, which started in 2010, it is aimed for every teacher

and student to use digital content. Under the FATİH Project, primarily the infrastructure of the schools was strengthened. It has at least established a new and usable internet and technology infrastructure for non-existent structures. Later, he installed interactive boards in each of the 450 thousand classrooms of approximately 14 thousand schools. Interactive boards contain all the features of the age and are easy to learn and use. Also, it distributed tablets integrated into interactive boards to 700 thousand teachers and students, primarily secondary education (Geçgel, Kana, & Eren, 2020). Afterward, the desired efficiency could not be obtained from the use of tablets and they were not distributed outside secondary education. Although redistribution for distance education has come to the fore during the pandemic process, there is currently no development. MoNE has provided in-service training to approximately 1 million teachers and administrators, as well as establishing the infrastructure for teachers, students, and schools. The purpose of this training, to have competent personnel who can use digital content and technology integration. Also, the Education Informatics Network (EBA) has been established so that teachers and students can both add their digital content and use existing digital content. EBA has been continuously updated. As a matter of fact, "EBA" has been its greatest savior during the pandemic period. Thanks to EBA, the relationships between printed educational materials and digital materials have been connected, and it has become a powerful supplementary resource for teachers and students (Özbek, 2020). With the integration of some digital programs with EBA, it has reunited the students who were at their homes during the pandemic and their teachers through a distance education..

Distance Education

It is known that one of the best aspects of traditional educational approaches is the ease with which one person can convey information to more than one person and save time. Distance education can be thought of as making this feature face-to-face with web support. It is seen as a kind of blended education (Budak, Çoban Budak, 2012). It is made by integrating the best features of technology with the best aspects of traditional teaching methods. Many people can be reached at the same time thanks to the Internet and computers. Also, one person can provide training on many subjects in a short time (Kartal, Toprak, and Genç Kumtepe, 2018). Especially since nobody has to get away from their surroundings and meet somewhere else. They only come together on the web, in other words in the digital environment. In essence, it is a very economical and time-space independent application. It will probably be very popular except for departments and programs that require practice or face-to-face training. However, educationally and pedagogically, it is thought that it is more appropriate to do this process face to face, especially from kindergarten to the last grade of high school.

Distance education is defined as a form of education that offers a wide variety of educational practices to students and supports all learning styles of normal education

practices without the intervention of teachers or guides (Yalman & Başaran, 2018). Although it is used under different names as distance education, e-learning, or computer-aided education due to needs or possibilities, it can serve a wide variety of fields. Many private, public and nonprofit institutions or organizations offer distance education due to the cost, speed in processing, storing, and transmitting data. It is one of the fastest-growing areas given its impact on social and economic development, its openness, and flexibility. It is an education that generally offers technology-integrated teaching methods to the individual outside of the traditional education environment. It is a process used for students to access learning, information source, etc. regardless of time and distance. For this reason, some universities today can serve approximately 200 thousand students with many departments and programs with the title of "open university" (Türkmen, Aşcı, & Zor, 2020). In general, the Council of Higher Education (CoHE) pointed out that while the total of undergraduate and associate degree students who continued their education life until the 2018-2019 academic year was approximately 8 million, half of these students were open education students (CoHE, 2019).

The pandemic period was affected by the disruption of the education of about 25 million students in Turkey (Booth, 2020). These students continued their education and training processes with distance education. Live lectures, online chats, recorded videos, reading texts, events, and discussion forums were used in distance education. The most important factor that hinders the distance education process is measurement and evaluation. Evaluations could not be made in the first period of the pandemic. In the current period, it is seen that schools will be opened gradually, and this has started. In general, although students do not know exactly what happened during the pandemic period (Dönmez & Gürbüz, 2020), it has been determined that some students see distance or digital learning better during the pandemic process (Bozkurt, 2020). Also, it has been determined that they do not lag behind their education with various applications and can receive online training even from home (Karadeniz, 2020)..

Conclusion and Recommendations

It is known that countries that have accomplished digital transformation in education in the world have climbed to the top in evaluations such as PISA that measure educational results (Akgün, 2019). Because it has been determined that digital learning resources perform many cognitive skills of students (Hover & Wise, 2020). For example, significant differences were determined in conceptual changes with the digital learning dimension (Tseng, Tuan, and Chin, 2010). Also, in the digital learning process, it has been determined that students appreciate digital learning materials and reach their learning goals (Busstra et al., 2008). Apart from these, some results are not clear in terms of the effects of using technology in digital learning processes on students' learning (Harju, Koskinen, & Pehkonen, 2019). Apart from all these data, it is known that studies

on digital learning are quite insufficient in some African countries (Unwin et al., 2010). New studies and applications will be made for digital learning. There are factors that educators and practitioners should pay attention to in the use of digital learning and digital tools.

Most of the information we reach through digital tools can be biased or inaccurate. In particular, pollution of information on the internet is one of the factors that should be considered (Kardeş, 2020). E-government, virtual commerce and social media have emerged with tools that have been acquired or in use thanks to digital transformations (Pala & Başıbüyük, 2020). These digital tools also cause cyber security threats such as identity theft, cyber fraud, cyberbullying and the rapid spread of false-misleading information (Bozkurt, 2020; Thoma et al., 2019). Apart from these, with technological digital transformation, students can be self-centered, materialist, unfaithful, bored and insatiable individuals as well as being at peace with themselves, active on social media, and questioning individuals. It is also important to note that students see digital technologies as a game, socialization, and information acquisition tool, but that they contain risks and threats in terms of deformation of moral values (Alp & Levent, 2020). In addition to all these, it is necessary to determine the causes of disruptions in digital learning, which has an important place in the education of the individual, and to eliminate these problems. As it can be understood from the face-to-face interviews with many teachers, especially during the pandemic process, it has been observed that almost 10% of the class attendees can be taught through distance education. It was determined that the remaining students could not attend the classes due to their disruptions in the network, internet, telephone, computer.

The main causes of the glitch occurring in the digital learning that are being implemented in conjunction with the digital transformation Turkey are listed below:

• *Lack of Internet Access:* Internet providers do not provide infrastructure unless personal applications are received, municipalities and governorships cannot provide technical support and financial means in this regard,

• *Restricted Access Internet:* In many families, the internet is mostly used part-time, it provides access at a certain time of the day, can be accessed even in the home on the roof, mountain or high places

• *Internet:* Although internet line cannot be installed in mountainous areas, it is weakened and worn out in rural areas and does not allow mass access, generally only fiber infrastructure is used in big cities,

• *Network:* Due to the construction of telephone networks by the private sector, there is still a network problem in steep and difficult areas,

• *Parental Perspective:* Lack of digital literacy, such as the fact that many individuals in the family before the 1980s consider telephone features only as communication, computer is a source of information but has concerns about its use, as a matter of fact, the vast majority of this age group only has a telephone,

• *The Trend in the Digital Generation:* Those born after 1980 and especially those born after 1990 are intertwined with technology, can use many technological tools both at home and from their friends, but prefer these technological tools more only for access to social media accounts,

• *Digital Tools:* In general, the presence of smartphones in homes, but the absence of computers and tablets, and the inadequacy of the phone for digital work with computers and tablets. According to the 2019 data it was determined that only in 18% of homes in Turkey have desktop computers, 38% have portable computers and 27% have tablets (Arseven, 2020).

It is known that many people in the society own a telephone. It is estimated that the majority of these phones have internet access. When they are asked to access a digital learning environment with their phones, they can access it with a few simple applications. However, their ability to remain sufficiently in the digital learning environment depends on their internet package capacity. In fact, instead of questioning the availability of telephone and internet in every individual in the society, the availability of sufficient internet packages should be questioned. Undoubtedly, it will be determined that many citizens do not have enough internets. In solving this problem; Internet providers that can be financed by municipalities can be placed in public areas, schools, universities, police stations, mosques, parks and gardens. Thus, the internet problem can be solved to some extent.

The places with old, worn out or completely absent internet infrastructure in the country should be determined and their deficiencies should be completed by public institutions or organizations. Also, telephone base stations should be established, and network problems should be eliminated in difficult to access, mountainous and rugged areas. Afterwards, all relevant infrastructures that will enable the use of digital technologies should be put into service. Finally, it is necessary to provide information on digital technologies and their use in education especially for parents, and introductions and even the training that will help the digital generation young people not to notice only the social media aspects but also the educational aspects of digital technologies.

References

Akgün, E. (2019). Digital transformation in the 2023 education vision. Seta – Perspective. https://www.setav.org/perspektif-2023-egitim-vizyonunda-dijital-donusum/ 19.10.2020

Alp, İ., & Levent, F. (2020).Teachers' opinions on the effect of digital transformation on students' values. *Turkish Studies, 15*(3), 1611-1633. https://dx.doi.org/10.29228/TurkishStudies.37035

Arseven, İ. (2020). Examinatıon of the correlation between digital addiction levels and self-regulated learning abilities of high school students. *EKEV Academy Journal, 24*(82), 173-196

Ataş, H., & Gündüz, S. (2020). Digital transformation in higher education (Edt; Çelik, İ. E. Digital Transformation with its economic and social dimensions). Ankara: Gazi Bookstore

Becker, B. W., (2010). Digital learning object repositories. *Behavioral & Social Sciences Librarian, 29*(1), 86-88. https://doi.org/10.1080/01639260903571898

Blau, I., Grinberg, R., & Shamir-Inbal, T. (2018). Pedagogical perspectives and practices reflected in metaphors of learning and digital learning of ICT leaders. *Computers in the Schools, 35*(1), 32-48, https://doi.org/10.1080/07380569.2018.1427960

Bozkurt, A. (2020). Coronavirus (Covid-19) pandemic process and educational evaluations in the post-pandemic world: New normal and new education paradigm. *Journal of Open Education Applications and Research, 6*(3), 112-142.

Budak, Y., & Çoban-Budak, E. (2012). The effects of simulation based applications on blended learning. *Online Academic Journal of Information Technology, 3*(6), 47-65. DOI: 10.5824/1309-1581.2012.1.003.x

Busstra, M.C., Geelen, A., Feskens, E. J., Hartog, R.J.M, & van 't Veer, P. (2008). Design and development of digital learning material for applied data analysis. *The American Statistician*, 62(4), 329-339, https://doi.org/10.1198/000313008X368837

Council of Higher Education (CoHE), (2019).*2018-2019 Higher education statistics.* Accessed from https://istatistik.yok.gov.tr/ on 20 October 2020.

Dönmez, İ ,& Gürbüz, S . (2020). Determining the cognitive structures of university students on covid-19 virus. *MANAS Journal of Social Studies, 9*(4), 2159-2172. https://doi.org/10.33206/mjss.763029

Eroğlu, A., (2020). *Using digital storytelling in Turkish lessons for 7th graders at secondary school*. Unpublished Doctoral Thesis, Sakarya University Institute of Education Sciences. Sakarya

Geçgel, H., Kana, F., &Eren, D., (2020).Investigation of the concept of digital competence in terms of different variables in Turkish education. *Journal of Mother Tongue Education, 8 (3), 886-904.*

Gilster, P. (1997). *Digital literacy.* New York: John Wiley.

Guo, K., Bussey, F., & Adachi, C. (2020). Digital learning across cultures: an account of activity theory. Intercultural Education, 31(4), 447-461, https://doi.org/10.1080/14675986.2020.1747259

Harju, V., Koskinen, A., &Pehkonen, L. (2019).An exploration of longitudinal studies of digital learning. *Educational Research*, 61(4), https://doi.org/10.1080/00131881.2019.1660586

Hover, A., & Wise, T. (2020). Exploring ways to create 21st century digital learning experiences. *Education 3-13,*https://doi.org/10.1080/03004279.2020.1826993

Işık, İ., Işık, A., & Güler, İ . (2010). Using the 3D web technologies in distance education. *Journal of Information Technologies, 1*(2), 75-78.

Jesson, R., McNaughton, S., & Wilson, A. (2015). Raising literacy levels using digital learning: A design-based approach in New Zealand. *The Curriculum Journal, 26*(2), 198-223, DOI: 10.1080/09585176.2015.1045535

Kara, A. (2020). The role and importance of national school for teaching and dissemination the new alphabet to nation after alphabet change in Turkey. *Journal of Oghuz-Turkman Researche*s, *4*(1), 114-141.

Karadeniz, C., (2020). The use of digital technologies in the museum and digital participation through pandemic process. *İDIL, Journal of Art and Language, 70*, 975-984. doi: 10.7816/idil-09-70-06

Kardeş, S. (2020). Digital literacy in early childhood*, Inonu University Journal of the Faculty of Education, 21*(2), 827-839. DOI: 10.17679/inuefd.665327

Kartal, G., Toprak, E., & Genç-Kumtepe, E. (2018).Culturally sensitive instructional design for distance learners and experiences. *Online Academic Journal of Information Technology*, 9(32), 123-148

Korucu, A. T. (2020). The effect of digital stories used in science education on academic achievement, digital empowerment and inquiry skills of teacher candidates. *Kastamonu Education Journal, 28*(1), 352-370. doi:10.24106/kefdergi.3617

Ling Koh, J. H., & Pei Kan, R. Y. (2020). Students' use of learning management systems and desired e-learning experiences: are they ready for next generation digital learning environments? *Higher Education Research & Development,* DOI: 10.1080/07294360.2020.1799949

Manap, A. & Durmuş, E. (2020).Development of digital parental awareness scale. *Inonu University Journal of the Faculty of Education, 21*(2), 978-993. DOI:10.17679/inuefd.711101

Ministry of National Education (MoNE), (2020). 2023 Education Vision. Access; http://2023vizyonu.meb.gov.tr/doc/2023_EGITIM_VIZYONU.pdf 19.10.2020

Murray, M. C., & Pérez, J. (2014). Unraveling the digital literacy paradox: How higher education fails at the fourth literacy. *Issues in Informing Science and Information Technology, 11*, 85-100.

Okur-Berberoğlu, E., & Uygun, S. (2013). Examining of outdoor education development in the world and in Turkey. *Mersin University Journal of the Faculty of Education*, 9(2), 32-42.

Özbek, Y. (2020). Classroom Teachers' Skills to Use Digital Content and Technology (Sınıf Öğretmenlerinin Dijital İçerik ve Teknolojiyi Kullanma Becerileri). Unpublished Master's Project without Thesis, Pamukkale University Institute of Educational Sciences. Denizli.

Özcan, A., (2017). Digital media literacy: Problems, practices and expectations. *Online Academic Journal of Information Technology, 8(*28), 55-66. DOI: 10.5824/1309-1581.2017.3.004.x

Pala, Ş. M., & Başıbüyük, A. (2020). The investigation of digital literacy of fifth grade secondary school students. *Cumhuriyet International Journal of Education, 9*(3), 897-921. http://dx.doi.org/10.30703/cije.672882

Parsehyan, B. G. (2020). Digital transformation in human resources management: HR 4.0. *Turkish Studies -Applied Sciences, 15*(2), 211-224. https://dx.doi.org/10.29228/TurkishStudies.41930

Potter, W. J. (2013). Review of literature on media literacy. *Sociology Compass*, 7(6), 417-435

Raike, A., Keune, A. Lindholm, B., &Muttilainen, J. (2013).Concept design for a collaborative digital learning tool for film post-production. Journal of Media Practice, 14(4), 307-329, https://doi.org/10.1386/jmpr.14.4.307_1

Selwyn, N. (2007). Curriculum online? Exploring the political and commercial construction of the UK digital learning marketplace. *British Journal of Sociology of Education*, 28(2), 223-240, DOI: 10.1080/01425690701192729

Sezgin, A.A., & Karabacak, Z. İ. (2020).A descriptive analysis for digital transformation

in higher education and digital literacy course. *Online Journal of the Faculty of Communication Sciences, 28*(1), 17-30

Taş, E., Gülen, S. Öner, Z., & Özyürek, C. (2015).The effects of classic and web-designed conceptual change texts on the subject of water chemistry. *International Electronic Journal of Elementary Education, 7*(2), 263-280.

Thoma, B., Turnquist, A., Zaver, F., Hall, A. K., & Chan, T. M. (2019). Communication, learning and assessment: Exploring the dimensions of the digital learning environment, *Medical Teacher, 41*(4), 385-390, https://doi.org/10.1080/0142159X.2019.1567911

Topuz, A. C., & Göktaş, Y. (2015). Projects for effective technology use in Turkish education system: Period of 1984-2013. *Journal of Information Technologies, 8(2*), 99-110 https://doi.org/10.17671/btd.43357

Tseng, C., Tuan, H., & Chin, C. (2010). Investigating the influence of motivational factors on conceptual change in a digital learning context using the dual-situated learning model. *International Journal of Science Education, 32*(14), 1853-1875, DOI: 10.1080/09500690903219156

Türkmen, B., Aşcı, Y., & Zor, E.U. (2020). The analysis on e-learning readiness levels of vocational school students during covid-19 social isolation period: a case study on Çaycuma vocational school. *The Journal of International Social Research, 13*(72), 690-700

Unwin, T., Kleessen, B., Hollow, D., Williams, J. B., Oloo, L. M., Alwala, J., Mutimucuio, I., Eduardo, F., &Muianga, X. (2010). Digital learning management systems in Africa: myths and realities. *Open Learning: The Journal of Open, Distance and e-Learning*, 25(1), 5-23, https://doi.org/10.1080/02680510903482033

Webb, S. (2019). Diversifying digital learning: Online literacy and educational opportunity. *Innovations in Education and Teaching International, 56*(5), 675, DOI: 10.1080/14703297.2019.1647991

Yalman, M., &Başaran, B. (2018). Education faculty students' views about distance education materials developed with web 2.0 tools. *Online Academic Journal of Information Technology, 9*(34), 81-95. DOI: 10.5824/1309-1581.2018.4.006.x

Yazıcıoğlu, A., Yaylak, E., &Genç, G. (2020). Digital literacy levels of prospective preschool and primary school teachers. *ODU Journal of Social Sciences Research, 10 (*2), 274-286.

About Distance Mathematics Education of Gifted Students Studying at Secondary School

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Introduction

It is a known fact that more information was produced in the last four decades, also known as the Information Age, than in the past five millenniums. In information societies, greater use of low-budget internet tools (e-learning tools) that focus on students and that have no temporal or spatial limits dynamizes learning and helps knowledge to be carried to, shared with and spread in wide masses. And so, e-learning that complements and supports modern formal education gains more and more importance (Balaban, 2012).

COVID-19 infection caused by new coronavirus (SARS-CoV-2) was first observed in Wuhan, China, in late December 2019, which then spread to the whole world due to its high transmission rates (WHO, 2020). Based on United Nations Educational, Scientific and Cultural Organization's data (UNESCO, 2020), as of April 7, 2020, schools were closed in 188 countries due to COVID-19 pandemic, affected approximately 92 percent of the students all around the globe (1,576,021,818 students). In Turkey, on the other hand, the first COVID-19 case was reported by the Ministry of Health on March 11, 2020, and the Ministry of National Education suspended face-to-face education in all primary and secondary schools, as well as in all education institutions affiliated to the Ministry, and initiated a temporary distance education. Accordingly, the crisis was managed urgently, and the education system, which was structured in accordance with the formal education, had to be turned into a web-based distance education system. In the primary and secondary schools weekly lessons were rescheduled, while EBA and TRT offered much needed remedial education support, first one through the internet and the latter through television screen (MONE, 2020).

Distance education students have very different characteristics from those studying at formal education institutions. Their main characteristics that differ from the others include their age, educational background, objective, employment status, marital status and motivation (Özer, 1990).

In the Strategy and Practice Guideline for Education of Gifted Individuals (2013) prepared by the Ministry of National Education, General Directorate of Special Education and Guidance Services, individuals with higher abilities than their peers in such areas as intelligence, creativity, art, leadership capacity, motivation or special academic fields are defined as gifted individuals. Main principles and values to be taken into consideration

in education of gifted students with special talents include:

- innovation and creativity,
- originality, flexibility and dynamism,
- an education environment that appreciates and supports differences,
- cooperation and team work,
- miscellaneous education models and identification.

Educating gifted individuals, who constitute approximately 2 to 3 percent of the society, making them productive individuals, and using their potentials for social development, is important for social welfare, society's future, and for its place among other countries. Thanks to their leadership skills, motivations, decisiveness, fast-thinking and creative problem solving abilities, gifted individuals serve as the engines that direct societies and accelerate development and change. Education of those people begins on the day they are born, and continues as a life long learning process. In Turkish education system, gifted individuals are educated in Science and Art Centers that fall under the scope of public schools and that are available in every city. Curriculums are enriched by adding or deepening activities horizontally or vertically with the aim of supporting academic development and increasing performance of gifted students. While implementing these activities, such areas as leadership, productive thinking skills, innovation, entrepreneurship and values education are attached greater significance. In-service training and distance education programs are created for teachers and managers serving at miscellaneous levels of education of gifted students to increase and improve their knowledge and skills of educating those special individuals. Seminars, conferences, workshops, panels and congresses are organized as well. In terms of educating gifted people, each country strives to define national standards and develop miscellaneous education models and programs in line with the principle of equal opportunity. Enrichment practices in education of gifted individuals have seven common characteristics in general:

1. Enrichment covers activities that address students' fields of interest.
2. It integrates high-level contents, processes and products.
3. It has a comprehensive and interdisciplinary content.
4. It supports effective, independent and self-learning.
5. It requires curriculum and education to be individualized and differentiated.
6. It develops creative problem solving skills and creativity.

7. It requires professional tools to be used in product development.

All enrichment theoreticians (including Renzulli, Frank Williams, George Betts, John Feldhusen and Penny Britton Kolloff, and Carol Schlichter) mentioned some or all of these characteristics in their own theories (MONE, 2013).

In the simplest way, mathematics is defined as "*an abstract form of life*". The factors that make mathematics significant can be summarized as follows: First of all, it is relevant to humans' desire to live. Humans want to live, and when they guarantee it, they want to live a quality life (Skemp, 1986). Mathematics creates the mathematical model (theoretical basis) of the solutions developed by people, and leads to emergence of thoughts that can serve as a model in many new inventions. The second factor that makes mathematics significant is that the natural assets and events act decisively, which can only be explained through mathematics. Third, which is relevant to the two above-mentioned factors, and which might be the most important one, is that fact that mathematics, and problem solving in particular, develop such skills as thinking, discussion, and reasoning. Apart from those natural factors, such other factors as the nature of the mathematical knowledge, children's mental development and needs, as well as the theories about how learning emerges have led to a movement in mathematics teaching (Altun, 2006). Due to their physical development children love playing games and sports activities, and their mental development leads them to think about problems, events and issues. "*They engage because they are interested, and they develop because they engage*" (Skemp, 1986). That is why they enjoy mathematical knowledge much more if they are the ones creating it. They do not like formulas or knowledge that are directly told. According to Şimşek (2006), it needs to be taken into consideration that there are many students with different learning styles. He therefore suggests teaching methods to be diversified, miscellaneous education environments to be used to present knowledge, as well as conceptual and experiential knowledge to be balanced.

The present study first addresses distance education and its development, and then introduces some programs, applications and websites that can be used in distance mathematics education of gifted students.

Process

The research method of this study is traditional literature review. In traditional literature review studies, scattered information in the literature is addressed holistically, and a connection is made with the points to be discussed or a synthesis is created (Baumeister and Leary, 1997). In the present study, first, distance education-related definitions are given, and then the phases and periods of distance education in the world and in Turkey, and the factors that carried distance education from the past to today were addressed historically. And finally, some programs, applications and web sites that can be used in

distance mathematics education of gifted students were introduced.

According to "learning pyramid" developed based on the studies of NTL (National Training Laboratories), such passive techniques as lecturing, reading and audio-visual presentation contribute learning at a rate between 5 percent and 30 percent, while the contribution of such active techniques as discussion groups, do/apply, use and teach others reaches up to 50 percent, 75 percent and 90 percent, respectively (NTL Institute for Applied Behavioral Science). It is known that the use of animations, simulators, class videos and other similar free-of-charge resources in e-learning methodologies accelerates learning and makes it more effective. These resources do not only support the quality of formal education, but they also constitute the most significant source of information of the distance education system (Balaban, 2012).

Distance Education

Such terms as distance education, distance learning and distance teaching are often used interchangeably. And their explanations are usually similar. According to Kazmer and Caroline (2001) distance education provides people with rare opportunities to study, but it does not concern their conditions or occupational obligations. The term distance education was initially used as a synonym of "correspondence course", but then televisions were used for distance education. But it really nourished thanks to the communication technologies including videos, teleconference systems, e-mails and internet. Based on the definitions of researchers, distance education can be defined as an education system in which the teacher and the learner, who are physically at separate locations, can adjust the training according to their own paces and capacities, use education technologies and continue their high quality learning and teaching activities in a productive manner (Balaban, 2012).

There is a wide range of distance education technologies including correspondence courses, printed materials, radio, television, audio and video tapes, multimedia, computer assisted education, e-mail, internet, databases, satellite technologies, video conferences, virtual reality and augmented virtual reality etc. They can be grouped as interactive and non-interactive education methods. Developments in internet and communication technologies have reduced the cost of distance education, and provided such opportunities as interaction, use of rich visual materials, and simultaneous and non-simultaneous applications. Interaction and communication are of great significance in education. When they first began to be used, distance education technologies were mostly non-interactive, but thanks to the developing technology learner-teacher, learner-learner and learner-teacher-material interactions have increased. Interactive distance learning systems can be divided into two groups, considering if the interactivity is synchronous (simultaneous) or asynchronous (non-simultaneous). Considering live (multi-cast or uni-

cast) and on-demand broadcasting in distance education, interaction can be one-to-one bi-directional and one-to-many one-direction, and thanks to modern technology one-to-many bi-directional interaction and communication is also possible. Each new technology brought a new distance education model. The technologies to be used have the potential to be used for different distance education purposes in miscellaneous environments such as text, sound, image and electronic media (Valcke, Leeuw and Kamperman; 2001).

According to Balaban (2012) distance education's advantages include reduced time requirement, reduced cost, greater number of opportunities for education, opportunity to reach greater number of students, increased information production and dissemination, easier and faster communication and interaction. Thanks to distance education programs, students are able to complete the whole education program or a part of it in a geographical location away from the education institute. Since it is accepted as a solution for education-related problems that cannot be solved with traditional methods, and thanks to the opportunities and flexibility it offers, distance education is gaining popularity. The most significant goal of e-learning is to spread more information to greater number of people. E-learning models include television / satellite / open education, video conference, asynchronous education, web or CD-ROM, PC-based, internet, live virtual class, live sound, application sharing and video, mixed models, live virtual class + asynchronous + face-to-face education models.

Commonly Used Terms in Distance Education

Traditional Education (Formal Education): It is a face-to-face formal education that takes place in the same location at the same time.

Distance Learning: It covers learning activities during which the teacher and the learner are physically in different locations.

e-Learning: It covers learning activities during which internet, a network or a computer is used. It is the other definition of distance education or distance learning.

Blended Education: In this type of education all kinds of technologies can be used, and traditional education can be integrated with different distance education models.

m-Learning: It means learning activities in which mobile communication tools are used.

Virtual Class: A group that is created to learn a certain content through a network.

Web-based Distance Education: Distance education activities in which web technologies are used.

Simultaneous (Synchronous) Learning: A learning during which individuals in different

locations simultaneously come together in a virtual environment using bi-directional communication technologies.

Online Learning: It means learning a content that is presented over a network.

Non-simultaneous (Asynchronous) Distance Education: It means education offered to learners at different times and in different environments.

Lifelong Learning: It means continuously learning throughout life.

Phases and Periods of Distance Education From a Global Point of View, Chronology

One of the models that paves the way for global education is distance education. Dating back to 1728, distance education began by mail, and its popularity increased at a corporate level in 1960s - approximately the same time when British Open University project was carried into effect - in European countries, North America and Australia. And then Asian, African and South American countries joined this rush (Taylor and Vernon, 1985). Table 1 presents the phases and periods of distance education from a global point of view.

Table 1. Phases and periods of distance education from a global point of view (Bozkurt, 2016).

Period	1st Period		2nd Period		3rd Period
	Correspondence		Audio-Visual Tools		Information Technology Based
Phase	1728 Letters	1925 Radio and TV	1970 Open University	1980 Teleconference	1990 - ... Internet - Web
Change	Teaching Centered			Learning Centered	
	Distance Education			Open and Distance Learning	

And today, thanks to the developments in information technologies, higher quality teleconference and internet-based applications are available. Such distance education practices make it possible for teachers and students to enjoy audio-visual communication even when they are in different environments kilometers away from each other (İşman, 2011).

Phases and Periods of Distance Education From the Viewpoint of Turkey, Chronology

The concept of distance education was discussed in Turkey from 1923 to 1960s. After 1970s, secondary education level distance education studies were conducted, experience was gained, and limited progress was made. After 1980s, and with the establishment of

Anatolia University Open Education Faculty, distance education began to be given at higher education level. During 1980s and 1990s, distance education at primary, secondary and higher education level matured, and became a system that served large student groups. Distance education gained popularity and acceptance thanks to the achievements made in those years. As of the end of 1990s and beginning of 2000s, information and communication technologies witnessed many developments, which increased distance education opportunities and made distance education serving millions of students a part of the mainstream education system (Bozkurt, 2017). Table 2 presents the phases and periods of distance education from the viewpoint of Turkey.

Table 2. Phases and periods of distance education from the viewpoint of Turkey (Bozkurt, 2016).

Period	1st Period	2nd Period	3rd Period	4th Period
	Discussion and Recommendations	Correspondence	Audio-Visual Tools	Information Technology Based
Phase	1923-1955	1956-1975	1976-1995	1996-...
	Conceptual	Letters	Radio-TV	Internet - Web
Stage	Incubation	Maturation	Mainstream	
Change	Non-formal Education	Distance Education	Open and Distance Learning	
	Training	Education	Learning	
	Teaching Centered		Learning Centered	

Distance Mathematics Education of Gifted Students

Certain basic tools are needed for distance mathematics education of gifted students. These tools include learning management systems that help students access asynchronous studies (Moodle, Maplesoft, Google Clasroom etc.), a live lesson platform (Adobe Connect, Zoom, Google Meet, Microsoft Teams, Skype, TeamLink, Google Hangouts, WhatsApp etc.) and an e-mail or live texting system to ensure individual or group communication. Researches show how significant quality and simplicity are in distance education. Accordingly, the content to be shared should not be too complex in order not to suffocate the students and cause them to give in. Especially the instructions given for asynchronous studies should be very clear.

In asynchronous platforms, students may be asked to do a pre-learning study, watch a video that will link the subject to their daily lives, or complete an engaging research

task before the classes. Students are required to understand mathematics, and actively structure new information on previous knowledge and experience (NTCM, 2000). Video creation programs (Powtoon, Animato, Explee, iMovie, Camtasia (paid) etc.) are used for video classes. Furthermore, distance education videos can also be created using screencast programs (Loom, Screenpresso, Screencastify, and Quicktime for Mac etc.).

And for synchronous classes, efficient activities can be designed for students. Before initiating live classes, teachers may highlight students' asynchronous studies, followed by concept formation activities, if new concepts are to be used in the activities. Such word cloud applications as Wordcloudy and Wordart etc. can be used for this purpose. Making the classes interactive and enriching them with activities during which materials are used together by the students are other points that should be paid attention to while working with gifted students. Geometry-related tools such as Wolframalpha, Maplesoft, GeoGebra, Sketchpad, and Cabri serve well in geometry-related activities, as well as in demonstration or comprehension activities (if appropriate). Such interactive applications as Geogebra Graph and Desmos can be used to model daily life situations and to make inferences. It is highly significant to create Q&A and discussion settings while teaching mathematics to gifted students, and such applications as Quizizz, FlipQuiz, and Kahoot Classic Mode can be used for this purpose. "The basic thing that help children learn" is (in-class) discussions that are based on students' problem solving methods and their own ideas (Wood and Turner-Vorbeck, 2001). When teachers want to go beyond solving questions and create a class board to reflect the ideas of all students, they can share the link of a previously created board during the live class, which will help them create a classroom board within seconds. Similarly, an interactive concept map can be created together with the students using such tools as Popplet. These tools can be used in asynchronous exercises too, but they should be placed into the design flow properly.

After synchronous classes, asynchronous exercises may be required in order for the students to reinforce what they have learned. This may include an interactive exercise prepared using such programs as LearningApps, Quizizz, Socrative, and Kahoot Challenge Mode etc., or a standard exercise for which books or printed worksheets (e.g. pdf) are used. Solutions of the exercises taken from books and the worksheets should be available in the asynchronous system. Since many resources use a QR-code, students should have a QR-code scanning program (e.g. Qrafter) in their tablets or mobile phones. Today, video solutions are preferred to be shared for students to watch. Accordingly, a solution video is created, which is then embedded into a QR-code using such programs as Unitag, Générateur de QR Code, and GoQR.me. Such web based games as Edpuzzle, Minecraft, and Lego are frequently shared for the students to practice, which help them review and practice what they have learned, while also providing teachers with feedback. For example, while making a video, questions may be added when required. Then the

answers are reported to those who have made the video, which gives the teacher the opportunity to evaluate the answers. In the asynchronous exercises, Google Documents, Google Slayts, and Google Spreadsheet can be used for collective studies, which increase interaction and contribute students' social development.

In order to measur and evaluate those live activities, such digital tools as EdModo and Google Forms can be used for measurements and assessments to be made during and at the end of the classes and at the end of the week. Furthermore, such applications as Wizer.me can be used to give more detailed feedbacks to children. These applications give students the opportunity to respond in writing, by drawing or through voice record, and the same methods can be used by teachers to give feedback. Questions, as well as lecture videos and documents can be added to the system, which makes it suitable for class review and practice studies.

Conclusion

While teaching mathematics to gifted students, standard activities should be enriched and some changes should be made. Within this scope, what comes into prominence is differentiation in learning outcomes in terms of horizontal and vertical expansion. Asynchronous exercises should be uploaded to the system for students who have greater interest in mathematics and who differentiate in this area in a positive way. These should be voluntary practices. To direct those students to mathematics studies proper communication methods should be used and their inner motivation should be boosted through suggestion. After completing those studies, students should be given feedbacks. Encouraging them to participate in miscellaneous national or international live events and competitions support their development in the field of mathematics. A similar approach should be adopted for students who have difficulty in activities. For those students, in some rare cases, over demanding tasks that will distract them from the process should be avoided, and they should be directed to basic exercises to reinforce upper cognitive outcomes. Accordingly, students' individual and group dynamics should be observed closely, and teachers should take required measures and ensure flexibility in activities.

References

Altun, M. (2006). The Teacher Trainees' Skills and Opinions on Solving Non-Routine Mathematical Problems. Paper presented at the 3rd International Conference on the Teaching of Mathematics, İstanbul.

Balaban, E. (2012). *Dünyada ve Türkiye'de uzaktan eğitim ve bir proje* önerisi *[Distance education in the world and Turkey and a project proposal],* İstanbul: Işık Üniversitesi.

Baumeister, R. F., & Leary, M. R. (1997). Writing narrative literature reviews. *Review of General Psychology*, 1(3), 311-320.

Bozkurt, A. (2016). *Bağlantıcı kitlesel açık* çevrimiçi *derslerde etkileşim* örüntüleri *ve* öğreten-öğrenen *rollerinin belirlenmesi [Interaction patterns in connecting mass open online courses and determination of teacher-learner roles]*, (Doktora Tezi) [PhD Thesis]. Anadolu Üniversitesi, Sosyal Bilimler Enstitüsü, Uzaktan Eğitim Anabilim Dalı. Eskişehir.

Bozkurt, A. (2017). Türkiye'de uzaktan eğitimin dünü, bugünü ve yarını [The distance education in Turkey yesterday, today and tomorrow]. *AUAd*, 3(2), 85-124.

İşman, A. (2011). *Uzaktan eğitim [Distance education].* Ankara: Pegem A Yayıncılık.

Kazmer, M. M. & C. Haythornthwaite. (2001). Juggling multiple social worlds: Distance students on and offline. *American Behavioral Scientist*, 45(3), 510–529.

Millî Eğitim Bakanlığı (MEB) [MONE]. *Basın açıklamaları [Press releases]*, Retrieved 30 November, 2020, from http://www.meb.gov.tr/

Milli Eğitim Bakanlığı (MEB) [MONE]. Özel *yetenekli bireylerin eğitimi strateji ve uygulama kılavuzu [Training strategy and implementation guide for gifted individuals] (2013),* Retrieved 30 November, 2020, from

https://orgm.meb.gov.tr/meb_iys_dosyalar/2013_11/25034903_zelyeteneklibireylerineitimistratejiveuygulamaklavuzu.pdf

Moodle-Open Source Learning Platform, Retrieved 30 November, 2020, from www.moodle.org

NCTM (2000). *Principles and standards for school mathematics,* Virginia: Reston.

Özer, B. (1990). Uzaktan eğitim sisteminin evrensel yapısı [Universal structure of the distance education system]. *Kurgu Dergisi*, 8, 569-594.

Skemp, R. E. (1986). *The Psychology of learning mathematics.* UK: Penguin Books.

Şimşek, A. (2006). Ön *bilgi. Eğitimde bireysel farklılıklar [Preliminary information. Individual differences in education].* (Ed: Y. Kuzgun ve D. Deryakulu). Ankara: Nobel Yayıncılık.

Taylor, J. C. and Vernon J. W. (1985). Why distance education? Distance education in Asia and the Pacific, *Bulletin of the Unesco Regional Office for Education in Asia and the Pacific*, 26, 1-12.

UNESCO (2020). *COVID-19 educational disruption and response,* Retrieved April 5, 2020, from https://en.unesco.org/covid19/educationresponse

Valcke, M. M., Leeuw, F. L., & Kamperman, A. (2001). *Evaluating digital distance learning programs and activities: studies, practices, and recommendations, World Bank Institute of the World Bank,* Retrieved 30 November, 2020, from

http://documents1.worldbank.org/curated/en/790431468161655983/pdf/489360NWP0Box31C10ES991211complete1.pdf

World Health Organization (WHO). *Q&As on COVID-19 and related health topics,* Retrieved May 10, 2020, from https://www.who.int/emergencies/diseases/novel-coronavirus-2019/question-andanswers-hub

Wood, T., & Turner-Vorbeck, T. (2001). Extending the conception of mathematics teaching. In T. Wood, B. S. Nelson, & J. Warfield (Eds.), Beyond classical pedagogy: Teaching elementary school mathematics (pp. 185–208). Mahwah, NJ: Erlbaum.

SECTION 3
STEM/STEAM EDUCATION

STEM Education Dimensions: from STEM Literacy to STEM Assessment

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Introduction

Social and economic development requires an education system to provide young people with the skills and abilities that enable them to benefit from the emergence of new forms of social and economic development in order to contribute their knowledge to the system's core assets (Techakosit & Nilsook, 2016). The importance of education in STEM disciplines is a matter of debate among policymakers and scientists. Researchers focus on how to encourage educational research on problems and practices, and how to accelerate change in educators' pathways. While Policymakers make demands for STEM education to meet the expected workforce (Bybee, 2013; National Research Council [NRC], 2011; Becker & Park, 2011; Alberts, 2013). In order to serve this purpose, there is a considerable interest towards the research and development of content with regard to K-12 that includes the curriculum, learning environment, career development and the embracement of teachers. This interest in STEM education reaches more than 450 million items with a simple Google search that includes the terms "STEM", "STEM education" or "STEM education research". Such a voluminous search shows that STEM education is a rapidly developing and vibrant field (Li et al., 2020). There are many studies that show STEM education contributes to students in various ways such as attitude, motivation and interest. However, STEM education has no equivalent as a separate course such as science and mathematics, this has led to confusion about which of the concepts constituting STEM should be more dominant (Ejiwale, 2013). Researchers have interpreted the integration between different disciplines of STEM differently using various terms such as multidisciplinary, interdisciplinary and interdisciplinary (Vasquez, Sneider & Comer, 2013). However, these have led to uncertainty and complexity in explaining and determining what constitutes STEM (Li et al., 2020). Many authors have prepared activities for STEM education over time, but it is another discussion about which activity exactly reflects STEM education in the best and most correct way. Since STEM education does not have a direct counterpart in terms of science or mathematics, teachers who want to carry their STEM education practices to their classes feel insecure (Ford, 2007). Therefore, the dimensions of STEM education need to be redefined.

To define STEM education, STEM literacy, STEM curriculum and content, STEM learning environments, STEM professional development and STEM assessment steps need to be defined. In education, first of all, goals and expectations should be defined.

Every society defines the educational expectations by focusing on the demands of both the educators and politicians and the expectations of the society (Skinner, Saxton, Currie, & Shusterman, 2017). The expectation in STEM education is that students become STEM literate and develop their problem-solving skills. For the teaching of these skills, the STEM curriculum and its contents need to be created first. Most educators want to enrich STEM activities without a curriculum and content. However, it would be a futile expectation to expect STEM to reach its goals without the STEM curriculum and content (Scaramozzino, 2010). Therefore, STEM curriculum and its contents will increase teachers' trust in STEM education and facilitate classroom practices. The curriculum should be structured around the current problems in order to meet the expectations of educators and policymakers. After the curriculum is completed, teachers need to be made competent in this field. Unless teachers are competent and well-equipped in STEM fields, practices cannot be expected to achieve their goals. A learning environment is needed for the implementation of STEM activities. The learning environment must meet expectations with psycho-social, infrastructure-equipment, space and time dimensions. After all these stages are implemented, teaching activities and teaching practices should be evaluated. it should not be forgotten that these dimensions interact with STEM components..

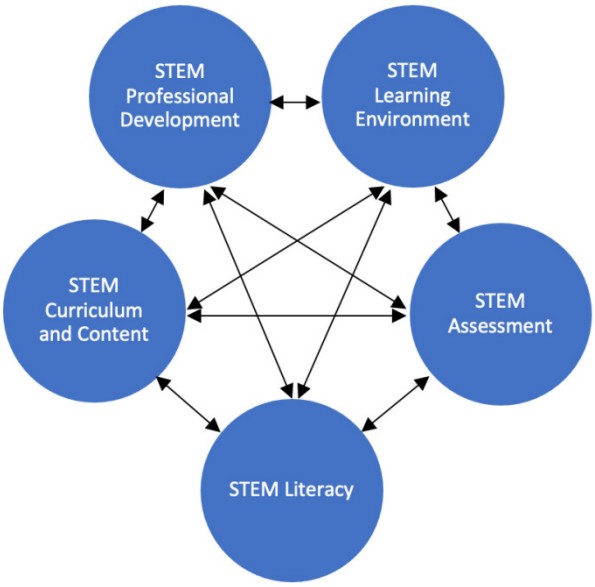

Figure 1. STEM Dimensions

STEM Literacy

STEM education is an approach that aims to provide students with better problem-solving skills, innovation, self-confidence, logical thinking and helps them become STEM literate (Morrison, 2006). In this context, it is seen that there is a transformation from science literacy to STEM literacy. STEM literacy is an interdisciplinary educational approach that enables individuals to improve their competitive ability in the economic

field and enables learning by applying science, technology, engineering and mathematics (Tsupros, Kohler & Hallinen, 2009). STEM literacy is to define, apply and integrate science, technology, engineering and mathematical concepts, to solve complex problems and to renovate them to solve them (Balka, 2011). STEM literacy is important for students as a step towards their future career. It is at the center of the basic skills needed in the twenty-first century for students to become top-level problem solvers, innovators, technologists, engineers and to build an educated population (International Technology Education Association [ITEEA], 2009). STEM literacy refers to the ability to apply an individual's understanding of how the laws of the world work within and across four interrelated areas. STEM literacy does not only mean achieving literacy in these four areas separately (National Governors Association [NGA], 2007). It also means more than mapping numerous overlapping interdisciplinary skills, concepts and processes. STEM literacy is the synergy of these areas - so STEM literacy cannot be expected to be improved through separate courses. As Aristotle put it, "The whole is greater than the sum of its parts." Starting from the first year of education, students' gaining STEM literacy will enable them to move towards a STEM-related field of study in the future (Tang & Williams, 2019). For this reason, it is important to teach STEM education lessons from an early age. Having a lesson called STEM education in primary and middle school will contribute to the development of STEM literacy. In high school and university years, the separate presentation of the dimensions that make up STEM, based on specialization, will contribute to the development of students' expertise in these areas. It seems that there is a need for a learning model that can facilitate the development of students' STEM literacy. By applying engineering design principles, students are required to apply their knowledge to the real-world situations and use the project-based STEM components in this process. Problem-solving and analytical thinking skills will be developed with engineering design skills. Also, it will respond to the expectations of policymakers and increase student's orientation towards STEM career interests. Therefore, the starting point should be STEM literacy. STEM literacy is the ability to apply concepts in STEM to solve problems that cannot be solved using a single discipline or would benefit from a creative solution involving multiple disciplines.

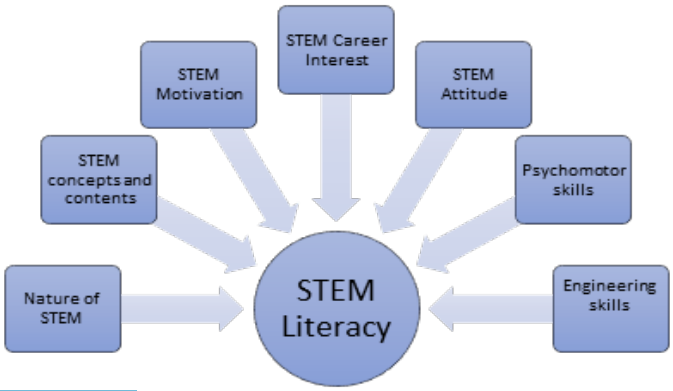

Figure 2. STEM Literacy Dimensions

For students to be STEM Literate, students should understand the nature of STEM. Basic concepts that compose STEM should be included in the course process. Students should use engineering skills during the course process, as a result of this, it is expected that their STEM attitude, motivation and career interest will increase.

STEM Curriculum and Content

Equal access to the high-quality STEM curriculum and opportunities for active participation focusing on student interest are considered as key elements of successful programs (Aldemir & Kermani, 2017). It is more important to have a curriculum that combines knowledge and competencies that can be applied in new situations than to have a curriculum that teaches pioneering technology but may become obsolete in a few years (Carracedo, et al., 2018). As the knowledge and skills required to solve technological problems become increasingly integrated and complex, the ability to apply interdisciplinary knowledge to solve these problems is greatly needed (Bybee, 2013; Havice, 2009). However, traditional school programs have long been organized separately in their subjects. Many reports state that school education cannot prepare our students to solve real-world problems due to the unconnected knowledge gained from individual school subjects. (Bybee, 2013; NRC, 2009). However, the lack of a common and clear understanding of integration continues to be a major obstacle to effective implementation (Stinson, Harkness, Meyer, & Stallworth, 2009). For example, integration approaches such as disciplinary, interdisciplinary, multidisciplinary (Berlin & White, 1995) are used in the literature instead of the education program. Due to the lack of STEM-specific teaching programs, it is seen that the contents of STEM are tried to be eliminated with uncontrolled and short-term practices. Some of the STEM activities focus on in-school and out-of-school education practices. In out-of-school activities, contexts such as field trips, summer camps, science clubs, science museums and science fairs and university workshops provide flexible learning environments for interdisciplinary STEM activities (Baran et al., 2019). Many studies state that out-of-school STEM practices increase students' attitude, interest and motivation towards STEM (Bell et al., 2009; Denson et al., 2015; Brown et al., 2016). However, most of these activities are short-term and semi-structured activities. For this reason, it is understood that there is a need for an inclusive and formal STEM lesson at preschool, primary school and middle school levels. Having a general lesson and curriculum on STEM itself will contribute to STEM literacy. A structured curriculum will enable students to pursue careers, interests and attitudes in STEM fields. STEM curriculum should indicate being based on social values, to be applicable, being suitable for the economy, being suitable for national education, being scientific.

Figure 3. Suggestion STEM Curriculum Stages in Education Levels

The preschool period is the period in which mental development is the fastest. Students' acquaintance with STEM in this period is critical for the development of problem-solving thinking skills. For this reason, there is a need for an inclusive program that will support the mental development of students between the ages of 3-6. The Primary school era is a period in which students gain literary experiences and then develop these experiences. In most countries, the curriculum includes mathematics lessons in the 2nd grade and science lessons in the 3rd grade. However, design and technology education start in the middle school years. For this reason, having a STEM course in primary school will contribute to students' ability to reason and think creatively on daily life problems while using science and mathematics. One of the ways to achieve this is to make activities with a project-based learning model based on STEM in this period. It is known that the choices of middle school students affect their future education and career searches (Trusty, Niles, & Carney, 2005). However, there is often not enough information about their STEM careers to make informed decisions about their future (Wyss et al., 2012). For this reason, it is necessary to use a STEM curriculum in which vocational introductions are made to increase the professional interest of students in the middle school period. In high school and university years, separate training can be given for the fields that constitute STEM.

This educational model will provide a deductive understanding, first of all, to have a general understanding of STEM and then to focus on more specific and professional areas. Although there is a difference, a similar one is applied in medical education. Medical students first learn general subjects and then turn to other areas that require expertise.

Planning and implementation of course contents are other problems while drawing the general lines of the STEM curriculum. Most institutions and organizations organize STEM planning competitions. Because how STEM contents should be structured is still a problem. STEM education practices should be structured with an inquiry-based approach. Which discipline should be centered is another matter of discussion? It is seen that most science teachers adopt STEM education more and therefore take science to the center. Some activities seem to be activities under the name of science and technology integration. It cannot be said that these activities completely reflect the nature of STEM.

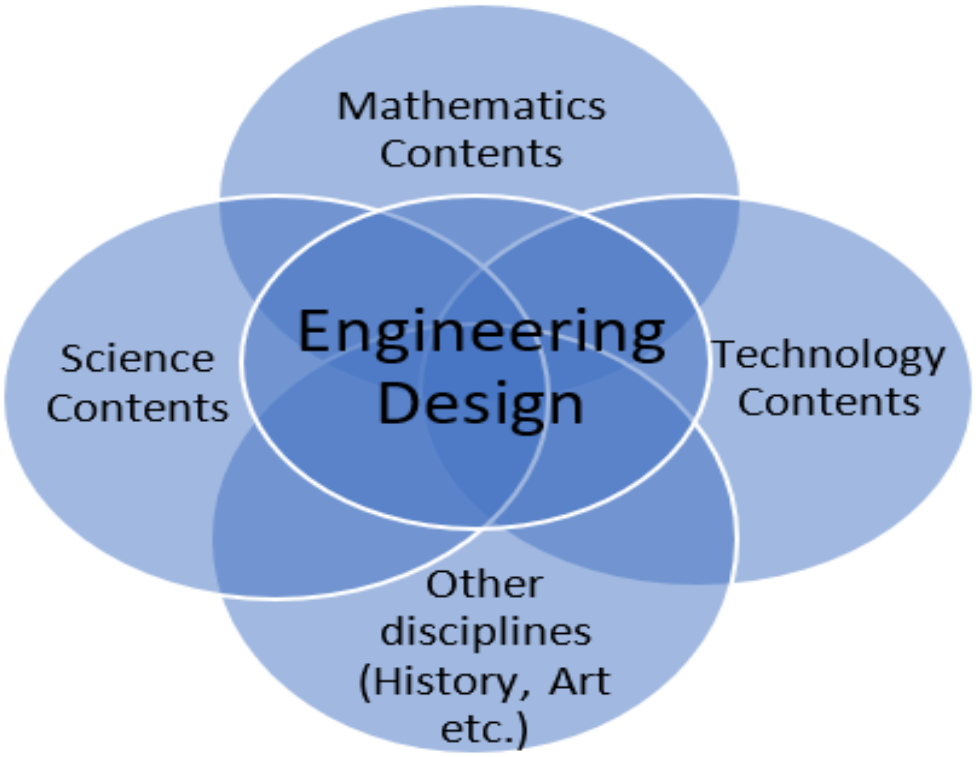

Figure 4. STEM Content Model

Engineering design skills should be at the center of STEM education. Although engineering is not a discipline, it is the only profession that uses the outputs of other disciplines. Therefore, engineering design skills should be taken to the center in effective STEM content. Engineering design skills should be aimed at solving daily life problems. as well as being a problem that concerns the whole society, it also can be a problem seen in certain regions. STEM teaching should not only focus on the development of content knowledge but also encourage the development of skills such as innovative problem solving and inquiry skills (Wang et al., 2011). The lesson content is designed within the framework of the engineering problem, a plan is made while producing solutions, science, mathematics and technology are used when testing the plan. If the solution fails, it will go back to the beginning. Since STEM education is an interdisciplinary approach, it can be used as an effective tool for problem-solving in other disciplines such as art and history.

STEM Professional Development

Teacher candidates and professional teachers should have content-specific knowledge as well as teaching skills and confidence across subjects to effectively integrate STEM learning experiences in their classrooms (Honey et al., 2014). It is seen that teachers need continuous training to improve their STEM teaching preparation (Nadelson et al, 2013). However, there is no lesson content on STEM education at university level. Teachers reach STEM with out-of-school activities. It is seen that the teachers who are the main implementers of STEM programs do not have sufficient knowledge about

STEM. Many primary school teachers do not have enough plan information for students to learn STEM, in addition they lack confidence and competence. For this reason, it would be appropriate to take a course on STEM education at the pre-school level and the primary school level. Since there are specialization lessons at middle school level, there should be a separate lesson for STEM teaching. In this section, it is suggested that STEM activities should be structured in a way that it strengthens the interdisciplinary curriculum. Professional development activities that will strengthen STEM knowledge and skills are recommended for teachers who have completed their departments. Today, many teachers avoid introducing innovative activities into the classroom environment due to their lack of self-confidence. For this reason, it is recommended that activities for students such as summer camps are designed in a way that allows teachers to be supported by new practices. Increasing the subject knowledge of teachers through many out-of-school practices such as workshops and courses will contribute to their professional development (Hewson, 2007).

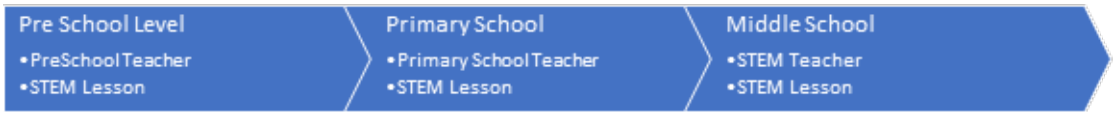

Figure 5. STEM Teacher Education Model

Since teachers are required to provide STEM education in pre-school and primary school years, they are required to receive four years of education structured on STEM education at the university level. STEM teachers who will teach at the middle school level must graduate from the STEM department as a separate specialty. Because, considering the STEM approach as a course that only science teachers give in extracurricular times creates a limited perspective against STEM, it is not an effective way to reach the goals of STEM. In these sections, pedagogy, the nature of STEM, STEM concept information, STEM philosophy, STEM Curriculum, effective practices, evaluation contents can be presented. For teachers to be effective in handling STEM misconceptions, they must have the correct knowledge of STEM concepts and be ready to teach the relevant content effectively (Ginns & Watters, 1995).

STEM Learning Environments

The learning environment has been defined as an element that contributes to successful STEM teaching (Maltese & Tai, 2010), and great importance has been attached to student and teacher perceptions of learning environments in individual STEM disciplines (Afari et al., 2013). A student-centered learning environment provides students with opportunity to take a more active role in their learning rather than being passive learners (Anderson, 2007). When we refer to STEM learning environments, it is specifically expressed as classrooms or schools where conscious and explicit efforts are made to coordinate the learning goals and learning activities of two or more STEM disciplines. (Glancy &

Moore, 2013). However, today, very few schools have STEM learning environments. Schools are generally designed for traditional education. Interactive science classes can be given as examples of classes in which learning environments are designed according to the course content. STEM classrooms should be designed to allow STEM activities. Therefore, STEM learning environments should be designed to allow for psycho-social, space, infrastructure-equipment and time dimensions

Psycho-Social Dimension: The psycho-social environment dimension of learning environments in STEM teaching should define a positive climate for learning-teaching. STEM education should create a supportive and convenient environment for learning instead of traditional practices. The psycho-social environment should take into account the individual differences of students such as motivation, interest, skills and learning styles. The psychosocial environment should encourage students to reflect, discuss and evaluate alternative thoughts that are put forward. It should give students opportunities to use the new concepts they have constructed in different situations. It should allow students to use their scientific process skills.

Infrastructure-Equipment Dimensions: One of the most confusing factors for educators about STEM education is which tools should be used in STEM education. Some researchers argue that STEM activities can be done with simple materials, while others recommend the use of robotic kits. This is because there is no consensus on which activities are STEM. The tools and materials that are going to be used in STEM education should be designed in a way that will arouse the interest of students in learning and help the emergence of new interests. Appropriate educational material will give students the ability to focus their attention and make decisions. In learning, students will be directed to various activities such as research, examination, experiment and observation, listening and reading. Appropriate materials appeal to multiple sensory organs such as vision, hearing and touch, providing accurate and complete learning that will give students a variety of experiences.

Space Dimension: For STEM education, it can be used not only in the classroom but also outside the school environment. However, it is recommended to have some characteristics in the classroom or school environment. the STEM classroom should be organized as an environment that encourages students to ask questions and at the same time allows them to use content such as observation, classification, data collection, explanation and experimenting. Instead of traditional education classes, environments, where students can work in groups, should be preferred. Students should have easy access to the environments that will allow them to conduct their research in the classroom. Students should be able to access computers, the internet, interactive whiteboard, etc. in school. It is recommended that students have mechanisms such as cameras to transfer the materials they produce as a result of STEM activities to the internet.

Time Dimension: Although time is a relative concept, it refers to the required time for STEM activities. Most educators state that they cannot find enough time for the activities they want to perform in the classroom environment. In STEM activities, more than one class hour is required for understanding and discussing the problem, producing solutions to the problem and testing it. Therefore, a STEM activity compressed or integrated into science class cannot be expected to be effective. Therefore, having a separate course for STEM applications will positively affect the use of time in STEM education. A well-planned lesson will reduce the waste of time and increase the time spent on learning in the lesson, allowing students to grasp new knowledge and absorb previous knowledge better.

STEM Assessment

The learning process, formative assessment, is an important element in improving teaching and learning. Formative assessment tracks the process by which students build knowledge and progress towards the final product. It encourages students to acquire high-level thinking skills (Lombardi, 2008). Although STEM has been an important movement in the last decade (Martín-Páez, Aguilera, Perales-Palacios, and Vílchez-González, 2019), research focuses more on teacher practices, student outcomes and STEM education design. Assessment approaches and their development are almost overlooked (Sondergeld, Koskey, Stone, & Peters-Burton, 2015).

More research is needed to develop competency-based assessments to explore how and to what extent STEM learning can improve students' inquiry abilities, higher-order thinking skills, or creativity (Fang & Hsu, 2019). First, it is important to identify the intended STEM learning outcomes (knowledge, attitudes or skills) to be developed in the learning process, and second, to consider how to design assessments that create evidence of STEM learning. A versatile STEM evaluation framework needs to be made. In this respect, it is necessary to focus on process evaluation instead of standard evaluation methods (Capraro & Corlu, 2013). In addition, evaluating the concepts that make up STEM one by one will only form a part of the evaluation process. It is necessary to take part in the evaluation process in variables such as teamwork, product and motivation. A three-stage model can be proposed in the STEM assessment processes. To examine students' STEM knowledge, knowledge, skills and values should be measured in the first stage. In the second stage, the skills of the concepts of STEM components should be measured. And in the third stage, observation, product evaluation and presentation skills can be evaluated through rubrics to measure the achievements of students in STEM activities.

Results and Discussions

All over the world, there is a growing need to provide high-quality STEM education

to students at the K-12 level to enable students to participate and follow STEM-related issues and careers (Metcalf, 2010). STEM education requires new teaching methods that go beyond the teaching of a specific discipline to teaching that involves the integration of different disciplines (Kelley & Knowles, 2016). However, the higher the expectations, the less likely it is to implement STEM education. This is because in most countries there is no consistent program for STEM. To solve this problem, educators need to repair the broken link between STEM education research education policy and practice. This study focuses on five dimensions of STEM education that need to be strengthened. To avoid this confusion in STEM education: STEM Literacy - STEM Curriculum and Content - STEM Professional Development - STEM Learning Environment, STEM Assessment dimensions should be strengthened. With this model proposal, the need for STEM education has been defined: Improving STEM education will contribute to the scientific, technological, mathematical and other integrated literacy of all people across the population. STEM literacy will enable students to compete in a new knowledge-based economic age. Developing STEM literacy is also the focus of STEM education (Krajcik & Sutherland, 2010). It is recommended to reorganize the training program after the goals are determined. With this model proposal, the applications of STEM education have been defined: STEM curriculum and its contents should be designed in a way that supports STEM literacy in a way that supports creativity, problem-based, project-based, daily life problems and critical thinking skills. The contents should be prepared in a way to guide teachers appropriately, with a focus on engineering design skills, using science, technology, mathematics and other disciplines. Teachers should be able to work flexibly through these applications.

With this model proposal, the need for STEM teachers was defined: Integrated teacher education programs should prepare the future teachers equipped with the knowledge, skills and beliefs to effectively implement STEM education that increases students' innovation capacity (Cuadra & Moreno, 2005). Prospective teachers who graduate from STEM teacher education programs with integrated teaching knowledge understand and teach STEM as an interconnected entity with a strong collaborative connection to life (Corlu, Capraro, & Capraro, 2014). The fact that teachers receive STEM education at the kindergarten and primary school level shows that there is a need for a new department specializing in STEM teaching at the middle school level. Because they are often trained as science, math or technology teachers, they rarely have the opportunity to experience multidisciplinary and interdisciplinary STEM education, collaborate with peers from different STEM backgrounds, or use technology to participate in STEM education (Martinovic, 2011). Graduated teachers, on the other hand, need to inform the education policy and participate in reliable and generalizable STEM education practices that can empower practitioners. Participation in activities that will allow teachers to develop their STEM education skills will encourage them in classroom practices. Trainees should

have the opportunity to experience the value of educational research for their teaching practice and to design and implement research-based pedagogies. This section has been associated with the concepts of STEM dimensions, which are related to each other.

With this model proposal, it is recommended to strengthen STEM learning environments: Although most research focuses on out-of-school practices, the majority of students spend most of their time at school. Providing STEM education to students in a short period is an obstacle for STEM education to reach its goals. Most schools experience problems in the psycho-social environment, space, infrastructure, equipment and time dimensions required by STEM learning environments. Therefore, it is important to strengthen STEM learning environments according to the specified dimensions.

With this model proposal, the need to re-evaluate STEM students' outcomes has been defined: With STEM education, it is aimed that students become productive individuals with a critical perspective. However, it is unthinkable to evaluate STEM education with classical tests and methods. Instead, it is necessary to evaluate students' achievements with multiple tools that focus on process evaluation. STEM attitude, motivation and career interest development of students should be followed regularly.

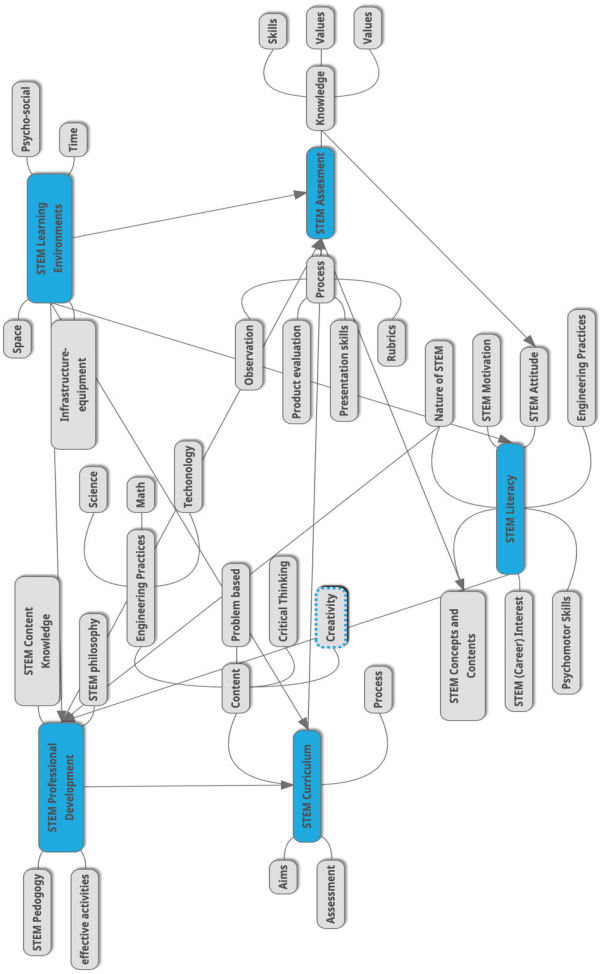

Figure 6. STEM Dimensions and Contents

Suggestions

• The aim of STEM education should enable students to be STEM literate. STEM literacy does not only mean gaining literacy in science, technology, engineering, and mathematics (Toulmin & Meghan, 2007). It also implies more than mapping numerous overlapping interdisciplinary skills, concepts and processes. STEM literacy is the synergy of these areas (Zollman, 2012).

• An accepted curriculum and contents for STEM education should be produced. Most applications refer to American-based studies. However, most countries in Europe and Asia do not have a STEM curriculum.

• STEM education experts that specialize only in this field should be trained in universities. It is a mistake to associate STEM curriculum and its contents with only science education. A science teacher cannot be expected to fully master other fields and cannot meet the students' expectations. Therefore, for effective STEM education, manpower trained in this field is needed.

• Professional development of teachers towards STEM should be supported. It is necessary to increase the activities for the professional development of teachers in STEM fields through universities.

• Assessment of STEM education should be emphasized. The assessment comes to the fore in meeting STEM education practices and expectations. However, STEM assessment studies are very new. Studies in this area are needed.

References

Alberts, B. (2013). Prioritizing science education. *Science, 340*(6130), 249. http://dx.doi.org/10.1126/science.1239041

Aldemir, J. & Kermani, H. (2017) Integrated STEM curriculum: improving educational outcomes for Head Start children, *Early Child Development and Care, 187*(11), 1694-1706, http://doi.10.1080/03004430.2016.1185102

Afari, E., Aldridge, J. M., Fraser, B. J., & Khine, M. S. (2013). Students' perceptions of the learning environment and attitudes in game-based mathematics classrooms. *Learning Environments Research, 16*, 131–150.

Anderson, R. D. (2007). Inquiry as an organizing theme for science curricula. In S. K. Abell & N. G. Lederman (Eds.), *Handbook of research on science education* (pp. 807–830). New Jersey: Lawrence Erlbaum Associates

Baran, E., Canbazoglu Bilici, S., Mesutoglu, C., & Ocak, C. (2019). The impact of an out-of-school STEM education program on students' attitudes toward STEM and STEM careers. *School Science and Mathematics*, *119*(4), 223-235.

Bell, P., Lewenstein, B., Shouse, A. W., & Feder, M. A. (Eds.). (2009). *Learning science in informal environments: people, places, and pursuits*. National Academies Press. https://doi.org/10.17226/12190

Becker, K., & Park, K. (2011). Effects of integrative approaches among science, technology, engineering, and mathematics (STEM) subjects on students' learning: A preliminary meta-analysis. *Journal of STEM Education: Innovations & Research, 12*, 23-37.

Berlin, D., & White, A. (1995). *Connecting school science and mathematics*. In P. House & A. Coxford (Eds.), Connecting mathematics across the curriculum (pp. 22-33). Reston, VA: National Council of Teachers of Mathematics.

Brown, P. L., Concannon, J. P., Marx, D., Donaldson, C. W., & Black, A. (2016). An examination of middle school students' STEM self-efficacy with relation to interest and perceptions of STEM. *Journal of STEM Education: Innovations and Research, 17*(3), 27-38.

Bybee, R. W. (2013). *The case for STEM education: Challenges and opportunities*. Arlington, VA: NSTA Press.

Capraro, R. M., & Corlu, M. S. (2013). *Changing views on assessment for STEM project–based learning*. In R. M. Capraro, M. M. Capraro, & J. Morgan (Eds.), STEM project-based learning: An integrated Science, Technology, Engineering, and Mathematics (STEM) approach (2nd ed., pp. 109-118). Rotterdam, the Netherlands: Sense Publishers.

Carracedo, F. S., Soler, A., Martín, C., López, D., Ageno, A., Cabré, J., ... & Gibert, K. (2018). Competency maps: An effective model to integrate professional competencies across a STEM curriculum. *Journal of Science Education and Technology*, *27*(5), 448-468.

Capraro RM, Slough SW 2013 *Why PBL? Why STEM? Why now? An introduction to STEM project-based learning: An integrated science, technology, engineering, and mathematics (STEM) approach*. InSTEM Project-Based Learning. Rotterdam: SensePublishers.

Corlu, M. S., Capraro, R. M., & Capraro, M. M. (2014). Introducing STEM education: Implications for educating our teachers in the age of innovation. *Education and*

Science, *39*(171), 74-85.

Cuadra, E., & Moreno, J. M. (2005*). Expanding opportunities and building competencies for young people: A new agenda for secondary education*. Washington, DC: The World Bank.

Denson, C. D., Hailey, C., Stallworth, C. A., & Householder, D. L. (2015). Benefits of informal learning environments: A focused examination of STEM-based program environments. *Journal of STEM Education: Innovations and Research, 16*(1), 11-15.

Fang, S. C., & Hsu, Y. S. (2019). *Assessment Challenges in STEM Reforms and Innovations.* In Asia-Pacific STEM Teaching Practices (pp. 191-203). Springer, Singapore.

Ford, B. A. (2007). *Teaching and learning: Novice teachers' descriptions of their confidence to teach science content*. Doctoral dissertation. Available from ProQuest Dissertations and Theses database. (UMI No.AAT 3272874)

Ejiwale, J. A. (2013). Barriers to successful implementation of STEM education. *Journal of Education and Learning, 7*(2), 63-74.

Glancy, A. W., & Moore, T. J. (2013). Theoretical foundations for effective STEM learning environments. *School of Engineering Education Working Papers, 1*, 1-23.

Ginns, I. S., & Watters, J. J. (1995). An analysis of scientific understandings of preservice elementary teacher education students. *Journal of Research in Science Teaching, 32,* 1098–2736.

Havice, W. (2009). *The power and promise of a STEM education: Thriving in a complex technological world.* In ITEEA (Ed.), The overlooked STEM imperatives: Technology and engineering (pp. 10–17). Reston, VA: ITEEA.

Hewson, P. (2007), *Teacher professional development in science*. In S. K. Abel and N. G. Lederman (eds.): Handbook of research on science education, Mahwah: Lawrence Erlbaum, pp. 1179–1203.

Honey, M., Pearson, G., & Schweingruber, H. (2014). *STEM integration in K–12 education: Status, prospects, and an agenda for research*. Washington, DC: National Academies Press.

Fang S. C. & Hsu Y. S. (2019). Asia-Pacific STEM Teaching Practices: From Theoretical Frameworks to Practices. Hsu, Y. S., & Yeh, Y. F. (Eds.). *Assessment Challenges in*

STEM Reforms and Innovations. (pp. 191-203). Springer Nature.

ITEEA board of directors, "Proclamation: ITEEA's Position on the "T" & "E" of STEM," 2009 [Online]. Available: http://www.iteaconnect.org/AboutITEEA/STEMProclamation.pdf.

Kelley, T., & Kellam, N. (2009). A theoretical framework to guide the Re-engineering of technology education. *Journal of Technology Education, 20*(2), 37–49.

Kelley, T. R., & Knowles, J. G. (2016). A conceptual framework for integrated STEM education. *International Journal of STEM Education, 3*(1), 1-11.

Krajcik, J. S., & Sutherland, L. M. (2010). Supporting students in developing literacy in science. *Science, 328*(5977), 456-459.

Li, Y., Wang, K., Xiao, Y., & Froyd, J. E. (2020). Research and trends in STEM education: a systematic review of journal publications. *International Journal of STEM Education, 7*(11), 1-16.

Lombardi, M. M. (2008). Making the grade: The role of assessment in authentic learning. Educause Learning Initiative, *International Journal of STEM Education, 1,* 1-16.

Maltese, A., & Tai, R. S. (2010). Pipeline persistence: Examining the association of educational experiences with earned degrees in STEM among U.S. students. *Science Education, 95,* 877 – 907.

Martín-Páez, T., Aguilera, D., Perales-Palacios, F. J., & Vílchez-González, J. M. (2019). What are we talking about when we talk about STEM education? A review of literature. Science Education. 103(4), 799-822.

Metcalf, H. (2010). Stuck in the pipeline: A critical review of STEM workforce literature. InterActions: UCLA. *Journal of Education and Information Studies, 6*(2), 1–20.

Nadelson, L. S., Callahan, J., Pyke, P., Hay, A., Dance, M., & Pfiester, J. (2013). Teacher STEM perception and preparation: Inquiry-based STEM professional development for elementary teachers. *The Journal of Educational Research*, *106*(2), 157-168.

National Research Council. (2009). *Engineering in K-12 education: Understanding the status and improving the prospects*. Washington, DC: The National Academies Press.

National Research Council. (2011). *Successful K-12 STEM education: Identifying*

*effective approaches in science, technology, engineering, and mathem*atics. National Academies Press.

National Governors Association (2007). Innovation America: Building a Science, Technology, Engineering and Math Agenda, http://www.nga.org/files/live/sites/NGA/files/ pdf/0702INNOVATIONSTEM.PDF

Nurlaely, N., Permanasari, A., & Riandi, R. (2017, September). Student's STEM literacy in biotechnology learning at junior high school. In *Journal of physics: conference series* (Vol. 895, No. 1, p. 012155).

Scaramozzino, J. M. (2010). Integrating STEM information competencies into an undergraduate curriculum. *Journal of Library Administration, 50*(4), 315-333.

Skinner, E., Saxton, E., Currie, C., & Shusterman, G. (2017). A motivational account of the undergraduate experience in science: Brief measures of students' self-system appraisals, engagement in coursework, and identity as a scientist. *International Journal of Science Education, 39*(17), 2433–2459.

Sondergeld, T. A., Koskey, K. L. K., Stone, G. E., & Peters-Burton, E. E. (2015). *Data-driven STEM assessment*. In C. C. Johnson, E. E. Peters-Burton, & T. J. Moore (Eds.), STEM road map: A framework for integrated STEM education. New York, NY: Routledge

Stinson, K., Harkness, S., Meyer, H., & Stallworth, J. (2009). Mathematics and science integration: Models and characterizations. *School Science and Mathematics, 109*, 153–161.

Tang, K. S., & Williams, P. J. (2019). STEM literacy or literacies? Examining the empirical basis of these constructs. *Review of Education*, *7*(3), 675-697.

Techakosit, S., & Nilsook, P. (2016). The learning process of scientific imagineering through AR in order to enhance STEM literacy. *International Journal of Emerging Technologies in Learning*, *11*(7), 57-63.

Trusty, J., Niles, S. G., & Carney, J. V. (2005). Education-career planning and middle school counselors. *Professional School Counseling, 9*(2), 136-143.

Vasquez, J., Sneider, C., & Comer, M. (2013). *STEM lesson essentials, grades 3–8: Integrating science, technology, engineering, and mathematics*. Portsmouth, NH: Heinemann

Wang, H.-H., Moore, T. J., Roehrig, G. H., & Park, M. S. (2011). STEM integration: Teacher perceptions and practice. *Journal of Pre-College Engineering Education Research, 1*(2), 1–13.

Wyss, V. L., Heulskamp, D., & Siebert, C. J. (2012). Increasing middle school student interest in STEM careers with videos of scientists. *International Journal of Environmental and Science Education, 7*(4), 501–522.

Zollman, A. (2012). Learning for STEM literacy: STEM literacy for learning. *School Science and Mathematics*, *112*(1), 12-19.

From Art and Music Education to STEAM

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Art

Art, which was created by the human in the search of fine, is the whole of beauties gradually surrounding him. In the line with requirements, human beings have created a variety of art works throughout the life span. These art works range from even ordinary expressions developed through such concerns as fineness or realism to the its own need for renaissance by replicating itself. The pleasure taken from creating an art urge people to reveal fresh works; as the expression ability of the artists has improved more and more, this development cycle has also flourished throughout the history. Human beings who tried to express themselves at first have developed visual, audial and dramatic arts with this pleasure circle; therefore, artists and works of art can remain alive through mutual interaction.

On the other hand, art is not just for pleasure, it should also prioritise nicety (Plehanov, 1987). At this point, besides its lexical meaning known as manufacturing, craftsmanship, ingenuity and craft, it is suggested that the meaning of the 'Sanat' which comes Turkish from Arabic may be originated from 'artificial'. In addition to this assumption, the similarities between 'art' and 'artificial in English; 'kunst' and 'kunstlich' in German corroborate this idea (Turhal, 2019). Thus, the art notion can be described as a presentation of the piece of reality through artificial expression by manipulating skilful actions. In that case, not only reflecting the reality via pleasure but also reflecting with the best possible defining is one of the responsibilities of art. At this point, similar to the assumption that there is no single reality, the notion that there is no single best reflation pattern allows art to offer limitless diversity. When the attempts of the artist to incorporate a part of himself into the work and his effort to survive via art works take into the consideration, an endless diversity came into being.

Honouring of this art works; even further approval of them has pushed artists to product more work. The approval of the idea that artworks have an artistic value just come true with the acceptation of the mass (Barrett, 2015) Admiration has usually motivated the artist, and it has also an inspirational effect to produce and improve new artworks. However, at that point, the dilemma in the notion of art come to the forefront.

The first idea is 'Art for people's sake'. In this definition, the relationship between society and acceptation of the art is at the forefront. Art is usually the most efficient means to express the fine and beauty (according to the acceptance of society). The second idea is 'art for art's sake''. According to this view, art is the means for the artist (in terms of his

own acceptance) to express something in a most efficient way. This approach enables the artist to be master in his field, and even to move beyond society.

But in this process, it may also lead to a disconnection between the artist and the mass and subsequently a detachment form the society subsequently (Plehanov, 1987). For this reason, certain artists couldn't be understood enough during their period and the deepness in their artworks was recognized afterwards. This deepness also kept artist's influence alive. On the other hand, some artists have never been understood and vanished in the dusty pages of history with their artworks.

This story of the art has lived in ages, in various cultures via different materials and movements. Around these two margins, these movements began for the sake of pursuit of the reality and aesthetics. On the other hand, the idea ''Art not only copies the life, but also tries to explain it' (Plehanov, 1987) has focused on another function of art. According to this aspect, art is regarded as an effort to make life meaningful. In this mission, art attempts to improve the humankind. This effort reveals unbreakable bond between art and education.

Art Education

Such concepts as art education or education through art are dilemmas that always exist in the story of the art. In art education, development process and the period of change have been shaped not only through the interaction between artists (or their works) but also through mentor system. In other words, an environmental education also becomes unavoidable as well as a formal vocational art education. On the other hand, this process embraces such branches as an art education to train an artist and an art education to create a good person. Moreover, it has sometimes handled by getting in touch with one another. In order to train a good artist, vocational art education has been given with a more professional manner in a narrow case while general art education has served more common mass as a basis for the discipline.

We also regard the art concept as a human effort to express himself aesthetically with various ways. This perspective has brought out the role of the art education in general education. In this respect, Reed's ideas such as 'art should be the base of the education…. the aim of the education should be to create productive humanity in various expressions' come to the forefront (Keel 1969:47). He argues that art should be a primary element in curriculum. Reed adopted 'art is an education form' idea (Keel, 1969). In other words, art is not an instrument to teach particular subjects. Artistic teaching is a general point of view that can handle many subjects. This idea lays its foundation on a point of view including not only visual arts but also all other branches of the arts ranging from music to drama or literature to architecture.

Reed also suggested an insight that unearths the creativity within the education (Keel, 1969). This insight mentions about a kind of education that helps individuals to discover their own abilities from their childhoods. Without doubt, creativity will make a great contribution to individuals' development and also lay the foundation of some qualities such as 'self-acquaintance' and 'self-development'. Now, we can realise the importance of this aspect with recent global human patterns.

These days, digital world has a variety of forms that can offer limitless production opportunities one hand and that restrict individuals' freedoms and shape aesthetic perception on the other hand. As a result of these forms, the merging 'dedifferentiation' of the aesthetic concepts like same dance movies, music or clothes by the youth from different cultures in from the different parts of the world can be regarded as globalisation. This approach may be considered as a menace for the colourful world culture in terms of standardization of it. On the other hand, digital world facilitates the interaction of the creative piece of works and accelerate the inclination and honouring of them.

The approaches that are condemned to uniformity and lack of creativity prove the importance of the art education and the education handled through creativity again. The most important point here is to generating people taking pleasure in creating on their own without being subject to the manipulation effect of the trend. Thus this existing global aesthetic perceptive penetrates its effects to people so easily and gives rise to standardization.

The aim of the art education is to teach seeing not looking, to teach hearing or even to teach perception to the students (San, 2004). With art education, it is aimed to increase consciousness level and awareness perception of the individual. By this way, individuals with advanced recognition abilities who found out their creative abilities have been brought up.

In the art education processes, one of the common criticism that educators face is the reluctance to product arts, because of a variety of notions like that art requires ability and the ones that are lack of this ability won't be successful in art education process or even 'they have no idea about art'. Before we reply to this criticism, we have to accept that it is crystal-clear fact that art absolutely requires ability and talent. However, this situation doesn't mean a need for classification in the education. Hence, many fields like Language, Mathematics, Science also require abilities (Kırışoğlu, 2002). In general education at a certain level of success can be achieved in these fields too. In addition art education also aims to achieve success at a certain level.

Another problem that is encountered in art education process is the insufficient weekly course hours of art courses in curriculums (Uysal & Uysal, 2015). The lack of fine equipment for art courses and the difficulties encountered to find appropriate places

can be regarded as other challenges. In fact, art education is a boundless form. For instance, the music created just with our voice and body percussion is quite didactic, remarkable and enjoyable. Similarly, visual arts can also offer lots of fantastic works by using various natural materials. On the other hand, insufficient weekly course hours allocated art courses is a harsh reality that we have to accept. But ideally, education patterns through art should be considered as a part of general education and offer an interdisciplinary approach.

Music and its Effect

Music has a special place in the Fine arts, because music, opening the doors of the acoustic world, is a kind of fine art that effects one's mood in the quickest way. Music consists of fluctuating sounds in harmony with systematic length and height in certain frequencies. This harmony and effect between Literature and Music lead to a solid alliance between them. Human beings have experienced their happiness, gloom or even their worship more efficiently through music over the last centuries. So that, music turns into a natural need and a significant part of the culture.

It is thought that the connection between humanity and music arouse out of a need for communicate and expression. The transformation of speeches into melodic conditions in expression may be evolved in first singing action afterwards. According to this thought, the emotions in expressions are pathfinders of the melodies and this situation leads to the composition of the first songs or piece of musical expressions. The line between Literature and music, like a snowball, has grown stronger and stronger. It is also thought that the first instruments accompany songs were percussion instruments. The use of percussions especially in certain ceremonies improve the effect of the expression. This effect plays an important role in today's military ceremonies, rites or even wedding ceremonies. Wind instruments are thought to have taken second place.

These instruments including small sound sequences at first have developed in the long run. Other instruments have also pursued this trend and come until today. Today instrumental revolution or evolution doesn't end; on the contrary it keeps up with the times. As the material cognisance and technology in instrument manufacturing have grown, the more durable and more loud-voice instruments matching with different tone colours can be manufactured. When the today's electronic instruments are also taken into the consideration, it is not surprising that the manufacturing of instruments will go on in the future and will be one of the field usually used by interdisciplinary studies.

The irresistible effect of the music has manifested itself not only in expressions or performance of the arts but also in the treatment methods by establishing a relationship with medicine. It is alleged that the earliest treatment methods with music were performed by David in BC 1000s. Moreover, it is well-established that Pentatonic scale

by Pythagorean, who has outstanding studies on such disciplines as philosophy and mathematics at the same time, was also used for treatment. Farabi also treated people via music and gave information about scales and their effects. Similar to lots of societies, this tradition grew up and took its root to Turkish society in Anatolia then, with the institutionalization of the 'Darussifas'(same as hospitals), it becomes one of our cultural heritages. Particular themes, affecting various mental illnesses, were determined at these institutions, then treatment process was supported by playing musical titles from these themes to patients.

Treatment methods via music is a popular field even today. A number of seminars have been conducted in many institutions. Further, certification programmes have been offered and various application fields have been created. Unlimited world of the technology has opened novel doors in this field. In the future, it is most probably that the musical treatment will turn into a field serving for different purposes more efficiently thanks to the technology. Theatre and Cinema, parts of the dramatic arts, are the fields in which music is put to use effectively. Today theatre, series and production of game music become a significant industry. Musical works composed mostly through digital ways spark off new sectors like electronic music. This increasingly growing digital production keep pace with the necessities of the time and go on its evaluation in parallel with technological development.

After all these experiences, the effect of the music is also subject to the certain physiological researches. In these researches, musical variance has been tested with a variety of variances such as different patterns, tones, instruments and human voices and in this way, it is tried to understand what kinds of moods stem from these variances (Baydağ, 2019). The results obtained from these studies become a source for various sectors. For instance, jingles have been canalized into the attraction centres of the target group or the musical genres prompting the customers to do more shopping have preferred in malls. So this way, trade blocs have reconstituted the effects of the music for professional purposes.

Music Education

Music like many other branches of fine arts has a significant effect on upbringing of a humankind. The habit of listening to relaxing music beginning from mother's womb goes forward with lullabies that help babies to sleep peacefully. This musical memory of the child, arising from the beginning of mother's womb, spurs him/her towards a potential musical concern in the future. This knowledge, whether it is conscious or unconscious, gives rise to a musical aptitude which approves itself hereafter. Which is why, proper guidance brings about positive outputs. If listening activity goes along with singing, development and interest increase. In the formal education, generally beginning with

preschool education, music is not only a means for other behaviours that are thought but it is also in the centre of the musical development. Listening activities are also in a relationship with development of the technological devices and software technologies.

There are critical periods in the musical development of the children. When they are educated well musically, it contributes to their following musical talents and interests. These periods may differ according to children' own socio-cultural context (Özmenteş & Adıgüzel 2017). When we take a look at today's musical talent tests, it is realized that there is a generally vocalization oriented trend among the students in terms of answering the questions. From this viewpoint, taking music education based on singing a song both in preschool and primary school periods promote skill development. Moreover, giving a rhythm oriented musical education to students and their accompaniment this rhythm or song with certain instruments or gestures in this education process can improve not only their musical development but also their self-acquaintance and self-expression.

One of the pioneer methods on this subject is Dalcroze method and the basic concept of this method is Eurhythmics. According to Jagues-Dalcroze 'We listen to music just with our ears but it resonates in our brains, hearts and eventually in our whole parts.' (İJD 2020). Eurhythmics is performed with an education conception which emerged in the light of an idea that body and music perception merge and turn into a motion (Eren, 2019). A variety of skills like hearing training, solfege and spontaneity are upskilled in this program. The acquisition of these skills with a motion brings about more efficient learning atmospheres (Özmenteş & Bilen 2005).

The Orff method, following the above, prioritises rhythm perception in music education. The method offers an Elemental course from the rhythm in the speech to gestures. This method also suggests to use rhythmic and melodic percussion instruments for basic music education. Furthermore; Carl Orff invented a number of afro-instruments through his own imagination and used them effectively. Orff method has also offered efficient results in musical education approaches (Kalyoncu 2006). The common aspect of both these two approaches and the other contemporary basic music education approaches is to be a game and dance oriented education approach which puts the student into learning environment by prompting him/her. In addition, spontaneity occupies an important position in these approaches.

Musical spontaneity enables students to discover their creative abilities. So their musical self-acquaintance and self-expression skills can improve. Another aspect of these contemporary approaches is to be more successful in terms of adapting to the other disciplines. The most common skill in these interdisciplinary relationships is to convert music into other expression arts. This may be a transformation from a piece of music to a paint, a poem, a story or vice versa.

One of the main dimensions of the music education is instrument training. This process requires to utilize a number of skills together from psychomotor behaviour necessary for instrument to analysis of the musical note by analysing and forming patterns. It is necessary to make progress with systematic experiences so as to gain these skills. In instrumental training process, one should take over his/her own learning responsivities and carry out the instrumental experiences with conscious studies. Therefore, a number of technical aspects pertaining to instrument can be achieved successfully. In general music education processes, the use of an instrument by students or trainer leads to a positive effect on students (Düzgören & Gerekten 2017). On account of this reason instrument training should be carried out with certain instruments like a block flute, melodica etc. within general education. Selections of the instruments may differ according to the socio-economic conditions of the schools. At this point, the basic factors effecting selection of the instrument can range from the suitability of the instrument for collective playing in terms of playing skills to transfer other instruments or to be affordable.

Today there are digital software supporting to the instrument training processes or even regulating the learning atmosphere that serves as a guide. Further, with the increasing use of technology, these programmes have a big potential to turn into more user-friendly ones.

The contents that are taught in general music education should be analysed meticulously. The songs taught should be chose in accordance with social values (Akıncı, 2019). When the grammar of the songs and the meaning of their lyrics are handled properly, positive acquisitions can be achieved. It is known that successful results are possible when the music is regarded as an effective language and preferred to teach by other disciplines (Dinçer, Ece & Yildizlar, 2010). Besides the music-aid educational studies in different fields, there are also a great number of interdisciplinary studies on the relationship between music and academic success, scientific- verbal education, mathematical ability etc. (Ece & Çesit, 2011). To sum up, music education is an unlimited field applied usually for interdisciplinary studies.

Interdisciplinary

Interdisciplinary concept can be recognized as the relationships established by common networks of different disciplines. In this concept, it is acknowledged the fact that a good number of disciplines, that we regard them as separate disciplines today, were parts of the entirety once upon a time and emerged from this entirety through the disintegrations in time.

Although disciplines separate from each other owing to their discrepancies, they cannot be clarified or born out without each other's assistance. Thus, interdisciplinary study habits are natural processes. While the interdisciplinary interactions are very popular

in education sciences today, it is also understood that some disciplines were in fact not different from each other in the past.

For instance, in ancient Greek education, this interdisciplinary approach existed naturally as the philosophy provided this interdisciplinary link. People known as philosophers had a knowledge level embracing a variety of fields that range from astrology to chemistry, from music to mathematics or from politics to sociology (Aydın&Arslan, 2015).

Similarly, the artists and scientists of the Renaissance revival also performed works with a multidisciplinary principle. Leonardo da Vinci is one of the best models of that period. He had designs like an engineer and he also devised prototypes of some designs. In other respects, with his unique style crowning the painting, he is one of the headstones of art history. On the other hand, it is established hat he made a living by playing lavta in the royal palace. This is a good example for his musician side. Da Vinci is also man of the age with his musician, painter, architect, engineer, astronomer, sculpture, botanist and writer aspects which we cannot mention now. In other respects, Mehmed the Conqueror with his conquest which is the starting point of the Renaissance revival, is a remarkable character with his knowledge about a variety of disciplines such as history, politics, religious, engineering and this knowledge informs us about the people of the age. Art education was a significant part of the general education in this era and the interdisciplinary interaction was higher-up.

It is considered that Modern thinking which is brought to agenda in 17th century, has allowed disciplines to move separately and to go into deeper part of their field. In this way, different science and art branches took root in itself and developed. On the other hand, this trend weakened interdisciplinary interactions and supported just too close disciplines. Postmodernism movement, which raises a criticism against Modernism, suggests that facts only bring to light with entire statements instead of a single truth. The notion of searching different statements is only possible with a relationship between different disciplines. Thus, thanks to postmodernism, this disintegration got behind again and interdisciplinary relationships has come to the forefront (Üstüner, 2007).

When we look at the present, thanks to the developments in the industry and technology, the importance of the reframing abilities and creativity has grown day by day. In order to reframe, it is necessary to look at with the eye of different disciplines or to gain fresh views via the various contacts with these disciplines. In line with this requirement, education programmes have been designed as interdisciplinary.

STEAM

In 1950s, it was aimed to design an associational education model which is thought to have been designed first in America and which embraced Science, Technology,

Engineering and Mathematics (STEM) fields. At the down of 21th century, the technological developments in Japan and the output growth in China have pushed the USA to make reforms in scientific works (National Research Council, 1996). These reforms shaped also the education and enhanced the interactions especially among the science, technology and engineering fields. In 2000s, these interactive relations were conceptualized as interdisciplinary education concepts and added to educational environments both in the USA and Europe.

Much as these interdisciplinary concepts were designed and used in education with different denotations at first, 'STEM' title became increasingly prevalent then. Innovative education insights, trying to catch the era and to equip the students for the future, have prioritised skill-based learning and struggled to use a teaching model targeting discoveries and creativity. This education platform gives an opportunity to utilize a widespread education environment ranging from preschool periods to doctoral degree.

Then there were some efforts to amend the scope of STEM and it was going to intend to add entrepreneurship and other things related to hardware system to its title, but they were not approved enough. After that, as result of a variety of studies it was well understood that only with art education it is possible to achieve creativity and ability that lie at the heart of all these projects. Therefore, STEM involved 'A' standing for Art and took its final for as STEAM.

Pyramid expression by Yakman (2010) was also effective within this period and STEM notion exerted an influence on education as from South Korea to the USA and European countries. Turkey was not also indifferent this approach and a STEM Education Report was published by the Ministry of National Education in 2016. Furthermore, Trainer Handbook of STEM Education was published in 2018 and another book titled Acquisition Centred STEM Applications was published in 2019 (MEB, 2016, 2018, 2019). Although art field was involved in certain events of this study and so on, applying without 'A' indicated that an understanding that lags behind in the developments on this subject and overlooks acquisitions of the art through interdisciplinary approaches still persists (Madden, et al., 2013).

On the other side, after postmodernism, art approaches also adopted interdisciplinary approaches in itself and took on a good structure via methods like using different materials and via use of the knowledge belongs to other disciplines (Edeer, 2005; Bolat Aydoğan, 2009). In this colourful world, art education enables individuals to gain a variety of acquisitions such as sensitivity, awareness, opening for improvement, creativity and so on (Mercin, 2018, Helvacı&Yılmaz, 2020). Moreover, an individual can improve his/her problem solving ability and gain multiple perspective thanks to the art education (Henriksen, 2014).

Results

Art education adapt to interdisciplinary approaches intrinsically. As we partly mentioned above, musical education processes are also used in various subjects in an interaction with different disciplines. Thus, STEAM education platform opens unlimited and delighted doors through music. Here below, there are certain examples about previous studies on music and STEAM including its subjects. In the one of these studies, music notes were studied in amino acid sequence (Acan&Acan, 2019) and sequence was performed with a common song. In another study web based 3D platform was created in order to form an interaction with virtual music instruments (Kritsis, et al., 2018) and the lesson handled this way. In his informatics musical thinking course, an artist also developed an algorithm that leads to thinking like him and he shared his STEAM experience which he practiced by composing music (Shafer & Skripchuk, 2020). Guy, designed Human Centred Design (HCD) in his study (2013) and suggested that art oriented education constituted in the light of solving problems by discovering and criticizing would reveal creativity and so the programmes formed in this way would provide prudential long term socio-technic benefits. Kim, tested a STEAM based music lesson given 3rd grade elementary school students in his study (2018) and established that STEAM support turned out an advantage in music lesson. With their project known as the iMuSciCA, Andreotti and Frans (2019) offer a curriculum including physics and engineering fields in music education. they set horizontal relationships by making contacts among disciplines via their knowledge. they also deep themselves in these related disciplines vertically.

Welch (2012) criticized English Bachelorhood and alleged that if there were as much support for art and social science including music as technology, school-aged children could be gain substantial learning outcomes. He also emphasized that STEM education platform should replace with STEAM.

All these studies indicate that art education can achieve remarkable learning outcomes through art education and especially with the STEAM applications in music education. It is clear that a great education platform STEAM has flourished more and has widened new horizons thanks to the music field. It is strongly believed that such kinds of interactive learning methods should be utilized effectively today and in the future.

References

Acan, S. C., & Acan, L. A. (2019). Music Notes To Amino Acid Sequence: A STEAM Approach Tostudy Protein Structure. Biochemistry and Molecular Biology Education. 47 (6) 669-671.

Akıncı, M. Ş. (2019). Kültürel ve Ahlaki Değerlerin Öğretiminde Müziğin Yeri ve Önemi. Akademik Sosyal Araştırmalar Dergisi. 7 (91) 98-108. Issn: 2148-2489 Doi Number: Http://Dx.Doi.Org/10.16992/Asos.14917

Andreotti E., & Frans, R. (2019). The connection between physics, engineering and music as an example of STEAM education. Physics Education, 54,(4).

Apaydın, A, İ., & Arslan, F. (2015). Antik Yunan Felsefesinde Ahlaki Eğitim Aracı Olarak "Müzik". Değerler Eğitimi Dergisi. 13(29), 323-342.

Barret, T. (2015). Neden Bu Sanat, 1. Press, (Translator: Esra Ermert Tınaz), İstanbul: Hayalperest Publisher.

Baydağ, C. (2019). Duygudurum Bağlamında Müzik ve İnsan Sesi. Yükseköğretim ve Bilim Dergisi/Journal of Higher Education and Science, 9 (3), 363-374. https:// doi. org/10.5961/jhes.2019.338

Bolat Aydoğan, K. (2009). Sanatta Disiplinlerarası Bir Yaklaşım: Performans Sanatı. Art-e Sanat Dergisi, 1 (1), 1-17. Retrieved from https://dergipark.org.tr/tr/pub/sduarte/issue/20720/221484.

Dinçer, M., Ece, A. S., & Yıldızlar, M. (2010). The Maths Educatıon Wıth Musıcal Games: The Maths Educatıon Wıth Musıcal Games On Acedemıc Success And The Attıtudes In Turkısh Elementary Schools. Germany: Lambert Publisher.

Düzgören, H., & Gerekten, S. E. (2017). Anadolu Lisesi Öğrencilerinin 'Müzik Dersi' Kavramına İlişkin Algıları. Onlıne Journal Of Musıc Sciences, 2. (3), 86-117.

Ece, A. S., & Çeşit, C. (2011). Türkiye'de Lisansüstü Düzeyde Yapılan Disiplinler Arası Müzik Araştırmaları ve Sonuçları. Uluslararası Sosyal Araştırmalar Dergisi. 4 (17) 599-617.

Edeer, Ş. (2005). Sanat Eğitiminde Disiplinler arası Yaklaşım. *On dokuz mayıs Üniversitesi Eğitim Fakültesi Dergisi. 19,* 78-84.

Eren, E. K. (2019). Emile Jaques-Dalcroze ve Ritmik Yöntemi. *Eurasian Journal of Music and Dance,* (14), 131-145.

Guy,A. B. (2013). From STEM to STEAM: Toward A Human-Centred Education, Creativity & Learning Thinking. in Papers. European Conference on Cognitive Ergonomics, (ECCE 2013). France: Toulouse.

Helvacı, İ., & Yılmaz, M. (2020). Görsel Sanatlar Eğitiminde Disiplinler Arası Yaklaşım: STEAM. *Kastamonu Education Journal, 28*(6), 2203-2213. doi: 10.24106/ kefdergi.797480

Henriksen, D. (2014). Full STEAM Ahead: Creativity in Excellent STEM Teaching Practices, *The STEAM Journal. 1,* (2), 15. doi: 10.5642/steam.20140102.15

İnstitut Jaques-Dalcroze. (2020, November 20). What is Eurhythmics?. Retrieved from: https://www.dalcroze.ch/english/what-is-eurhythmics/

Kalyoncu, N. (2006). Türkiye`de Orff-Schulwerk Uygulamaları Abant İzzet Baysal Üniversitesi Örneği, Yaratıcı Drama Dergisi. 1-2. 89-104.

Keel, J. (1969). Herbert Read on Education through Art. *Journal of Aesthetic Education, 3*(4), 47-58. doi:10.2307/3331429

Kim, O.-J. (2018). The Effects of Music Lesson Applying the Blended Learning-based STEAM Education on the Musical Knowledge and STEAM Literacy of Pre-service Kindergarten Teachers. Journal of the Korea Convergence Society.9(2). 217-227 2233-4890 (pISSN) 2713-6353 (eISSN) **https://doi.org/10.15207/JKCS.2018.9.2.217**

Kırışoğlu, O. T. (2002). Sanatta Eğitim. Ankara: Pegem Publisher.

Kritsis, K., Gkiokas, A., Acosta, C., Lamerand, Q., Piéchaud, R., Kaliakatsos-Papakostas, M.A., & Katsouros, V. (2018). A web-based 3D environment for gestural interaction with virtual music instruments as a STEAM, education tool. İn: Dahl Bowman, T. M. L. (Ed.). Proceedings of the International Conference on New Interfaces for Musical Expression, Blacksburg, Virginia, USA: Virginia Tech, 348-349.

Madden M. E., Baxter, M., Beauchamp, H. Bouchard, K. Habermas, D. Huff, M. Ladd, B. Pearon, J., & Plague, G. (2013). Rethinking STEM Education: An Interdisciplinary STEAM Curriculum, Procedia Computer Science, 20, 541-546,ISSN 1877-0509. https://doi.org/10.1016/j.procs.2013.09.316.

Mercin, L. (2018). STEAM Eğitiminde Sanatın Yeri, Inonu University *Journal of Art and Design* ISSN: 1309-9876, E-ISSN: 1309-9884

Milli Eğitim Bakanlığı. (2016). STEM Eğitim Raporu. Retrieved from http://yegitek.meb.gov.tr/STEM_Egitimi_Raporu.pdf

Milli Eğitim Bakanlığı. (2018). STEM Eğitimi Öğretmen El Kitabı. Ankara: Milli Eğitim Bakanlığı Publisher.

Milli Eğitim Bakanlığı Özel Öğretim Kurumları Genel Müdürlüğü. (2019). Kazanım Merkezli STEM Uygulamaları. Retrieved from: https://ookgm.meb.gov.tr/meb_iys_dosyalar/2019_01/29164143_STEM_KitapYk.pdf .

National Research Council. (1996). National science education standards. Washington, DC: National Academy Press.

Özmenteş, G., & Bilen, S. (2005). Dalcroze Eurhythmıcs Öğretiminin Müziksel Beceriler,

Müzik Dersine İlişkin Tutumlar ve Müzik Yeteneğine İlişkin Özgüven Üzerindeki Etkileri**.** *İnönü Üniversitesi Eğitim Fakültesi Dergisi. 6* (10). Issn: 1300-2899 / 2149-9683.

Özmenteş, G., & Adızel, F. (2017). Müzik Gelişimi ve Öğrenmede Sosyo-Kültürel *Bağlam. Eğitim ve Öğretim Araştırmaları Dergisi, 6* (1) 36. Issn: 2146-9199

Plehanov,G. V. (1987). Sanat ve Toplumsal Hayat. Çev. Selim Mimoğlu. İstanbul: Sosyal Publisher.

San, İ. (2004). Sanat ve Eğitim. Ankara: Ütopya Publisher.

Shafer, J., & Skripchuk, J. (2020). Computational Thinking in Music: A Data-Driven General Education STEAM Course. In Proceedings of the 51st ACM Technical Symposium on Computer Science Education (SIGCSE '20). Association for Computing Machinery, New York, NY, USA, 1312. DOI:https://doi.org/10.1145/3328778.3372597

Turhal, E. (2019). Sanat ve Müzik, İn (Ed.) Apaydın, Ö., Müzik Eğitimine Giriş 1. Bursa: Ekin Publisher.

Uysal, A. & Uysal, E. (2015). Sanat Eğitimi İçerisinde Görsel Sanat Kültürü Öğrenme Alanının Etkiliği, Akademik Sosyal Araştırmalar Dergisi, 3, (21) ,S. 105-123.

Üstüner, Ö. (2007). Disiplinlerarası Sanat ve Sanat Eğitimine Etkileri. Gazi Üniversitesi Eğitim Bilimleri Enstitüsü Uygulamalı Sanatlar Eğitimi Anabilim Dalı. Unpublished Master Thesis. Ankara.

Welch, G. F. (2012). The arts and humanities, technology and the 'English Baccalaureate': STEAM not STEM *Journal of Music, Technology & Education, 4* (2-3) 245-250 (6).

Yakman, G. (2010). What is the point of STE@M? - A Brief Overview. Retrieved from: http://www.steamedu.com/2006- 2010_Short_WHAT_IS_STEAM.pdf

Engineering Design Approach in 21st Century Science Education

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Introduction

In the century we live, in other words in the 21st century, the importance of qualified manpower is increasing day by day. However, the qualities expected from today' individuals are changing every day. Technological and scientific developments play a major role in this situation. Individuals that we will define as qualified people can be considered as individuals who will adapt to what the era brings. The leading countries in technology and science reform their education systems in order to raise qualified individuals who have the ability to adapt to the requirements of the age. The reason for these changes is the scientific and technological developments, to which a new one is added every day, as well as the increasing human population. On the other hand, the interest of all individuals, who live in today's society surrounded by technology, towards technology is increasing day by day. The contribution of technological innovations that are supported by new ideas and useful products to the economy of the country is gradually growing (Dugger, & Gilberti, 2007). This leads societies and individuals to professions related to engineering, science and technology. Therefore, in the 21st century, science, technology, engineering and mathematics disciplines play a key role in solving current and future problems.

21st Century Skills

21st century skills are defined by different institutions and organizations. The Partnership for 21st Century Skills (P21, 2002), established in 2002 with the support of the US Department of Education, is one of them. Its mission is to "Putting 21st century preparation at the center of US K-12 education by establishing cooperative partnerships between education, business, society and top leaders" (Kyllonen, 2012). P21 21st grouped century skills under three main themes: learning and innovation skills; information, media and technology skills; and life and career skills.

P21 also suggested that the outcomes of 21st century student can affect standards and assessment, program and teaching, professional development, and learning settings (Kyllonen, 2012). These skills are defined as the keys unlocking lifelong learning and creative work (Trilling & Fadel, 2009).

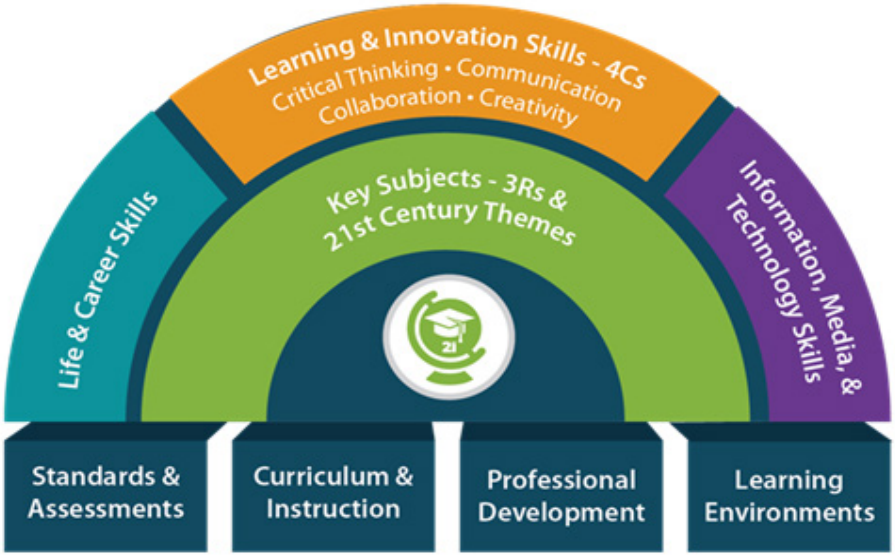

Figure 1. *The 21st Century Knowledge-and-Skills Rainbow (P21).*

Life & Career Skills

Life and career skills include flexibility, entrepreneurship, social skills, productivity, and leadership sub-themes. There is no common definition in the literature for life skills. Life skills are defined as skills that enable individuals to be successful in different environments such as school and home (Danish, Forneris, Hodge, & Heke, 2004). These skills are also defined as adaptation skills that enable individuals to cope with the problems they face in daily life (World Health Organization [WHO], 1997). As can be seen from these definitions, life skills are the skills that are desired to be gained by the individuals for living in the society. These skills are aimed to be acquired by students through education, because the individuals with life and career skills possess various skills including flexibility and harmony in both daily and business life, entrepreneurship and self-direction, productivity, leadership, responsibility, and social and intercultural skills. In this sense, flexibility and adaptability skills that every individual should gain in order to keep up with the new terms of the constantly changing world and to adapt the existing situations to the new situations are considered as indispensable skills (Trilling & Fadel, 2009). In addition, the individuals who have self-regulation capacity, who gained social communication skills, who are open to innovations, and who can take individual and group responsibilities are considered as the individuals who acquired 21st century skills, which describe the profile of the era's desired individual. For this reason, 21st century skills form the skeleton of the skills required for the individuals of our age and the future, to be able to exist in life and in the world. 21st century skills are classified in different ways by different sources. The common skills in these classifications are critical thinking, problem solving, communication, cooperation, effective use of technology,

creativity, innovation, and entrepreneurship (Beers, 2011).

Entrepreneurship is the skill that stands out among life and career skills. Although entrepreneurship seems to be a very new term, the history of this concept is very old. The concept of entrepreneurship was first used economically (Curth, 2011). This concept, which has gained importance in recent years, has reached its scope after 80's. There is no common definition for entrepreneurs and entrepreneurship accepted by everyone. Entrepreneurship is a kind of behavior that represents a combination of risk, creativity, personal success and innovation, focused on opportunities and economic resources, and also adopts financial, moral and social responsibility to create a new and profitable business idea that can contribute to solving social problems (de Lourdes Cárcamo-Solís , 2017).

The need for manpower, which has been increased with the advancements in science and technology, requires individuals to benefit from existing opportunities and express new business ideas. Providing students with entrepreneurial features should be included in school guidelines for the benefit of school and society (Adeyemo, 2009). From this point of view, science teachers play an important role in gaining entrepreneurship to students. In the science curriculum implemented in Turkey, students are first expected to identify a problem encountered in daily life, create a product and develop their engineering design skills, then to develop their entrepreneurship skills by creating marketing strategies for the product and using promotion tools (MEB, 2018).

Learning & Innovation Skills

Meeting the demands of the 21st century world, helping to build a better world, creating new knowledge and innovations are always at the center of learning and innovation skills. Learning and innovation skills consist of three sub-themes, namely critical thinking and problem solving, communication and cooperation, creativity and innovation (Trilling & Fadel, 2009).

Critical thinking, which is one of the learning and innovation skills, is a high-level thinking skill consisting of various processes such as reasoning, applying, analyzing, evaluating and creating (Hughes, 2014). Critical thinking is the mental processes that people use when solving problems, making decisions and learning new concepts (Sternberg, 1986). In critical thinking the knowledge is not used as learned, new knowledge is combined with previous knowledge, which improves learning outcomes. Critical thinking is the skill that allows problem solving by using knowledge and arguments. Considering these features of critical thinking, it can be concluded that it is related to 21st century skills. Problem solving is the ability to deal constructively with the problems we face (WHO, 1997). Problem solving is often the knowledge and skills required to effectively deal with complex situations (Funke, Fischer, & Holt, 2018). Critical thinking and problem

solving is the process of developing solutions using knowledge and arguments. These skills are integrated with 21st century skills.

Another skill included in the learning and innovation skills is communication and collaboration. Communication has been defined as expressing emotions, thoughts and ideas by effectively using verbal and non-verbal communication types with different methods and under different conditions (Trilling & Fadel, 2009). Communication cannot be considered apart from education because all learning and teaching activities are intertwined with communication. The social skills of the people who are successful in communication are also strong and they are also successful in teamwork, respectful to listening and thinking, sensitive and open to sharing. Cooperation, on the other hand, can be defined as the partnership that individuals create in line with their benefits and interests. In short, new ideas arising from personal differences lead to creativity and innovation.

Regarding the time period from past to present, imagination and creativity played an important role in the development of science and technology. Creativity, which play an important role on scientists' work, is defined as the process of producing new ideas and products (Isbell & Raines, 2003) using the acquired knowledge and skills. Creativity and innovation, which are among the learning and innovation skills, constitute learning environments that encourage inquiry, openness to new ideas, self-confidence and learning from errors and failures (Trilling & Fadel, 2009). Individuals who have creativity skill are expected to be productive, innovative, to produce comprehensive ideas and to have high-level thinking skills. These individuals are open to innovations, they are not stuck in stereotypes.

Information, Media, & Technology Skills

Information, media and technology skills include information literacy, media literacy, ICT (Information, Communication and Technology) literacy. The individuals who have information literacy, media literacy and ICT literacy skills are thought to be able to acquire 21st century technology skills. In this sense, the concept of literacy should be perceived as having the skills that people can continue their lives by working in a technological world and being able to acquire technology-based skills (Panel, 2002).

The prominent 21st century skills such as adaptation, entrepreneurship, productivity, creativity, innovation, critical thinking, problem solving, communication, collaboration, information, media and technologies are also among the skills that are effective in STEM education and engineering design process. These skills required for life and work are considered to be related to STEM integration and engineering design process to produce target and need-oriented new knowledge, new services and new products, briefly for discoveries and inventions.

Science, Technology, Engineering and Mathematics Education (STEM)

With globalization, the leadership race between countries is increasing rapidly every day in many fields such as health, technology, science, art and industry. The competition of the countries in all these fields requires that they do not fall behind in the areas such as technology and science. In order not to be the last in this race, countries have reformed their education policies. STEM, which is an interdisciplinary approach in raising individuals who will reflect the change, is included in the educational objectives of many countries. Many countries, especially United States (USA), Japan, Korea, China, have started STEM practices in education to create an innovative society. In many countries, the inclusion of these applications that are based on the integration of these four disciplines in the education program necessitates to make reforms in teacher training education, which plays a key role in the training of future architects.

Although the concept of STEM emerged in the late 19th century, its foundations go back much earlier (Ostler, 2012). It was first used by Judith A. Ramaley in the 1990s (Bybee, 2013; Sanders, 2009). In the literature, there is no common definition about STEM. The National Research Council (1996) defined STEM as a teaching and learning approach. Lantz (2009) stated that these four disciplines are expressed as a meta-discipline and it is a body in which these disciplines are integrated. Gillies (2015) categorized STEM in two dimensions: education and business. Here, the dimension of education is formed by the fields of science and mathematics, whereas the dimension of business is formed by engineering, technology, career, and economic growth.

STEM education can be expressed as the understanding of the world we live in by the integration of the subjects across science, technology, engineering and mathematics disciplines (Dugger 2010). In addition, compared to the traditional education approach STEM education is an approach mostly based on research, project, student-centered and collaborative learning (Breiner, Johnson, Harkness, & Koehler, 2012; Israel, Maynard, & Willamson, 2013).

STEM education has been implemented at all levels of education in many countries such as USA, European Union countries, Japan, Korea, Germany and China. STEM education aims to increase students' orientation towards STEM fields at the university and to provide solutions to the problems they encounter in daily life based on science, mathematics, engineering and technology knowledge (Thomasian, 2011). In addition, STEM education aims to improve students' ability to compete in the economy and develop STEM literacy (Ejiwale, 2013). The training of individuals who are competent in the field of STEM, STEM literate and adapted to the professions of the future is important for the development of the national economy.

Engineering Design Process

The integration of all disciplines included in STEM education approach is not possible due to the current structure of schools and education programs (Bybee, 2010; NRC, 2012). Therefore, it seems likely to implement STEM activities by integrating technology and engineering into the curriculum of science and mathematics courses (Bybee, 2010). Another integration is to provide engineering education by integrating engineering into science, technology and mathematics through appropriate activities. The most appropriate way to achieve this is to carry out the activities within the scope of the engineering design process (Felix, Bandstra, & Strosnider, 2010). The engineering process is defined as making the knowledge suitable for others by using it to create new things (Brophy, Klein, Portsmore & Rogers, 2008). Designs are the way that engineers use to solve engineering problems. Design is considered as a recurring process carried out within predetermined constraints to develop products or systems meeting human needs and desires. Design typically includes components such as problem definition, data analysis, modeling, and solution development, and can have both technological and social components (Daugherty, 2012).

Steps of the Design Process

The engineering design process is more than an applied science and includes a recurring process to turn problems into solutions (NGSS Lead States, 2013). Engineering design process is a problem-solving method that uses the knowledge coming from different disciplines to produce a solution for the described problem through a non-linear process. This process is carried out by using the knowledge coming from many fields, including mathematics and science, in a cyclic process to produce solutions for technological problems, thus creating and developing solutions that answer the problem or need.

Regarding the steps of the design process, different cycles were created by the researchers. Tayal (2013) specified the steps in this process as identifying the problem, conducting research, determining the needs, selecting solutions, development, constructing the prototype, test and redesign. These steps are similar to those of Hynes et al., (2011) and Mangold & Robinson, (2013).

On the other hand, there are also researchers who express these steps shortly (Brunsell, 2012; NRC, 2012; Wendell et al, 2010). In the classification of Mentzer (2011), these steps are defined as identifying the problem, solutions, analysis/modeling, experimenting, decision making, and teamwork. In a program developed for elementary school students (Engineering is Elementary [EiE], 2013), these steps were described as “ask, imagine, plan, create, develop” cycle. The review of the studies revealed the differences in terms of suitability for student level and staging.

All these processes have common steps such as the identification of the problem, revealing possible solutions, analyzing and evaluating the solutions, and redesigning if necessary (Brunsel, 2012). In the studies involving the steps of the design process, the most comprehensive staging was performed by Hynes, et al. (2011). They used an engineering design process that includes various steps such as identifying the problem, developing solutions, constructing a prototype, evaluating the solution, redesigning, and completing the decision (Figure 1.).

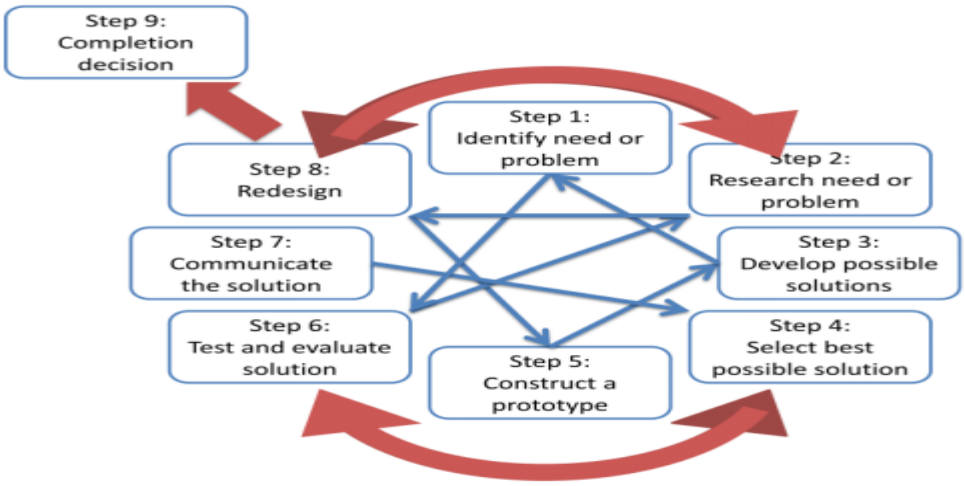

Figure 1. Engineering Design Process (Hynes et al., 2011)

Identifying the Problem: It is seen as the first and most important step of the design process. At this stage, engineers try to identify the criteria and restrictions of the product or need through questions to better define the problem (Brunsell, 2012). In educational process, this step enables students to use their critical thinking skills and to handle identified problems.

Specifying the Needs for the Problem: It is the stage where the students discover that there are alternative solutions instead of solving the problem with the first obvious solution. In this step, students start to analyze the need or the problem and redefine it accordingly. Thus, it will be possible to discover new paths and prepare the ground for the successful continuation of the process on these new paths.

Developing Possible Solutions: At this stage, brainstorming takes place to produce multiple solutions, thus contributing to the creativity of the students. This step is also considered as the stage where the creativity of students is at the maximum level (Hynes et al., 2011).

Choosing the Best Solution: This stage involves the selection of the most suitable solution by evaluating the ideas discovered by the students in problem identification and research stages, in accordance with the criteria and restrictions.

Construction of a Prototype: The prototype can be defined as a representation or physical model of the decided solution. It can also be a virtual or mathematical model (Hynes et

al., 2011). At this stage, individuals design prototypes to visualize, present, and show the details of their solution and improve the design (Tayal, 2013).

Testing and Evaluating the Solution: At this stage, students perform testing operations according to the specified criteria and restrictions in order to evaluate whether their prototypes are successful. In this way, they find out the methods and tools that can define the requirements well. However, if necessary, they can go back to the identification of the needs stage and handle the process more confidently.

Presenting the Solution: At this stage of the engineering design process, the ideas and findings about the solutions are shared with the others for feedback. Solutions can be shown through written documents or presentations, which include performances, topics, limitations and restrictions (Hynes et al., 2011). At this stage students have also the opportunity to revise their works based on the feedback given at the end of the presentation.

Redesign/Revision: At this stage, the strengths and weaknesses of the design are identified after presenting the solution. It is the stage where prototype development, tests and evaluations continue until a final product that meets all requirements and criteria is produced.

Completion of the Decision: It is the stage when students decide that the design needs are sufficiently satisfied and they are ready to implement their prototypes as the final product (Gentilli et al., 1999).

Design Based Science Education

These steps of engineering education have been used in science education in recent years, especially with the inclusion of STEM education into the curriculums. The integration of science education with other disciplines (mathematics, engineering and technology) is carried out based on engineering design problems (Wendell et al, 2010). The realization of the learning in science education through engineering design problems is named as design-based science education in the literature (Mehalik, Doppelt, & Schunn, 2008; Wendell et al, 2010). De Vries (1996) suggested that students should be helped to integrate the knowledge they have acquired into their design processes.

One objective of design-based learning (DBL) is providing students with a variety of opportunities to integrate what they have learned in the classroom into real life situations (Ryan, Camp, & Crismond, 2001). First, it motivates students to learn by applying their knowledge into real life situations, since a good design should meet existing and real needs (Doppelt, 2003). Second, design-based learning has all the features of active learning since it is active (Doppelt, Mehalik, Schunn, Silk, & Krysinski, 2008). Third,

design-based learning is typically a team activity and therefore includes the characteristics of cooperative learning. A learning environment that allows cooperative learning also improves students' communication and problem-solving skills (Doppelt, 2004; 2006). Design-based learning is a versatile process that motivates learning, supports active and collaborative learning, and improves students' communication and problem-solving skills. Many US teachers lack design skills (Ritz & Reed, 2006) and this is not very different in Turkey. Thus, before developing students' design skills, a large number of works are needed to improve the design skills of teachers.

Literature Review

21st Century Skills

In the literature, there are studies related to 21st century skills conducted with teachers, students and academicians. In a study by Shidiq and Yamtinah (2019), teachers have shown positive attitude towards 21st century skills, but their working approach lacked communication and collaboration skills. In the study aiming to identify the methods implemented in the curriculums to give 21st century skills to the students, Sweet (2014) found that project-based method is the most used teaching method. Dibenedetto (2015) investigated the professional competencies of teachers for the skills and attitudes that high school students need for specifying their careers in the 21st century. This study revealed that career and technical education teachers have a higher perception level and sense of responsibility than other teachers.

The study conducted by Amran, Perkasa, Satriawan, Jasin, & Irwansyah (2019), showed that students' 21st century attitude (critical thinking, cooperation, communication and creative thinking) can be categorized as low, whereas their environmental awareness can be categorized as sufficient. The learning model that teachers use in teaching was considered as the reason of students' low skill level and it was thought that this could be prevented by designing a course for improving 21st century skills. In addition, there is a study in the literature examining undergraduate students' entrepreneurship experiences, which is one of the 21st century skills (Ghafar, 2020). In this study, the themes such as 21st century skills, creativity, leadership, entrepreneurial values, experiential learning and entrepreneurial education were used to develop an interview guide. At the end of the study, the entrepreneurship training was observed to develop some 21st century skills such as social relations, leadership, creativity and critical thinking, and in this case, it was observed to further strengthen students' entrepreneurial intentions. Hence, this study revealed that entrepreneurship training offers various ways to further improve the integration of 21st century skills.

Boe (2013) applied the 21st century skills inventory to the students and academicians at the university and reported that; participants agreed that technology skills should be

used as a tool, they adapted them without much difference, and students showed more participation in critical thinking and self-control skills (Boe, 2013).

STEM Education

Regarding the studies about STEM, there are studies conducted with teachers, preservice teachers and students. In the study by Geng Jong and Chai (2019), it was concluded that teachers do not find themselves ready for STEM and they have concerns about "knowledge", "management" and "outcome" regarding the implementation of STEM education in schools. Jho, Hong and Song (2016) examined the achievement conditions for STEM teacher education and practice. As a result of this study, it was found that for teachers to gain competence for STEM education a free working environment should be created and common goals should be set through interdisciplinary studies. Pinnell, et al. (2013) conducted workshops and activities about the effects of STEM education on the knowledge and skills of teachers and preservice teachers. During the trainings, they worked with a faculty member from the engineering faculty, an engineer working in the industry and an engineer candidate studying at the engineering faculty. As a result of the research, design and engineering-based STEM education practices were found to improve leadership skills and perceptions about teaching competencies.

In their study Siverling and Suazo-Flores (2019) concluded that while students justify their engineering design ideas and solutions in engineering design-based STEM integration units, they integrate the content from all four STEM disciplines and thus support engineering design-based STEM integration as a curriculum model. Saleh (2016) investigated the effect of STEM education on students' problem-solving skills levels and attitudes towards STEM education. In the study, a STEM program was designed and applied to students. As a result of the study, it was concluded that STEM education increased students' problem-solving skills and attitudes. Brown, Concannon, Marx, Donaldson and Black (2016) analyzed STEM approach-based teaching according to various variables. As a result of the research, significant differences were found between the gender and beliefs, perceptions and interest towards STEM. Dass (2015) examined the effects of STEM practices and full learning on students. In addition, he analyzed students' attitude towards STEM, interest in science, inquisitive thinking skills, and the change of academic achievement. As a result of the research, STEM applications and full learning were found to have a positive effect on interest in science and academic achievement. However, he concluded that STEM practices and full learning had no effect on the attitude towards STEM and the development of inquisitive thinking skills towards science.

Another study with preservice teachers (Ring, 2017) has investigated how the concepts about STEM education integrated into the lessons of pre-service teachers are effective in

the implementation of STEM programs.

Unlike other studies, Hasanah and Tsutaoka (2019) aimed to identify and classify the barriers in front of the Science, Technology, Engineering and Mathematics (STEM) Education worldwide. In STEM education, the intrinsic barrier arises from the personality of the teacher and the student, while the extrinsic barrier mainly arises from the inadequate and/or improper arrangement of the infrastructure. Institutional barriers are concluded to be the curriculum, policy, technology and organizational feeding in the field of education.

Design Based Learning (DBL)

Some researchers have noted the advantages of design-based learning (DBL) as a tool to increase motivation, develop high-level cognitive skills and develop personal and interpersonal traits (Doppelt, 2003). There are many studies showing interesting findings regarding the advantages of DBL.

There are various studies in the literature on the decision making and problem-solving skills of design-based learning (Fortus, Krajcik, Dershimer, Marx, & Mamlok-Naaman, 2005). Moreover, there are studies in the literature that examine the relationship between perception towards problem-solving skills and decision-making attitudes, which are considered important in the design process (Seckin-Kapucu & Karakaya-Ozyer, 2019). There are also many experimental studies in the literature that examine the effect of design-based learning on students' academic achievement in science education (Doppelt, 2003; Doppelt, Mehalik, Schunn, Silk & Krysinski, 2008; Mehalik, Doppelt, & Schunn, 2008; Schnittka & Bell, 2011).

The studies conducted with students have shown that they can successfully participate in engineering design (Wendel, 2011). King and English (2016) tried to encourage students for engineering applications by combining real-life problems with engineering design applications. There are many studies in which students experienced engineering design applications and developed products as a result of these experiences (Lamb, Akmal, & Petrie, 2015; Wendell & Rogers, 2013).

There are many studies in which the engineering design process is integrated into science courses (Apedoe et al., 2008; Schnittka & Bell, 2011). In their study, Schnittka and Bell (2011) performed engineering design activities involving heat transfer and thermal energy subjects with secondary school students. In their research, Apedoe et al. (2008) used the engineering design process in the eight-week Warming-Cooling Systems unit in order to create a guide that combines design-based learning with science subjects, to teach difficult chemistry concepts and to increase interest in engineering career. Roth (2001) combined the design activities that students will carry out on simple machines

subject with engineering applications and identified the product design stages to be carried out.

There are also studies in which engineering design process is integrated into science education, focusing on design development with students (Sadler, Coyle, & Schwartz, 2000; Ellefson, Brinker, Vernacchio, & Schunn, 2008). In their study, Sadler, Coyle and Schwartz (2000) asked students to improve the prototypes offered to them. Ellefson, Brinker, Vernacchio and Schunn (2008) used design-based learning to teach the topic of "gene transfer" in their research.

The review of the studies conducted with teachers showed that they attempted to improve teachers' understanding of engineering design process (Felix, Bandstra, & Strosnider, 2010; Hynes, 2012), the opinions of science teachers about engineering applications were collected in science lessons (Capobianco, 2011; Cuijick, et al., 2009), and teachers' perceptions towards engineering education were identified (Hsu et al., 2011)

Regarding the studies conducted with preservice teachers, they mostly provided vocational training on engineering design process (Dailey et al., 2018) and aimed to reveal what they learned about engineering design-based science teaching (Culver, 2012). The trainings about engineering applications to be given to teachers and preservice teachers in-service or during undergraduate programs are important for better implementation of the engineering process in schools and for the students to acquire the skills required in the engineering design process. Further studies should be conducted after giving these trainings to the teachers and preservice teachers.

Conclusion

Rapidly changing world conditions brought some skills required to support individuals' success in daily and business life. In our age, these skills stand out as 21st century skills. 21st century skills put the school courses to the core and build life and career skills, learning and innovation skills, and information, media and technology skills on them (Trilling & Fadel, 2009). The sub-skills of these 21st century skills include entrepreneurship, productivity, responsibility, creativity, innovation, critical thinking and problem solving, communication, cooperation, and technology literacy skills. These skills are among the skills that are effective in STEM education and engineering design process.

STEM which has emerged in the United States (USA) in 1990, has been implemented in many countries. STEM is included in the education systems of many countries in the world that care about technology and aim to progress in innovation. STEM acts as a bridge in the passage of the children, who will build the future, from education to business (Gomez & Albrecht, 2014).

STEM was defined as a teaching and learning approach that integrates the content and

skills included in science, technology, engineering and mathematics disciplines (NRC, 1996). Compared to traditional education approaches, this approach appears as an active process that pushes students to research, solving problems by combining them with daily life, decision making, critical thinking, taking responsibility, and project-based learning. The objective of the integration of the disciplines mentioned in this approach is that students understand the world we live in. Another objective is to gain the ability to make products that will provide economic development through the competence in STEM fields. Engineering is one of the areas that will ensure this. STEM education can be provided by integrating engineering into science, technology and mathematics fields through appropriate activities. The most effective way of this integration is to handle the activities within the scope of the engineering design process. Design is the process where engineers solve engineering problems. The design process is similar to problem-solving and includes identifying the problem and specifying the need, collecting information, bringing alternative solutions to the problem, selecting the most appropriate solution, designing and creating a prototype, and evaluation stages (Doppelt, et al., 2008).

The field-specific skills mentioned in science curriculum implemented in Turkey and updated in 2018, include life skills and engineering design skills. Life skills include basic skills that individuals need in their daily lives (analytical thinking, decision-making, creative thinking, entrepreneurship, communication and teamwork). Engineering and design skills include innovative thinking skills that enable students to create a new product by making inventions and innovations. At the same time, engineering practices are integrated into all grade of the science curriculum starting from the 4th grade.

Engineering design skills are considered as a product creation process by integrating science, mathematics, technology and engineering disciplines, and using individuals' knowledge and skills from an interdisciplinary perspective. In order to reach knowledge in this process, life skills such as decision making, entrepreneurship and teamwork should be gained. Depending on the acquisition of these skills, a purposeful product is created. On the other hand, it is seen that entrepreneurship become a part of the efforts when a value can be assigned to the created products by developing strategies.

The inclusion of engineering in the K-12 Science Education and Next Generation Science Standards Framework (NGSS) creates new requirements for science teacher education (National Research Council [NRC], 2012). On the other hand, very few teachers can experience engineering or "engineering design" in their schools, and many afraid of transfering these processes to their students, especially at primary school level (Cunningham & Carlsen, 2014).

Teachers are expected to direct their students to product development, invention and innovation by considering their potential as well. However, the review of the teacher

training programs in our country revealed that there is no course for teaching 21st century skills such as STEM, engineering practices, entrepreneurship, life skills. In this sense, training programs should be strengthened in order to gain the mentioned skills, and the necessary trainings on how these skills can be given to students should be provided to both teachers and preservice teachers. Accordingly, efficiency will be be ensured in education and at the same time the individuals who may meet the needs of the country and the economy can be raised. At the same time, it is thought that this may contribute to the future generations and will provide a basis for them to take part in the education system that has a strong infrastructure. In this way, it is envisaged that well-supported individuals, both individually and socially, can be trained for today and the future.

References

Adeyemo, S. A. (2009). Understanding and acquisition of entre preneurial skills: A pedagogical re-orientation for classroom teacher in science education, *Journal of Turkish Science Education, 6*(3), 57-65.

Amran, A., Perkasa, M., Satriawan, M., Jasin, I., & Irwansyah, M. (2019, February). Assessing students 21st century attitude and environmental awareness: promoting education for sustainable development through science education. In *Journal of Physics: Conference Series* (Vol. 1157, No. 2, p. 022025). IOP Publishing.

Apedoe, X. S., Reynolds, B., Ellefson, M. R. & Schunn, C. D. (2008). Bringing engineering design into high school science classrooms: The heating/cooling unit. *Journal of Science Education and Technology, 17*(5), 454-465.

Beers, S. (2011). 21st century skills: Preparing students for their future. Retrived from https://cosee.umaine.edu/files/coseeos/21st_century_skills.pdf.

Boe, C. S. (2013). Have 21st century skills made their way to the university classroom? A study to examine the extent to which 21st century skills are being ıncorporated into the academic programs at a small, private, Church-Related University, Gardner-Webb University.

Breiner, J. M., Harkness, S. S., Johnson, C. C., & Koehler, C. M. (2012). What is STEM? A discussion about conceptions of STEM in education and partnerships. *School Science and Mathematics*, *112*(1), 3-11.

Brown, P.L., Concannon, J. P., Marx, D., Donaldson, C. W., & Black, A. (2016). An examination of middle school students' STEM self-efficacy with relation to interest and perceptions of STEM. *Journal of STEM Education: Innovations and Research*, *17*(3), 27-38.

Brunsell, E. (2012) The engineering design process. In E. Brunsell (Ed), *Integrating*

engineering + science in your classroom (3-5). Arlington, Virginia: National Science Teacher Association Press.

Bybee, R. W. (2010). Advancing STEM education: A 2020 vision. *Technology and Engineering Teacher*, *70*(1), 30-35.

Bybee, R. W. (2013). *The case for STEM education: challenges and opportunities.* Arlington, Virginia: NSTA Press.

Capobianco, B. M. (2011). Exploring a science teacher's uncertainty with integrating engineering design: an action research study. *Journal of Science Teacher Education, 22*, 645-660.

Crayton, J. E. (2011). STEM art education movement a creative approach to education in innovation for the 21st Century. Retrived from http://janedapain.net/files/STEM_Art_Education_Movement_crayton.pdf.

Culver, D. E. (2012). *A qualitative assessment of preservice elementary teachers' formative perceptions regarding engineering and K-12 engineering education.* Master's Thesis, Iowa State University, Iowa.

Cunningham, C., & Carlsen,W. S. (2014). Teaching engineering practices. *Journal of Science Teacher Education*, *25*(2), 197–210.

Curth, A. (2011). Mapping of teachers' preparation for entrepreneurship education. *Final Report, Framework Contract No EAC*, *19*(6).

Dailey, D., Jackson, N., Cotabish, A., & Trumble, J. (2018). STEMulate engineering academy: Engaging students and teachers in engineering practices. *Roeper Review*, *40*(2), 97-107.

Danish, S. J., Forneris, T., Hodge, K., & Heke, I. (2004). Enhancing youth development through sport. *World Leisure Journal*, *46*(3), 38-49.

Dass, P.M. (2015). Teaching STEM effectively with the learning cycle approach. *K- 12 STEM Education*, *1*(1), 5-12.

Daugherty, J. (2012). Infusing engineering concepts: Teaching engineering design. Retrieved from ERIC database.

De Vries, M. J. (1996). Technology education: Beyond the "technology is applied science" paradigm. *Journal of Technology Education*, *8*(1), 7–15.

Dibenedetto, C.A. (2015). Teachers perceptions of their proficiency and responsibility to teach the knowledge, skills, and dispositions required of high school students

to be career ready in the 21st century, Florida University, ProQuest Dissertations Publishing.

Doppelt, Y. (2003). Implementing and assessing project-based learning in a flexible environment. *International Journal of Technology and Design Education*, 13, 255–272.

Doppelt, Y. (2004). Impact of science-technology learning environment characteristics on learning outcomes: Pupils' perceptions and gender differences. *Learning Environments Research*, *7*(3), 271–293.

Doppelt, Y. (2006). Teachers' and pupils' perceptions of science–technology learning environments, *Learning Environment Research*, 9 (2), 163-178.

Doppelt, Y., Mehalik, M. M., Schunn, C. D., Silk, E., & Krysinski, D. (2008). Engagement and achievements: A case study of design-based learning in a science context. *Journal of Technology Education, 19*(2), 22-39.

Dugger, W. E. (2010, December). Evolution of STEM in the United States. In *6th Biennial International Conference on Technology Education Research in Australia.* Retrieved from *http://www. iteea. org/Resources/PressRoom/AustraliaPaper. pdf*..

Dugger, W. E., & Gilberti, A. F. (2007). Standards for technological literacy: Content for the study of technology. Virginia: International Technology Education Association (ITEA).

EIE (Engineering is Elementary) (2013). Engineering Design Process. Museum of Science. Retrived from https://www.eie.org/overview/engineering-design-process.

Ejiwale, J. A. (2013). Barriers to successful implementation of STEM education. *Journal of Education and Learning, 7*(2), 63-74.

Ellefson, M. R., Brinker, R. A., Vernacchio, V. J., & Schunn, C. D. (2008). Design-based learning for biology. *Biochemistry and Molecular Biology Education, 36*(4), 292-298.

Felix, A. L., Bandstra, J. Z., & Strosnider, W. H. J. (2010, March). *Design-Based science for STEM student recruitment and teacher professional development.* Mid Atlantic American Society for Engineering Education Conference. Philadelphia.

Fortus, D., Krajcik, J., Dershimer, R. C., Marx, R. W., & Mamlok-Naaman, R. (2005). Design-based science and real-world problem-solving. *International Journal of Science Education*, 27(7), 855-879.

Funke, J., Fischer, A., Holt, D. V. (2018). Competencies for complexity: Problem solving

in the 21st century. In Care, E., Griffin, P., Wilson, M. (Eds.), Assessment and teaching of 21st century skills: Research and applications (pp. 41–53). Dordrecht, the Netherlands: Springer.

Geng, J., Jong, M. S. Y., & Chai, C. S. (2019). Hong Kong teachers' self-efficacy and concerns about STEM education. *The Asia-Pacific Education Researcher*, *28*(1), 35-45.

Ghafar, A. (2020). Convergence between 21st Century Skills and Entrepreneurship Education in Higher Education Institutes. *International Journal of Higher Education*, *9*(1), 218-229.

Gillies, A. (2015). Whereare the 'T' and 'E' in STEM education. *Techniques, 90*(4), 60-61.

Gomez, A., & Albrecht, B. (2014). True STEM education. *Technology and Engineering Teacher, 73*(4),8-16.

Hasanah, U., & Tsutaoka, T. (2019). An outline of worldwide barriers in science, technology, engineering and mathematics (STEM) education. *Jurnal Pendidikan IPA Indonesia*, *8*(2), 193-200.

Hsu, M. C., Purzer S. & Cardella M. E., (2011). Elementary teachers' views about teaching design, engineering and technology. *Journal of Pre-College Engineering Education Research, 1*(2),31–39.

Hughes, C. (2014). Theory of knowledge aims, objectives and assessment criteria: An analysis of critical thinking descriptors. *Journal of Research in International Education*, *13*(1), 30-45.

Hynes, M., Portsmore, M., Dare, E., Milto, E., Rogers, C., Hammer, D., & Carberry, A. (2011). Infusing engineering design into high school STEM courses. National Center for Engineering and Technology Education. https://digitalcommons.usu.edu/ncete_publications/165

Hynes, M. M. (2012). Middle-school teachers' understanding and teaching of the engineering design process: A look at subject matter and pedagogical content knowledge. *International Journal of Technology and Design Education*, *22*(3), 345-360.

Isbell, R. T., & Raines S. C. (2003). *Creativity and the arts with young children*. Canada: Thomson Delmar Learning Printed.

Israel, M., Maynard, K., & Williamson, P. (2013). Promoting literacy-embedded,

authentic STEM instruction for students with disabilities and other struggling learners. *Teaching Exceptional Children*, *45*(4), 18-25.

Jho, H., Hong, O., & Song, J. (2016). An analysis of STEM/STEAM teacher education ın korea with a case study of two schools from a community of practice perspective. *Eurasia Journal of Mathematics, Science & Technology Education*, *12*(7), 1843-1862.

King, D., & English, L. D. (2016). Engineering design in the primary school: Applying STEM concepts to build an optical instrument. *International Journal of Science Education*, *38*(18), 2762-2794.

Lamb, R., Akmal, T., & Petrie, K. (2015). Development of a cognitionpriming model describing learning in a STEM classroom. *Journal of Research in Science Teaching*, *52*(3), 410-437.

Lantz, H. B. (2009). Science, technology, engineering and mathematics (STEM) education what from? What function? Retrived from https://dornsife.usc.edu/assets/sites/1/docs/jep/STEMEducationArticle.pdf.

Mangold, J., Robinson, S., 2013. The engineering design process as a problem solving and learning tool in K-12 classrooms. Paper presented at 2013 ASEE Annual Conference & amp; Exposition, Atlanta, Georgia.

Mehalik, M. M., Doppelt, Y., & Schunn, D. C. (2008). Middle-school science through design-based learning versus scripted inquiry: Better overall science concept learning and equity gap reduction. *Journal of Engineering Education, 97*(1), 71–85.

Mentzer, N. (2011). High school engineering and technology education integration through design challenges. Journal of STEM Teacher Education, 48(2), 103-136.

Miaoulis, I. (2009). Engineering the K-12 curriculum for technological innovation. *IEEE-USA Today's Engineer Online.* Retrived from http://www.todaysengineer.org/2009/Jun/K-12-curriculum.asp.

Ministry of National Education (MEB). (2018). *Fen Bilimleri Dersi Öğretim Programı (İlkokul ve Ortaokul 3, 4, 5, 6, 7 ve 8. Sınıflar*). [*Science Education Curriculum*], Ankara: Millî Eğitim Bakanlığı Yayınları.

National Research Council [NRC]. (1996). *National science education standards.* Washington, DC: National Academy Press.

National Research Council [NRC]. (2012). *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas*. Washington, DC: The National

Academies Press. https://doi.org/10.17226/13165.

NGSS Lead States. (2013). *Next Generation Science Standards: For states, by states*. Washington, DC: The National Academies Press.

Ostler, E. (2012). 21st century STEM education: A tactical model forlong-rangesuccess. *International Journal of Applied Science and Technology*, 2(1), 28-33.

Panel, I. L. (2002). *Digital transformation: A framework for ICT literacy*. Educational Testing Service.

Partnership for 21st Century Skills (P21). (2002) Learning for the 21st century. A report and a mile guide for 21st century skills. Retrieved from http://www.p21.org/images/stories/otherdocs/p21up_Report.pdf.

Pinnell, M., Rowley, J., Preiss, S., Franco, S., Blust, R. ve Beach, R. (2013). Bridging The Gap between engineering design and PK-12 curriculum development through the use of the STEM education quality framework. *Journal of STEM Education*, *14*(4), 28-35.

Ring, E. (2017). Teacher conceptions of integrated STEM education and how they are reflected in integrated STEM curriculum writing and classroom implementation (Doktora tezi). Unıversıty of Minnesota.

Ring, E. (2017). Teacher conceptions of integrated STEM education and how they are reflected in integrated STEM curriculum writing and classroom implementation. Retrieved from the University of Minnesota Digital Conservancy, http://hdl.handle.net/11299/188899.

Ritz, J., & Reed, P. (2006). Technology education and the influence of research: A United States perspective, 1985–2005. In M. J. de Vries & I. Mottier (Eds.), *International handbook of technology education: Reviewing the past twenty years* (pp. 113–124). Rotterdam: Sense Publishers.

Ryan, M., Camp, P., & Crismond, D. (2001). Design rules of thumb – connecting science and design. *Meetings of the American Educational Research Association*, Seattle, WA

Sadler, P. M., Coyle, H. P. & Schwartz, M. (2000). Engineering competitions in the middle school classroom: Key elements in developing effective design challenges. *The Journal of the Learning Sciences, 9,* 299–327.

Saleh, A.H. (2016). A Proposed unit in the light of STEM approach and its effect on

developing attitudes toward (STEM) and problem solving skills for primary students. *International Interdisciplinary Journal of Education*, *5*(7),186- 217.

Sanders, M. (2009). STEM, STEM education, STEMmania. *The Technology Teacher, 68*(4), 20- 26.

Schnittka, C. & Bell, R. (2011). Engineering design and conceptual change in science: Addressing thermal energy and heat transfer in eighth grade. *International Journal of Science Education, 33(13),* 1861-1887.

Seckin-Kapucu, M. & Karakaya-Ozyer, K. (2019). Secondary school studensts' selfassessment of design process: A study on scale development and prediction by various variables. International Online Journal of Educational Sciences, 11 (4), 296-310.

Shidiq, A. S., & Yamtinah, S. (2019, February). Pre-service chemistry teachers' attitudes and attributes toward the twenty-first century skills. In *Journal of Physics: Conference Series* (Vol. 1157, No. 4, p. 042014). IOP Publishing.

Siverling, E. A., Suazo-Flores, E., Mathis, C. A., & Moore, T. J. (2019). Students' use of STEM content in design justifications during engineering design-based STEM integration. *School Science and Mathematics*, *119*(8), 457-474.

Sternberg, R. J. (1986). *Critical thinking: Its nature, measurement, and improvement*. Washington, DC: National Institute of Education.

Sweet, D. (2014) Strategies california superintendents use to ımplement 21st century skills programs, university of southern California, California. Retrieved from http://digitallibrary.usc.edu/cdm/ref/collection/p15799coll3/id/408457

Tayal, S. P. (2013). Engineering design process. *International Journal of Computer Science and Communication Engineering*, *18*(2), 1-5.

Thomasian, J. (2011). Building a science, technology, engineering, and math education agenda: An update of state actions. Washington, DC: National Governors Association, Center for Best Practices. Retrieved from https://files.eric.ed.gov/fulltext/ED532528.pdf.

Trilling, B. & Fadel, C. (2009). *21st century skills: Learning for life in ourtimes*. San Francisco: John Wiley & Sons.

Wendell, K. B., Connolly, K. G., Wright, C. G., Jarvin, L., Rogers, C., Barnett, M., & Marulcu, I. (2010). Incorporating engineering design into elementary school science curricula. American Society for Engineering Education Annual Conference

& Exposition, Louisville, KY.

Wendell, K. B., ve Rogers, C. (2013). Engineering design-based science, science content performance, and science attitudes in elementary school. *Journal of Engineering Education*, *102*(4), 513-540.

WHO (World Health Organization). (1997). Life skills education for children and adolescents in schools. *Introduction and guidelines to facilitate the development and implementation of life skills programs.* Geneva, Switzerland: World Health Organization..

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