E-DYS-LEARN: Improving Teaching Competency of Pre-Service Primary School Teachers on Learning Disabilities

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LECTURERS HANDBOOK

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PART 1: LEARNING DISABILITIES

CHAPTER 1: LEARNING DISABILITIES: DEFINITIONS, CLASSIFICATION, THEORIES

1. CONCEPTS; DIFFERENT UNDERSTANDING

1.1. DEFINITIONS

Over the years, different scientists, groups of scientists, organizations and institutions have given different definitions of what constitute learning disabilities and what learning difficulties are. There are many common features between these definitions, but also some differences. There are also differences of opinion as to whether a distinction should be made between these two concepts or whether they are interchangeable. The understanding and use of the concepts is different in the different countries (and respectively the accepted definitions and classifications); even in countries where the same language is spoken (e.g. USA, UK, Australia). Below are some of the most commonly used definitions, as well as the definitions adopted in the project partner countries.

1.1.1. NJCLD (National Joint Committee on Learning Disabilities)

In the United States, there is an organization known as the NJCLD (National Joint Committee on Learning Disabilities), which brings together representatives of various organizations involved in the education and welfare of people with learning disabilities. According to the definition adopted by the NJCLD, the concept of “learning disabilities” is an indicator of a significant discrepancy between the child's obvious ability to learn and the results achieved. Several criteria have been identified to define a difficulty as a learning disorder. One of these criteria is the presence of dysfunction in the central nervous system. However, this contradicts the fact that many people with central nervous system disorders (e.g. cerebral palsy) do not have learning disabilities. The NJCLD notes that learning difficulties may be accompanied by disabilities of different nature, but there is no direct link between them. Therefore, the specialists conducting the investigation and assessment of learning disorders should be especially careful and precise.(NJCLD, 1987)

1.1.2. LD Roundtable (2002)

In 2002, a Round Table on Learning Disorders (LD Roundtable) was held with the participation of ten of the leading organizations in this field. After discussions the following definition of learning disorders and in particular specific learning difficulties was formulated: Group of disorders affecting learning and cognition. They are considered specific in the sense that each of these disorders has a significant impact on a relatively limited aspect of the learning process and the learning outcomes. Specific learning disabilities may exist in combination with other disorders (e.g. intellectual disabilities, behavioural disorders, lack of learning opportunities or primary sensory deficits), but they are not a consequence of these concomitant deficits.(Reschly, D.J.; Hosp, J.L.; Schmied, C.M., 2003; Bradley, R.; Danielson, L.C.; Hallahan, D.P., 2002)

1.1.3. DSM-5 (American Psychiatrist Association)

The issue of determining learning disabilities has caused significant and ongoing controversy among specialists. The term "learning disability" does not exist in the DSM-4 (Diagnostic and Statistical Manual of Mental Disorders), but in 2013 was added in the latest edition of the catalogue of the American Psychiatrist Association - DSM-5. This new edition contains a section on neurologically based disorders, including specific learning disabilities, as well as communication and motor disorders. Specific learning disabilities according to the DSM-5 include reading, writing and math difficulties. At the same time, DSM-5 does not limit learning disabilities to a specific diagnosis such as reading, math, or writing disability. Instead, a single diagnostic criterion was used, describing deficits in general academic skills, which included detailed specific characteristics for the areas of reading, mathematics and written expression. (DSM-5,2013)

1.1.4. ICD-10 (World Health Organisation)

In the last edition of ICD of the World Health Organisation (ICD-10), issued in 2016, the all range of learning disabilities are described under the code F81 - Specific developmental

disorders of scholastic skills. This includes disorders in which normal patterns of skill acquisition are disrupted in the early stages of a child's development. This is not simply a consequence of a lack of learning opportunities, it is not just the result of mental retardation and is not due to some form of acquired brain trauma or disease. Learning disorders cover several areas in the acquisition of which the individual encounters characteristic difficulties, usually caused by unknown factors. When we talk about "typical learning difficulties", this does not exclude the possibility of learning effectively in different ways (with different methods and strategies). Therefore, it would be more accurate to say that some people have specific learning differences, thus avoiding their misclassification as people with disabilities and inability to learn, which puts them on a negative label.

1.1.5. Other

The Learning Disability Association (LDA) considers three aspects of the definition of what constitutes a learning disability: practical, medical and legal. What the three definitions have in common is the fact that learning disorders are associated with deficits in one or more psychological processes, which can be manifested by difficulties in mastering certain elements of learning, such as reading, writing, mathematics.

From a practical point of view, learning disabilities (sometimes the term “specific learning difficulties” is used) are a generalizing concept that includes a wide range of neurologically based learning disabilities. These disorders are related to visual and auditory perceptions, memory capabilities, expressive speech, gross and fine motor skills, etc. It is important to note that specific learning difficulties are not caused by problems with intelligence or emotional development, they are not a result of poor parenting or bad teaching.

We will not consider the legal aspect of the concept in this handbook, as it is determined by the legislation in the individual countries, where there are differences not only in the understanding of learning disorders, but also in the assessment procedures and the possibilities for support.

1.2. LEARNING DISABILITY; LEARNING DISORDER AND LEARNING DIFFICULTY

1.2.1. Differences in the concepts used in different countries

The way in which concepts are considered and interpreted in different countries depends on the ideas, norms, language, historical heritage and scientific paradigms that shape education and the education system in a given country. Thus, the understanding of the concept of "learning disabilities" varies from its acceptance as a disorder characterised by an average and above average level of intelligence lagging behind in one or more very specific areas (e.g. reading, writing, arithmetic), to a state very similar with what was previously defined as "mild mental retardation" (nowadays this concept is no longer considered politically correct).

In some countries (e.g. USA) terms Learning disabilities and Learning Difficulties are used interchangeably. According to the Neurological Disorders and Stroke (NINDS) "Learning disabilities are disorders that affect the ability to understand or use spoken or written language, do mathematical calculations, coordinate movements, or direct attention. Although learning disabilities occur in very young children, the disorders are usually not recognized until the child reaches school age." Among the most common learning disabilities are listed dyslexia, dyscalculia, ADHD, etc.

In other countries (e.g. UK) a distinguish is made between Learning disability and Learning difficulty. Learning disability refers to developmental disabilities or conditions that are almost invariably associated with more severe generalized cognitive impairment. *The Lancet* defines "learning disability" as a "significant general impairment in intellectual functioning acquired during childhood". This means difficulty with everyday activities – for example household tasks, socialising or managing money – which affects someone for their whole life. People with a learning disability tend to take longer to learn and may need support to develop new skills, understand complicated information and interact with other people.

From the other hand Learning difficulties (term "specific learning difficulties" is also used) define conditions in which a person has difficulty learning one or more skills directly related to the academic field. The presence of specific learning difficulties does not mean that the individual is not able to learn and achieve good academic results, but that it is difficult to do

so in the traditional way. The most common specific learning difficulties include dyslexia (difficulties in mastering the ability to read), dysgraphia (difficulties in mastering the ability to write), dyscalculia (difficulties in mastering mathematical skills), dyspraxia (motor and coordination difficulties). This group also includes the condition, known as Attention deficit/hyperactivity disorder (ADHD).

1.2.2. Understanding of Learning disabilities/Learning difficulties in partner countries

a/ Definitions and Expressions of Learning Disabilities in Bulgaria

The terms “specific learning difficulties” and “specific learning disabilities” are used without special distinction in the Bulgarian legal framework. In different documents the terms “learning disorders” and “learning difficulties” are used interchangeably. In the Regulations for implementation of the Public Education Act, Additional Provisions, § 3.2. (amended, SG No. 43/2014, effective 23.05.2014) we read: "Children and pupils with special educational needs are children and pupils with educational needs who may experience sensory disabilities, physical disabilities, multiple disabilities, mental retardation, communication disorders, specific learning disorders (dyslexia, dysgraphia, dyscalculia), autism spectrum disorders, emotional and behavioral disorders.” (Regulations for implementation of the Public Education Act, 2014). In Bulgaria children and students with specific learning difficulties are integrated in kindergartens and schools in the public education system, receiving psychological and pedagogical assistance from a psychologist, speech therapist and SEN teacher.

The same is situation with the term “dyslexia” which is used to cover a wide range of specific learning difficulties. According to prof.V.Matanova “Dyslexia is a general category of specific learning disorders, which refers to the ability in seven specific areas of functioning: impressive speech, expressive language, basic reading skills, comprehension of reading, basic writing skills, understanding of the writing, basic math skills and mathematical thinking” (Matanova, 2001). Terms dysgraphia, dyscalculia and dyspraxia are also used by specialists to name the difficulties in some specific areas of learning.

Inclusive education according to the Ordinance for inclusion of education under The Ministry of Education and Science of Bulgaria (2017) is "a process of awareness, acceptance and support for each child or student based on their needs and for diversification of the needs of all children and students by activating and including resources aimed at removing all obstacles in the process of studying and learning, and providing opportunities for development and participation of all children and students in all aspects of community life" (Section II, Article 3 (1)). There are different forms of the inclusive education (Radulov & Tzvetkova, 2013; Tzvetkova-Arsova, 2014, 2018):

1. Physical Inclusion - This most basic form of inclusion presupposes that students with SEN are physically present in the mainstream classroom, and it is believed that once students with and without SEN are together in one classroom, communication and socialization processes will take place between them, without any real guarantees that this will happen.

2. Social Inclusion - It assumes that teachers, teaching assistants, parents and other school staff would organize and facilitate the communication and socialization of students with SEN with their classmates, encouraging interactions.

3. Educational Inclusion - This is the highest and the most complex form of inclusion. It is built on physical and social forms. In it, students with and without SEN study together the same school subjects, although they may not master the same study material or not at the same level.

The main aim of the modern education is to implement all forms of inclusion for students with special educational needs in the mainstream schools.

b/ Definitions and Expressions of Learning Disabilities in Turkey

Students with learning disabilities in Turkey continue their education in inclusive classrooms and special education and rehabilitation centers (Deniz, 2019). Regulations and support activities are carried out for the related learning disability training and diagnosis processes. Regulations continue to be published in their current form by being rearranged according to changing needs. In the regulation published for the first time in 1962, no classification was made for individuals with special education needs, while students with special needs were

classified into categories in the regulation published in 1968, but there was no expression of special learning difficulties among these categories (MEB, 1962; MEB, 1968). In 1975, although the term special learning disability was used for the first time, difficulties such as reading, writing and drawing were included in the definitions (MEB, 1975). Until today, definitions of special learning difficulties have been expanded in line with the needs and similar expressions have been used in these publications (MEB, 1985; MEB, 2000; MEB, 2006; MEB, 2012; MEB, 2018). According to the published regulations, the definition of special learning disability "special education and support due to difficulties in listening, speaking, reading, writing, spelling, concentration or mathematical operations that occur in one or more of the information retrieval processes required to understand and use language in writing or verbally. individual who needs education service" *(*MEB, 2012). Learning difficulties in studies conducted in Turkey until today; Although it is used with terms such as learning disability, specific learning disability, specific learning disability and learning disorder, it has also been defined as individuals with difficulties in reading, writing and mathematics (Görgün & Melekoğlu, 2019; Özkardeş, 2013).

c/ Definitions and Expressions of Learning Disabilities in Lithuania

In Lithuania a clear distinction is made between the terms "Learning disability", "Learning Disorder" and "Learning Difficulty" (LR Švietimo ir mokslo ministro, LR Sveikatos apsaugos ministro ir LR Socialinės apsaugos ir darbo ministro įsakymas Nr. V-1265/V-685/A1-317, priimtas 2011 m. liepos 13 d.).

Learning disabilities

- Intelligence disorders
- Vision disorders
- Hearing disorders
- Movement disorders
- Developmental disorders (childhood autism, Asperger syndrome, Rett syndrome)

Learning disorders

- General learning disorders
- Specific learning disorders:
- *Reading disorders*

- *Writing disorders*
- *Arithmetic learning disorders*
- Non-verbal learning disorders
- Emotional-behavioral difficulties:
    - *Activity/attention disorders*
    - *Activity disorder*
    - *Attention disorder*
    - *Activity and attention disorder*
    - *Behavior disorders*
    - *Emotional disorders*
- Language disorders

Learning difficulties - Temporal difficulties due to health difficulties, emotional crises etc.

d/ Definitions and Expressions of Learning Disabilities in Poland

In Poland terms as "disability" and "special educational needs" are not synonymous and cannot be used interchangeably. The Polish education system recognizes the fact that students' needs may differ and in some cases, they may require special approach of teachers, both when it results from certain disabilities and when they are not found in a student (Bartnikowska & Antoszewska, 2017).

There are many private schools in Poland supporting students with learning disabilities or disorders (LDs). This includes schools in Warsaw, Kraków, Poznań, Wrocław, Łódź, Gdańsk, Szczecin, Bydgoszcz, Lublin, and Rzeszów.

Some schools in Poland provide full-time support for students with learning disorders, through a dedicated class or program. Others provide part-time LD support through in-class accommodations or modifications. Either option can a great fit for both international and domestic students with one or more LDs or special needs.

There are many different types of private and non-public schools in Poland. This includes learning disability schools (and other special needs schools). There are private learning disability schools at the preschool, elementary, middle, and high school level.

These schools provide support for a wide range of learning disorders. They do this through skilled instruction and specialized programs. Some of the main types of LD schools and programs are described below.

Dedicated LD schools: These are self-contained learning disability schools (both day and boarding), where 100% of the students have LDs. They provide full-time support for students with one or more LD. Trained teachers and staff can focus on tailoring the environment for LD students, without compromise. These schools also normally have lots of special resources, such as extra support staff, technological aids, and counselling and tutoring programs. Some of these schools focus on one or more specific LDs, while others offer support for most or all LDs.

Dedicated LD classes: These are schools with at least one separate, dedicated class, where 100% of the students have learning disabilities. These classes take place alongside regular, non-LD classes. Normally, these classes provide full-time support for students with one or more learning disability. They usually have teachers with specialized training, as well as extra support staff.

Withdrawal or pull-out LD classes: These are schools with special education classes, where students receive LD support on a part-time basis. LD students, in these schools, are taken out of regular class periodically to receive specialized support and programming for their learning disabilities. These special ed. classes can take place anywhere from once a week to multiple times a day. They're meant to supplement and reinforce learning done in the regular classroom.

Schools with in-class LD support: Some schools do not have a dedicated learning disability class or part-time special education class, yet still provide LD support. In these schools, teachers provide support for students with LDs in a regular classroom. This is done by making in-class accommodations, such as allowing more time for tests or assignments, or modifications, such as changing the curriculum or grade-level expectations for students with LDs.

e/ Definitions and Expressions of Learning Disabilities in Latvia

Learning disabilities are neurological disorders that affect the brain's ability to understand, remember or communicate information. These disorders are associated with uneven maturation of the brain - some abilities develop more slowly or not enough, which makes learning very difficult. Learning disabilities are not mental disabilities. In fact, these disorders are often difficult to spot, as children's intelligence can range from moderate to excellent. Experts believe that these disorders are in fact much more common and that many children do not attend school as well as they could because of their undiagnosed learning disabilities. Learning disabilities do not go away, they persist throughout life - they are persistent and persist in adults.

Manifestations of learning disabilities:

- Learning disabilities are characterized by information processing difficulties that affect basic learning skills.

- Students with learning disabilities are characterized by a mismatch between normal intelligence and poor achievement. So the first thing to pay attention to is whether the child's success is in line with his intellect.

- A student with a learning disability may have both poor reading and writing skills and difficulty solving arithmetic and text problems.

- These students usually need more time to process information, which means that the thought processes are slower or different from those of other children.

Learning difficulties may also be due to reduced or delayed development of all cognitive abilities, when the child is able to acquire knowledge and skills only at an incomplete or basic level according to the standard of education and to do so the child needs individual and specifically adapted pedagogical assistance. Parents can often not recognize this type of developmental disorder, because they can be detected only by specialists - a psychologist, psychiatrist, speech therapist, teacher. This help is most effective for a child with developmental disabilities at pre-school and younger school age. Learning difficulties can also occur as a consequence of emotional experiences - stress, family conflicts, insufficient

care or parental presence, over care, experiences of abusive violence, long term health problems that make it difficult to integrate into peers and learning rhythms, negatively affect self-esteem. Learning difficulties can be related to insufficient development of the child's will and motivation, which can be a consequence of mental health disorders, insufficient upbringing, permissiveness and lack of boundaries in the treatment of children, negative family attitudes towards school and education as a consequence of values.

Based on the National Education Law of Latvia since 1 September 2020 special basic education programs for students with physical disabilities, somatic diseases, language disorders, learning disabilities have to be implemented in general (mainstream) schools in the form of special classes or groups of schools, as well as to integrate SEN students into general education classes.

1.3. CAUSES OF LEARNING DISABILITIES

The causes of learning disabilities have not yet been well studied, but experts, while not unanimous, agree that there is no factor that can be cited as the only cause of learning difficulties. Among the possible reasons are listed the delayed maturation of the left cerebral hemisphere, dysfunctions of the central nervous system, deficits in perceptions or problems with processing the information.

1.3.1. Heredity and Genetic

Often children who have learning disabilities have parents and/or siblings who have the same struggles. But there are also many cases, when children have so called “spontaneous mutations” (which means that the problem is not observed in either parent), that may cause different kind and different level of severity developmental disorders including learning disabilities (Johnson, B., 2017). Some studies (McRae et al., 2017) state that approximately 0.33% of children have such spontaneous mutations. Another resource (Walsh, 2017) points out as an example that a fault in the CDK13 gene affects children’s learning and communication skills.

1.3.2. Neurological

For many years it was thought that learning difficulties are due to problems in the development of the specific areas in the brain. But some resent studies changed this theory, suggesting that learning problems stem from poor connectivity between different brain areas. Children who have poor correlation between different brain regions are more likely to have learning difficulties, a recent study by the University of Cambridge reveals (Siugzdaite et al., 2020). According to the conclusions made by Dr. Duncan Astle "hubs play a key role in sharing information between brain areas." (Science Daily, 2020).

In fact, a century ago Samuel Orton first suspected a connection between underdevelopment of the correlation between two hemispheres of the brain as a main reason for reading difficulties.

1.3.3. Cognitive

Learning difficulties of children refer to "the impairment in the acquisition or development of learning skills in school-age children who have appropriate learning opportunities, due to environmental, psychological and quality reasons, which are manifested by frequent poor academic achievements or the resulting grade retention" (Reis, Baum & Burke, 2014).

When we talk about cognitive functions that may cause learning difficulties, we can focus on speech development, memory skills, attention aspects and the speed the child process information with.

Working memory and long term memory are especially important when it comes to learning. Problems with the working memory can affect the child's ability to follow directions, to cope with multi-steps instructions, to process information quickly, etc. It affects also the acquisition of basic skills such as reading and writing. Long term memory problems from the other hand may lead to difficulties to recall information, to deal with sequences, to organise thoughts and ideas and to be able to communicate them clearly (both orally and in writing). Organisation of the activities (especially tasks completion of which requires more than two

steps), as well as calculations or performing them in the correct order (in accordance with math rules) may also be problematic.

Attention also plays a very important role in learning, because it affects child's ability to complete a task within proper time and with proper quality. According to J.R Anderson attention is behavioural and cognitive process of selective focusing on a particular aspect of information, ignoring the remaining, unnecessary part. (Anderson, 2004)

Attention consists of several main components, three of which are of great importance for learning: concentration (ability to consciously focus attention on an object, its components, the ability to understand the task), sustainability (for how long one can keep his attention to the same object at the original level) and switching (ability to shift focus from one object to another when needed).

1.4. EFFECTS

1.4.1. In academic area

Dyslexia is a disorder that mainly affects the ability to read and write, thus generating difficulties in the aspect of language, as an essential part of learning that is affected in the processing of information creating a gap between skills and abilities, having as a very important factor age, academic performance (Castejón & Navas, 2011). At the same time, dyslexia affects not only learning, but all aspects of person's every-day life (Riddick, 2009).

Reading is a complicated process, the mechanisms of which are largely invisible to an observer (Clay, 1991, 2005, 2009) and is still not well-understood. There are many publications in which authors present different models of the process describing how children learn to read: some of them look at comprehension (Spiro, Coulson, Feltovich, & Anderson, 1994; Anderson, 2003; Ruddell & Unrau, 2004), others consider the word recognition (Adams, 1990), others focus on students' attitude (Mathewson, 1994) or students' interaction with text (Rosenblatt, 2004). No matter which model of reading acquisition will be followed, there are a lot of skills that a child should develop at good enough level long before he/she starts school. In order to go through this process smoothly, the child has to have good eye

muscles coordination (so the eyes can follow the lines in the text), good spatial orientation (to interpret letters and words), well-developed memory (visual, auditory and working). The process also requires the ability to work with sequences, good knowledge and understanding of sentence structure and grammar; the ability to categorise and analyse, etc. In addition, it is necessary to mention that the reading is not just the ability to decode the words correctly; the second very important aspect of reading is comprehension. Comprehension is "the ability to understand information presented in the written form is called reading Comprehension" (Keith, Foorman, Perfetti, Pesetsky & Seidenberg, 2001). In order to achieve good level of reading comprehension it is necessary to decode the words correctly and to make connections between the text and the previous knowledge. In other words, the comprehension is a "creative, multifaceted process" dependent upon four language skills: phonology, syntax, semantics, and pragmatics (Tompkins, 2011).

In case of deficits in perceptions, spatial orientation, memory and/or attention it is very likely that the young learner will have problems with acquiring good reading technique and the level of reading comprehension will also be lower. As a result, the child will not feel any pleasure of reading. If in addition he can't see improvement in his reading technique and/or comprehension, despite his efforts, he will very soon lose interest in reading and motivation to read.

The processes of reading and writing are closely linked, which explains the fact that in most cases, when there are difficulties in reading, writing is also affected. When it comes to problems related to writing, we highlight two aspects: spelling and handwriting. In some countries the term "dysgraphia" is used to describe the difficulties in both aspects, in other countries are used two different terms: "dysorthography" (a specific disorder of spelling) and "dysgraphia" (problems related to handwriting). No matter which definition is used it is important to know that poor handwriting and incorrect spelling are not always the result of a lack of effort and diligence. It is supposed that by the end of the primary school level even a student with dyslexia has managed to learn to read and write, very often many of the problems he faces in the process of reading and writing acquaintance, are still observed during the higher school levels, which makes his reading and writing far from the age/class level.

Quite often difficulties with reading and writing are accompanied by difficulties with numeracy and maths (dyscalculia). Dyscalculia is a learning disability that impairs an

individual's ability to learn number-related concepts, perform accurate math calculations, reason and problem solve, and perform other basic math skills (American Psychiatric Association, 2018). Different studies mention different percentage – from 30 to 70% of students with LD experience problems with math (e.g., Badian, 1999; Kovas et al., 2007; Landerl & Moll, 2010; White, Moffitt, & Silva, 1992). Difficulties in math are observed in about 11% of children with ADHD/ADD, too (Soares & Patel, 2015). Many authors (e.g. De Smedt & Boets, 2010; Göbel, Watson, Lervåg & Hulme, 2014; Simmons & Singleton, 2008; Träff & Passolunghi, 2015) believe that math associated problems can be attributed to deficits with the phonological processes (which is also one of the most important components in the reading acquisition).

The most common difficulties, associated with dyscalculia are:

- Difficulties with processing numbers and quantities;
- Difficulty linking numbers and symbols to amounts;
- Difficulty to learn and recall mathematical facts (e.g. multiplication tables);
- Difficulty to manipulate money and telling time, etc.

Of course, problems with reading and writing affect mathematical skills as well, especially when it comes to word problems (difficulty to read and understand) and/or writing down the answer (swapping digits). Deficits in spatial orientation may cause difficulty with Geometry. Performing actions with large numbers is also problematic, as well as solving more complex numerical expressions, due to the mandatory order of performing arithmetic operations.

Nowadays, with the acceleration of the globalization, it is almost a must for every person to be able to communicate in at least one foreign language. Therefore, the learning of a foreign language is considered an important part of education from the very beginning. At the same time learning a foreign language can be an extra load for students with dyslexia who are striving to acquire basic oral and written language skills in their mother tongue (Peer & Reid, 2000; Simon, 2000; Lundberg, 2002; Schneider & Crombie, 2003). There are four basic linguistic skills necessary to acquire linguistic competence in every language: oral comprehension, oral production, written comprehension and written production. The competence in a spoken language consists of the ability to use the sounds that form words and

sentences, in order to convey meanings. In order to speak we need to be able to articulate, through particular movements of the oral articulatory organs, the sounds of our language and, in order to understand the spoken language, we need to recognize the same sounds in all the various auditory stimuli we perceive in the surrounding environment (Nespor, M. & Bafile, L., 2008). As dyslexia causes difficulties at first place in reading in writing acquisition in the first language, it is obvious that the development of these skills will be problematic in a foreign language, too. The problem is not only with new sounds (that do not present in student's native language), but with the morphological and morpho-syntactic aspects of the language, with learning new vocabulary (both the pronunciation and the meaning of the new words), with spelling, grammar, punctuation; in other words – practically in all aspects of the language learning.

There are school subjects that require a lot of reading and some writing, like History, Geography, Science. Poor reading techniques, low level of reading comprehension, difficulties with extracting information, remembering and recalling the facts, inability to make connection between the new information and the old knowledge – all these deficits (observed in students with learning difficulties) affect their learning and their results. Even in subjects that are considered easy, like Music, Art, Sport, dyslexic students may face some difficulties. Research has shown that music and language skills are related, as far as both are based on the phonological perceptions, which is one of the perquisites for developing good reading skills (Jentschke, Koelsch & Friederici, 2005; Legg, 2009; Forgeard, 2008). At the same time notes as well as the letters are graphical images, and the cognitive processes involved in their acquisition are similar, so children with dyslexia more likely will have difficulties to learn notes, music signs and all their combinations. Problems for those with dyslexia when reading notation, says Westcombe (Westcombe, 2001), include poor eye-ear-hand co-ordination, slowness in processing symbolic information, and delay in actions becoming automatic.

The relationship between drawing and writing has been well described and explained in many publications (Brittain, 1979; Gardner, 1980; Dyson, 1983). Drawing and colouring affects the development of fine motor skills which are so important for handwriting. A study of a group of researchers from the University of Thessaly (Greece) shows the significant correlations between drawing and writing (Bonoti, Vlachos & Metallidou, 2005).

It is very beneficial for children with dyslexia not only to actively participate in the Physical Education classes at school but to be engaged with some sport activities out of school. But quite often dyslexic children are clumsy, not well coordinated and balanced (Fawcett & Nicolson, 1995; Fawcett, Nicolson & Dean, 1996). This cause them considerable difficulties to perform well enough in PE classes, especially in team sports (basketball, softball, football, etc.). Despite these difficulties dyslexic students should be encouraged to play sports, as it will help the improvement of their gross motor skills, their spatial orientation, the ability to understand orally given instructions and to follow them, sequencing skills, organisational skills, to teach them discipline and time management.

1.4.2. In organisational and time management skills

Practically all students with learning difficulties experience problems with organization and time management. Completing a task may take them considerably longer time in comparison with their peers/classmates, they have to put much more efforts and need more explanation and step-by-step instructions. It is especially true when it comes to school work.

In case of a child with specific learning difficulties (like dyslexia) their deficits in organizational and time management skills are often not understood by teachers and parents and these children are accused of being lazy, immature and unmotivated. Problems with the organization and management of time can manifest itself in different ways and to different degrees - from difficulties in mastering the clock, poor time orientation (younger students confuse concepts such as "last night - tonight", "the other day - the day after" and etc.), to the impossibility to independently distribute their time so that it is enough for them to cope with all their tasks. And because learning activities (especially those that require reading and writing) are difficult for them, they try to postpone them in the hope that they will be able to avoid their completion.

In order to complete a task one needs to be able to make a plan how to achieve the desired result; during the process of realization to be able to make the necessary amendments, to maintain the motivation, to be persistent and at the same time to follow the timetable and to keep the deadlines. All this is very difficult for the most students with learning difficulties as they have problems with executive functioning.

Organisational and time management skills are not innate in human beings, but it is expected that one will develop and improve it while growing up. Children with learning difficulties have a different perception of time. That's why it is necessary these skills to be purposefully taught and developed.

1.4.3. Emotional and behavioural aspects

Samuel Torrey Orton (1879 –1948) was an American physician who pioneered the study of learning disabilities. He examined the causes and treatment of dyslexia. His key contribution was to recommend teaching that was multi-sensory, incorporating both hemispheres of the brain. was the first to study the emotional aspects of learning difficulties (and especially of dyslexia). According to the results of Orton's research "most of preschool children who subsequently experience difficulties with learning are well adapted to the environment, have good self-esteem and feel happy. Emotional problems begin after the child starts school." (Orton, 1937) And despite of the fact that many of children with learning difficulties have average (or even above average) intelligence, their academic results are far from expectations of teachers and parents. If we talk about adults with learning difficulties, we can expect that they will understand the reasons of their difficulties and will search for and find some compensatory strategies that will help them to cope with the situation. But when it comes to 7-8 years old children such understanding is impossible for them, they feel confused and frustrated when they see that their efforts do not lead to the expected results, while their classmates achieve better results with less efforts and time.

Underachievement and the feeling of failure that children with learning difficulties experience lead to low self-esteem, self-confidence and demotivation. With regards to behavioural characteristics, learning difficulties affects children's personality – they are shy, often are isolated from the group/class activities, have difficulties with making friends and maintaining relationships, can be object of bulling… Anxiety, anger, dissatisfaction that children with learning difficulties feel often results in emotional and behavioural problems which sometimes are more serious than the difficulties themselves.

1.5. IDENTIFICATION OF LD

Learning Disabilities range in severity and interfere with the acquisition and use of one or more of the following: oral language – listening, speaking, understanding; reading – decoding, phonetic knowledge, word recognition, fluency and comprehension; writing – written expression, spelling, fluency; mathematics – computation, problem solving, math fluency (Learning Disabilities Association of America/LDA).

The definition of learning disabilities generally rests on three assumptions: heterogeneity, exclusion and discrepancy. The heterogeneity assumption is that LD is domain specific and different in phenotypic definitions and intervention requirements, but some authors (e.g. Fletcher, Lyon, Fuchs & Barnes, 2006) believe that LD cannot be considered a single overarching concept. They recommend teachers to monitor students' progress of achievement in word recognition, reading fluency, math and spelling. The exclusionary criterion assumes that children with LD display unexpected underachievement and differ in their needs of intervention when compared to children who have low achievement due to mental retardation, sensory disorders, emotional disturbance, social, economic or cultural factors (Lyon, Fletcher & Barnes, 2003).

In many definitions of LD the discrepancy between the person's abilities and achievements is mentioned as one of the main criteria. But it has been a subject of a great debate (Frances et al., 2005; Lyon et al., 2001). Despite of the fact that there is little support for the validity and reliability of the discrepancy component, it has largely shaped the current conception and practice of identifying the learning disabilities (Grigorenko, 2008).

According to most definitions intelligence is made up of the skills of logical reasoning, problem solving, critical thinking, and adaptation (Siegel, 1999). IQ tests in most cases are composed of verbal and performance sections, and is still widely used in LD diagnosis to check the level of discrepancy between person's intelligence (potential) and his/her achievements. In the subtests of the Verbal scale the vocabulary, expressive language and memory skills, while in the Performance scale, visual-spatial abilities, fine motor coordination, perceptual skills, and in some subtests speed, are essential for scoring (Siegel, 1989). As Siegel rightly points out, IQ tests measure, for the most part, what a person has *learned***,** not what he or she is capable of doing in the future (his potential) (Siegel, 1999).

According to the same author, as people with LD have deficiencies in one or more of the component skills that are part of the IQ tests (memory, language, fine motor skills, etc.) they will show have lower results than people without LD, even though they may both have the same reasoning and problem-solving skills. In other words, the lower IQ score, therefore, may be a result of the learning disability, and may underestimate the real intelligence of the individual with a learning disability (Siegel, 1989).

Based on what was already said, the assessment of a child in case of suspected learning disabilities should include not a single test, but a series of tests, evaluation and interviews, conducted by a specialist (or group of specialists) aimed at evaluation of all areas of potential deficits. Cognitive, achievement and psychological tests are also included. The specific tests vary depending on child's age and the issues. Cognitive testing aims at identifying issues with key skills like processing speed, auditory and visual processing, thinking and reasoning ability, etc. Achievement testing evaluates abilities in academic areas, such as reading (technique and comprehension), writing (spelling and organising thoughts and ideas in writing), math (calculation and reasoning), oral language/verbal abilities. Assessment procedure may also include tests related to the memory and attention skills. A very important part of the assessment is the interview with parents in order to gain more information about child's background (physical, emotional and psychological development, health), family and school environment, extra curricula activities, interests, strengths and difficulties, and so on. Specialist who is doing the assessment may also decide to interview the child's teacher in order to gain additional information about child's performance and behaviour in the classroom.

2. TYPES OF SPECIFIC LEARNING DIFFICULTIES

There are different classifications of learning disabilities, but here we will consider only two of them: 1/ classification by the stage of information processing, and 2/ classification by the area of difficulty.

2.1. CLASSIFIACTION BY STAGE OF INFORMATION PROCESSING

According to this classification there are four types of learning disabilities depending on at which stage the problem with information processing occurs. (National Dissemination Center for Children with Disabilities (NICHY). Academy for Educational Development (AED), 2004).

2.1.1. Input

The main channels through which one perceive information are visual and auditory, and when individual's visual and/or auditory perceptions are distorted some very specific difficulties are observed. If the deficits are in the visual perceptions the child may not be able to recognise shapes, position or/and the size of an item. Problems with sequencing may also be observed. In case of auditory perception problems, the child more likely will have difficulties with auditory differentiation and discrimination, as well as in screening out competing sounds in order to distinguish the one that is important and to focus on it (e.g. on an announcement at a noisy train station).

2.1.2. Integration

This is a stage in the information processing when the perceived information (input) is analysed, categorised, compared, placed in a sequence and integrated with the previous knowledge. If a child has problems at this stage, he will have problems to memorise sequences of information (e.g. days of the week, months in the year), to integrate the new information to what he already knows, to tell a story in the correct chronological order, to remember facts, etc. Poor vocabulary is also one of the signs for problems at this stage of the processing information.

2.1.3. Storage

This stage is directly related to all forms of memory (visual, auditory, work memory, short-term and long-term memory, semantic memory, etc.). If in a child memory deficits are observed, then it can be expected that such a child will need more time and much more repetitions in order to learn new material; the process of automation is very slow and sometime hardly possible (very well seen when a child tries to learn his multiplication tables, or a poem). This may affect child's spelling skills as well.

2.1.4. Output

This is the last stage of the information processing, where the perceived, integrated and stored information is interpreted via speech, writing, drawing, gestures, and other means of communication. In case of deficits in some of the previous stages it would be impossible for the child to interpret the information correctly and completely. In such a case the child will have difficulties with spoken language (to retell a story, to answer open questions, to participate in discussions on a topic, etc.). In most cases problems with written language will also present. If in addition, the individual has problems with motor skills (if they are underdeveloped), it will result in gross and/or fine motor problems. Such a child will be clumsy, have difficulties with running, climbing, jumping, playing with a ball, participating in a team games. If the fine motor skills are not developed well enough, then the child will have problems with colouring, cutting, tying shoelaces, buttoning (can be observed since the pre-school age) and handwriting (when he starts school).

2.2. CLASSIFICATION BY THE AREA OF DIFFICULTIES

2.2.1. Dyslexia

If briefly – dyslexia is a specific learning disability associated with difficulties in reading acquisition that affect writing as well. People with dyslexia usually have average or above

average intelligence and despite of the difficulties, if the problem is identified early and addressed adequately, they can achieve very good academic results.

Dyslexia is a quite widely spread condition. According to some resources the number of individuals with dyslexia between 10% (British Dyslexia Association) and 16% (Dyslexia Action). Dyslexia International (2017) suggests that between 5-10% of the world population, while other research (Sprenger-Charolles & Siegel, 2016) suggests that the figure is expected to be around 17% of the world's population.

2.2.2. Dysgraphia

Dysgraphia can be defined as difficulties with spelling and/or trouble expressing thoughts and ideas in written form. Specifically, the disorder causes a person's writing to be distorted or incorrect. In children, the disorder generally emerges when they are introduced to writing, but there are some signs that let specialists to predict possible problems with writing when a child starts school. Dysgraphia can demonstrate itself in different ways – wrong/unusual pencil grip, inappropriately sized and spaced letters, illegible and messy handwriting, slow and laboured writing, misspelled words, despite thorough instruction, inability to implement correctly grammar and punctuation rules, difficulties to express thoughts and ideas in writing, etc. (National Institute of Neurological Disorders and Strokes, 2006).

2.2.3. Dyscalculia

Dyscalculia is a term referring to a wide range of life-long learning disabilities involving math (National Center for Learning Disabilities, 2006). These disabilities affect a person's ability to understand and/or manipulate numbers, perform mathematical operations, and/or conceptualize numbers themselves as an abstract concept of comparative quantities (Pierangelo & Guiliani, 2008). Dyscalculia can be suspected even before a child starts school, and should be addressed as early as possible.

1.1.1. Non-Verbal LD – Dispraxia; ADHD; Executive Functioning

Nonverbal learning disabilities, although not so obvious, may also have a great effect on child's academic performance. Among them will be enough to mention dyspraxia, ADHD and executive functioning (in some countries, e.g. Lithuania, ADHD is not considered a non-verbal LD).

Dyspraxia causes difficulty in performing activities related to both fine and general motor skills. Children's inability to color, cut, or jump and play with a ball is not due to low intelligence, but is the result of the brain activity, which is responsible for coordinating body movement in space or hand-eye coordination. Children with dyspraxia look clumsy, they are often mocked by their peers and are excluded from the team games. It is not always, but it happens, that children with dyspraxia behave immaturely, which hinders their social activity. Dyspraxia is one of those conditions that accompanies a person throughout his life, but if detected and treated in time, children's motor skills can be significantly improved (Gibbs, Appleton & Appleton, 2007).

Attention Deficit Disorder (ADD) and Attention Deficit Hyperactivity Disorder (ADHD) are two concepts that for long time used to be considered separately. In fact, until 1984, when doctors decided all forms of attention deficit disorder to be called "Attention deficit/hyperactivity disorder" even when the person is not hyperactive (Mayes & Horwitz, 2005). According to this last definition, now ADHD is divided into three types: 1/ inattentive ADHD (when person shows symptoms of inattention/easy distractibility, but at the same time is not impulsive or hyperactive); 2/ impulsive or hyperactive (when person shows symptoms of impulsivity/hyperactivity, but no symptoms of inattention); 3/ combined (when person shows symptoms both of inattention and impulsivity) (DSM-4, 1994).

Children with ADHD have difficulty following instructions, do not complete tasks, do not pay attention to details. If it is combined with hyperactivity, children have inexhaustible energy, can't follow rules, can't stay focused on school tasks, etc. (Sroubek, Kelly & Li, 2013).

Executive function is a group of mental skills, which includes working memory, flexible thinking and self-control. These skills are of great importance for effective learning. Deficits in their development cause difficulties not only in learning, but in every-day life as well, as

they affect many neuropsychological processes: time-management, planning, organisation, remembering details, etc. (Reiter, Tucha & Lange, 2005).

CONCLUSIONS

Despite the differences in the proposed definitions, all experts agree on the understanding that learning difficulties can be described as a problem with the brain's ability to process information. Learning difficulties affect all aspects of students' life, not only their academic performance. It does not mean that students with learning difficulties cannot learn, they just cannot learn the same way and/or as fast as their peers. They need an adapted approach that best suits their learning style. With adequate and on-time intervention and support, these students can compensate their difficulties and can succeed. Adults' (teachers and parents') responsibility is to provide students with LD with all the opportunities to be effectively included in the mainstream school.

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CHAPTER 2. DYSLEXIA – THE MOST COMMON SPECIFIC LEARNING DISORDER

1. SHORT INTRODUCTION TO READING AND WRITING

Reading and writing are not natural, innate or "spontaneous" skills; these processes are human cultural inventions. Reading and writing are extremely complex processes depending on a number of cognitive sub-skills (Ott, 2007; Lachman, 2018).

Reading is comprised of two major skills: *decoding* (ability to decode separate words), and *comprehension* (ability to comprehend the content) (in Simple View of Reading model, Gough & Tunmer, 1986). **Writing** involves two main skills, *composition* and *transcription* (spelling and handwriting), as well as a number of sub-skills. Composition involves generating ideas, describing responses and an ability to write in different forms for different audiences. Cognitive models of writing stress the need for transcription skills (spelling and handwriting) to be automatized to allow working memory resources to be devoted to the higher-level processing of composing a written text (Sumner, Connelly & Barnett, 2014).

Children have to be taught how to read and write and it requires direct and explicit teaching. Successful literacy acquisition depends on the interaction of both the learning environment and individual factors (Ott, 2007; Lachman, 2018). Even though literacy acquisition is quite a challenge for the brain, with the appropriate learning conditions and instructions almost all individuals will eventually become fluent in reading and writing, no matter which orthographic system is involved. However, some individuals have serious problems to acquire these skills adequately. If these problems are restricted to literacy development (i.e., no general cognitive deficit) and are not justified by insufficient learning conditions, then this specific learning disorder is defined as *developmental dyslexia* (or dyslexia) (Lachman, 2018).

2. DEFINING DYSLEXIA

Dyslexia is the most common specific neurodevelopmental learning disorder, accounting for about 80% of all learning disorders cases (Donfrancesco et al., 2010). There is currently an ongoing debate about what dyslexia is and what to do with the term, *dyslexia* (Fallon & Katz,

2020; see discussion Elliot & Grogorenko, 2014a, 2014b; Vellutino, 2014; Stein, 2014). Despite the scientific debate, the term *dyslexia* is still used and following the cognitive neuroscientific model proposed by Frith (1999), it is important to understand the phenomenon of dyslexia from the perspective of three levels: *biological*, *cognitive* and *behavioural*. The use of the above levels allows the organization of a significant amount of knowledge defining dyslexia.

In 2002, the International Dyslexia Association adopted a standard definition of dyslexia, developed by a team of researchers, practitioners and leaders from IDA. This group developed the most up-to-date definition of dyslexia based on more than 30 years of research (Huffman, Shaw & Thompson, 2020). The definition of dyslexia used by the IDA highlights both the neurological and cognitive underpinnings of the disorder as well as its signs (Snowling, Gooch & Henderson, 2012).

Dyslexia can be defined as a neurodevelopmental disorder with a biological origin that is the basis for abnormalities at a cognitive level, which are the immediate causes of the behavioral signs of dyslexia:

> Dyslexia (or developmental dyslexia) is a neurodevelopmental disorder, resulted from a deficit in the phonological component of language that is often unexpected in relation to other cognitive abilities and the provision of effective classroom instruction. Dyslexia characterized by persistent difficulties with accurate and/or fluent word recognition and by poor spelling and decoding skills. Secondary consequences may include problems in reading comprehension and reduced reading experience that can impede growth of vocabulary and background knowledge (Lyon, Shaywitz & Shaywitz, p. 2).

It is important to note that dyslexia manifests as severe and persistent difficulties in reading and writing fluently and accurately separate words, which are unexpected, as they appear despite adequate cognitive capacity and instructional or environmental opportunities. Dyslexia is not caused by sensory impairment, lack of motivation, emotional disturbances, or any other possible extraneous factors (Lohvansuu et al., 2021).

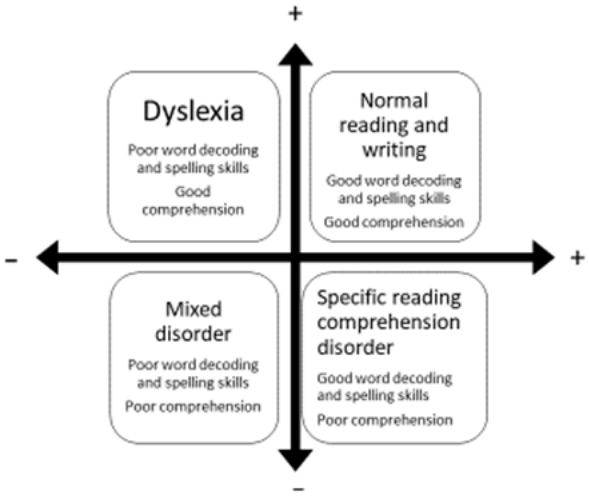

Figure 1. Dyslexia. *Source: Tunmer (2008), modified by Gedutienė (2017)*

Some researchers describe dyslexia as an unexpected weakness in a sea of strengths. In this model, dyslexia is viewed as a paradox. Dyslexia is identified in students who are demonstrating an unexpected difficulty with reading and spelling – not due to their intelligence (Huffman, Shaw & Thompson, 2020).

3. THE MAIN CAUSES OF DYSLEXIA: GENETIC AND ENVIRONMENTAL FACTORS

The aetiology of dyslexia involves multiple interacting risk factors. Different causal mechanisms can be involved in dyslexia, including combination of genetic and environmental factors.

Dyslexia is a highly heritable disorder (Grigorenko, 2001; Shaywitz, 2003; Shaywitz & Shaywitz, 2005; Scerri & Schulte-Körne, 2010). Difficulties to read and write are likely not to be caused by a single gene but through the interaction of multiple genes, with possibly different gene sets being involved with different behavioural signs of dyslexia (Nicolson, 2001). Evidence of a (poly)genetic influence in dyslexia was proved in numerous studies.

Over the past decades, genetic studies have examined which loci and specific genes contribute to dyslexia. Genetic linkage studies have identified *nine genes* as possible candidate susceptibility genes of dyslexia termed DYX1–DYX9 (e.g., 15q15-q21 (DYX1), 6p21.3-p22.2 (DYX2), 2p11-p16 (DYX3), 6q12 (DYX4), 3p12-q13 (DYX5), 18p11.2 (DYX6),

11p15.5 (DYX7), 1p34-p36 (DYX8), Xq26-Xq28 (DYX9)) (Brooks, 1997; Warnke, 1999; Grigorenko, 2001; Raskind, 2001; Vellutino et al., 2004; Galaburda et al., 2006; Nicolson & Fawcett, 2008; Benitez-Burraco, 2010; Scerri & Schulte-Körne, 2010; Corona et al., 2012; Reid, 2012; Eicher & Gruen, 2013; Neef et al., 2017). A key function of many of these genes is their mutation and involvement in neuronal migration causing main structural and functional neural alterations in the brains of individuals with dyslexia (Benitez-Burraco, 2010; Scerri & Schulte-Körne, 2010). What is inherited is not, of course, dyslexia per se, but aspects of language processing (Snowling, 1998); for instance, it has been found that children with familial risk have altered structural brain networks in language areas and impaired auditory processing (Lyytinen et al., 2005; van der Leij et al., 2013).

Evidence for the genetic explanation comes from twin and family studies, which indicate that genetic factors explain a large part of individual differences in children's word-level reading ability (Swagerman et al., 2017). There is as much as 50% probability of a boy to have dyslexia if his father has dyslexia (about 40% if his mother has dyslexia), and a somewhat lower probability of a girl developing dyslexia (about 20%) (Snowling, 1998; Warnke, 1999). The risk of siblings being affected is 38–62% (Snowling, 1998; Warnke, 1999). Warnke (1999) has reported inconsistent results concerning the heritability of reading deficits (heritability ranging from 3–60 %). The heritability of spelling disorder, on the other hand seems to be higher (60–70%). Stein (2008) added that heritability turns out to explain around 60% of familial variance in reading, so that the environment that twins share in common explains only around 20%. Thus, more than half of the differences that children show in reading ability can be explained by their genetic inheritance (Stein, 2008). Eicher and Gruen (2013) reported that family studies have shown that dyslexia and overall reading abilities have significant genetic components, with heritability estimated at 54–84%. In the Jyväskylä Longitudinal study of dyslexia Lyytinen and colleagues (2008) have observed that parent's dyslexia multiplies the likelihood of problems in reading acquisition among their children. Almost half of children with familial risk faced problems in learning to read and almost one-third of them ended up getting diagnosis of dyslexia in one of the first three school grades.

Results of Swagerman and colleagues (2017) research show that variation in reading ability is mainly caused by additive and non-additive genetic factors (64%). The substantial assortative mating (father–mother = 0.38) has scientific and clinical implications. We conclude that

parents and offspring tend to resemble each other for genetic reasons, and not due to cultural transmission

Genes are important, but they are not a final determination. The environment in which a child is raised, the parenting, nutrition, health care, peer relations, and education can influence the expression of those genes (Grigorenko, 2001; Raskind, 2001; Reid, 2012). Families share both genetic and environmental factors. For example, Mascheretti with colleagues (2015) research data have indicated that lower parental education, younger parental age at birth, and having risked miscarriage during pregnancy additively increase the offspring's risk for dyslexia. Moreover, the quality of parenting and early family life associated with younger maternal age can impinge negatively on offspring's reading abilities, whereby young mothers provide less verbally stimulating environments. Genetic and additional factors like prematurity, repeated ear infections and autoimmune disorders (allergies and asthmas) will make a child vulnerable to a number of developmental disorders including dyslexia. Delayed motor and language development and familial occurrence of dyslexia and/or related learning disabilities are considered risk factors of dyslexia (Helland, Plante, & Hugdahl, 2011).

Taken together, the findings suggest that dyslexia is a multifactorial trait in which basic constitutional (genetic) vulnerabilities (notably in phonological skills) interact with other cognitive skills and environmental factors to produce an increased risk of dyslexia in a continuous way. Arguably, when the level of risk reaches a certain threshold, the classic dyslexia profile emerges (Vellutino et al., 2004).

4. THE "READING BRAIN": NEURAL SYSTEMS OF READING AND FUNCTIONING OF "DYSLEXIA BRAIN"

4.1. NEURAL SYSTEMS FOR READING

Converging evidence indicates **three important systems** in reading (word identification), in **the left hemisphere** (see Figure 2). These include an anterior system and two posterior systems:

1. anterior system in the left inferior frontal region (Broca's motor speech area);

2. dorsal parieto-temporal system involving angular gyrus, supramarginal gyrus and posterior portions of the superior temporal gyrus;

3. ventral occipito-temporal system involving portions of the middle temporal gyrus and middle occipital gyrus (Pugh et al., 2001, 2005; Stein, 2008).

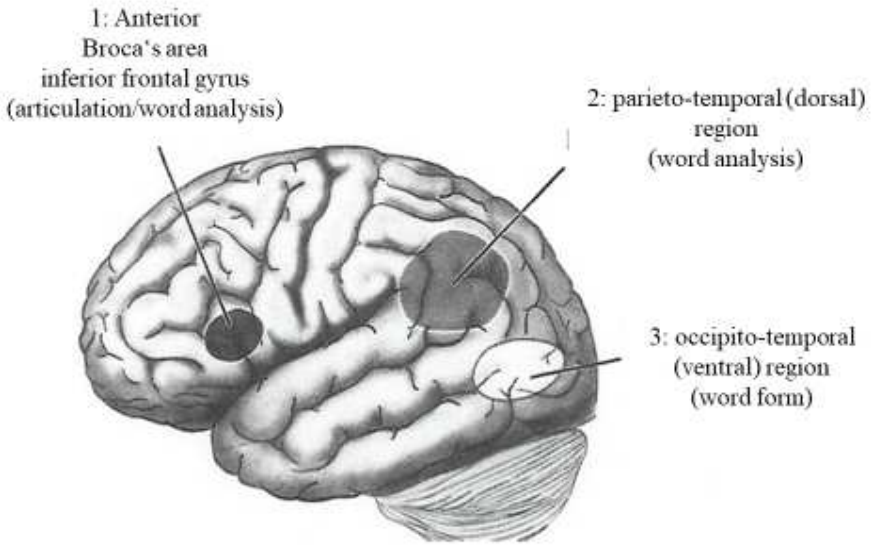

Figure 2. Neural systems for reading. *Source: Shaywitz et al., 2002; Pugh et al., 2001, 2005*

These three systems are critical in the development of skilled, automatic processing of words (Shaywitz et al., 2002; Pugh et al., 2005):

1. **word analysis** (parieto-temporal (dorsal) region, operating on individual units of words such as phonemes, requiring attentional resources and processing relatively slowly; operating in in mapping visual percepts of print onto the phonological and semantic structures of language). This system is associated with decoding and is critical for extracting and learning the relationships between the orthography and its phonological forms, it predominates in beginning readers who will eventually become skilled readers as it first learns to decode print.

2. **word form** (occipito-temporal (ventral), operating on the whole word; a system that does not require attention and processes very rapidly on the order of 150 msec after a word is read), functioning as a visual word form area (VWFA). The VWFA appears to respond

preferentially to rapidly presented stimuli and is engaged even when the word has not been consciously perceived,

3. **articulation/word analysis** (anterior: inferior frontal gyrus, associated with articulation and also serves an important function in silent reading and naming). This system is associated with phonological recoding during reading, among other functions (e.g., phonological memory, syntactic processing); the more anterior aspects of inferior frontal gyrus seem to play a role in semantic retrieval. The phonologically relevant components of this multifunctional system, like the temporo-parietal system, are more strongly engaged by low-frequency words and pseudowords than by high-frequency words, and by low-frequency words with inconsistent orthographic-to-phonological mappings. There is a speculation that this system operates in close conjunction with the temporo-parietal system to decode new words during normal reading development.

4.2. ON DISTINCTION BETWEEN THE DORSAL AND VENTRAL NEURAL CIRCUITS

In skilled readers, the **dorsal circuit** responds with greater activation to pseudowords and low-frequency words (words that must be decoded effortfully) than to familiar high-frequency words. The increased response to unfamiliar stimuli by the dorsal system suggests that it is engaging in decoding, an effortful phonological analysis.

The ventral system shows the opposite response profile with higher activation to familiar words than to pseudowords. The ventral circuit appears to support a type of processing that depends strongly on familiarity (i.e., memory): activation is higher for well-learned words. Further evidence that suggests this distinction shows that simple word identification tasks make maximum demands on ventral sites with limited demands on dorsal sites, while tasks that involve phonological or semantic analysis show heightened dorsal responses (Pugh et al., 2001).

The neural process of reading may be characterized as follows: in beginning readers, there is an increase in activity in the left temporal–parietal cortex (attributed to phonological processing) accompanied by decreasing activity in right infero-temporal cortical areas

(attributed to decreasing reliance on 'visual engrams'). As fluency increases a gradual reduction in activity in the left temporal-parietal cortex and increasing activity in the left ventral occipital–temporal cortex (the so-called visual word form area) reflecting fast, direct access to lexical or semantic processing (Nicolson, Fawcett, Brookes & Needle, 2010).

4.3. FUNCTIONING OF "DYSLEXIA BRAIN"

Dyslexia is a neurobiological condition as evidence for a neurobiological basis for dyslexia comes from post-mortem examinations and brain imaging of individuals with dyslexia (Scerri & Schulte-Körne, 2010). Differences in brain structure and function, particularly in left hemisphere temporal region, have been observed when people with dyslexia have been compared with normal readers (Snowling, 2005). Anomalies of cell migration have been observed by researchers in the perisylvian cortex of dyslexia brain, predominantly in the left hemisphere, and with a much greater prevalence than in control brains. Many studies have demonstrated **altered activity of the left hemisphere regions** (in parieto-temporal, inferior frontal gyrus and occipito-parietal) in the brain of individuals with dyslexia (Scerri & Schulte-Körne, 2010; Finn et al., 2013).

Using a variety of functional neuroimaging techniques, researchers have demonstrated **increased activity** in left inferior frontal gyrus (LIFG or Broca's territory) in the left hemisphere of individuals with dyslexia as a function of reading task demands, a result suggesting engagement of compensatory mechanisms in response to the difficulty of reading (Odegard et al., 2008). In contrast to skilled readers, individuals with dyslexia frequently show a relative **underactivation of left parieto-temporal and occipito-temporal regions** (Rimrodt et al., 2010). However, it is often observed that the equivalent **right-hemisphere homologs** display **increased activity** in dyslexia brain; perhaps as a compensatory measure (Odegard et al., 2008; Scerri & Schulte-Körne, 2010; Finn et al., 2013).

Findings of Finn and colleagues (2013) suggest that individuals without dyslexia are better able to integrate visual information and modulate their attention to visual stimuli, allowing them to recognize words on the basis of their visual properties, whereas individuals with

dyslexia recruit altered reading circuits and rely on laborious phonology-based "sounding out" strategies into adulthood (Finn et al., 2013).

In sum, recognition of neural systems allows researchers to suggest an explanation for the brain activation patterns observed in children with dyslexia. Rather than the smoothly functioning and integrated reading systems observed in non-impaired children, disruption of the posterior reading systems results in children with dyslexia attempting to compensate by shifting to other, ancillary systems, for example, anterior sites such as the inferior frontal gyrus and right hemisphere sites. The anterior sites, critical in articulation, may help the child with dyslexia develop an awareness of the sound structure of the word by forming the word with his/her lips, tongue, and vocal apparatus and thus allow the child to read, albeit more slowly and less efficiently than if the fast occipito-temporal word identification system were functioning. The right hemisphere sites may represent the engagement of brain regions that allow the poor reader to use other perceptual processes to compensate for his or her poor phonological skills. A number of studies of young adults with childhood histories of dyslexia indicate that although they may develop some accuracy in reading words, they remain slow, non-automatic readers. In conclusion, in readers with dyslexia disruption of both dorsal and ventral left hemisphere posterior reading systems underlies the failure of skilled reading to develop, whereas a shift to ancillary systems in left and right anterior regions and right posterior regions supports accurate, but not automatic, word reading (Shaywitz et al., 2002).

5. COGNITIVE THEORIES OF DYSLEXIA

The first theories of developmental dyslexia postulated underlying deficits in visual processing („word blindness"). Recent evidence from developmental psychology, genetics, and brain imaging suggests, however, that the central deficit in developmental dyslexia is a linguistic one; as learning to read and write is actually a linguistic process (Goswami, 2015).

Because different areas of cognitive functioning are affected in dyslexia, it has proven particularly difficult to put forward a unified theoretical framework that is able to provide a satisfactory explanation for this complex picture of cognitive impairments (Ramus et al., 2003; Szmalec et al., 2011). Instead, influential accounts of dyslexia have focused on key

aspects of impaired language processing, in **the phonological deficit theory** (e.g., Vellutino, Fletcher, Snowling, & Scanlon, 2004), on associated auditory and visual–sensory problems in **the magnocellular deficit theory** (Stein, 2001) and on motor learning dysfunctions in **the automaticity/cerebellar deficit theory** (Nicolson & Fawcett, 1995). The most dominant and influential theory to explain dyslexia is the **phonological deficit theory.**

5.1. THE PHONOLOGICAL DEFICIT THEORY

The predominant etiological view of dyslexia is the **phonological deficit theory,** which postulates that reading and spelling difficulties originate from a cognitive deficit that is specific to the mental representation and processing of speech sounds (Ramus & Ahissar, 2012; Couvignou, Peretz & Ramus, 2019).

Genetically driven focal cortical abnormalities such as ectopias and microgyri, in specific areas of left perisylvian cortex involved in phonological representations and processing, are the primary cause of dyslexia (see Figure 3). This is consistent with: (a) anatomical studies of dyslexic brains showing loci of cortical abnormalities; (b) functional brain imaging studies showing that the very same areas are involved in phonological processing, and show abnormal activation in individuals with dyslexia. **The phonological deficit** (and poor performance of individuals with dyslexia) is manifested in three main areas:

1. *Phonological awareness* (the ability to explicitly attend to, judge, and manipulate speech sounds),

2. *Verbal short-term and working memory* (the ability to temporarily maintain phonological representations active in short-term storage, ability to manipulate and repeat words or pseudowords),

3. *Rapid lexical retrieval* (the ability to retrieve and name lists of digits, colours, or objects) (Galaburda et al., 2006; Ramus & Ahissar, 2012).

Such a phonological deficit seems to play a causal role in the development of poor reading and spelling skills. These difficulties compromise the child's ability to learn alphabetic mappings between sounds and letters for reading and for spelling (Snowling, 2005).

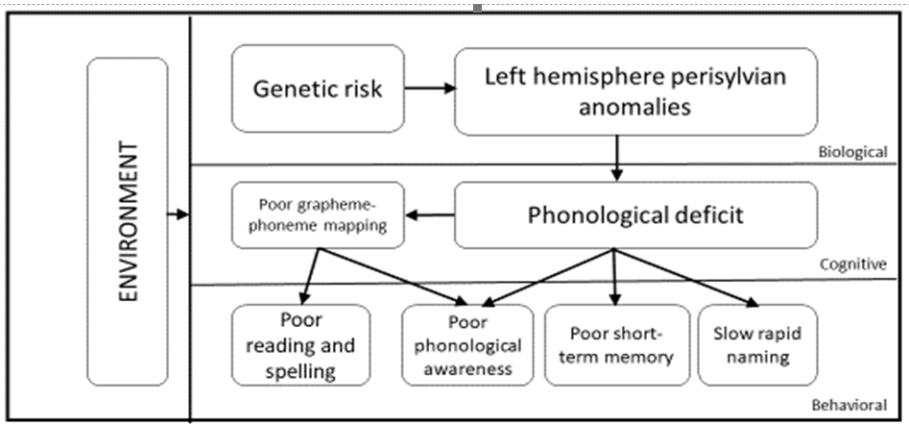

Figure 3. Phonological deficit theoretical model. *Source: Ramus et al. (2003), Ramus (2004)*

To learn to read, a child must first develop an appreciation of the segmental nature of speech and come to realize that spoken words are composed of the smallest of these segments – the phoneme. This appreciation of the segmental nature of speech is termed phonological awareness. Subsequently, the beginning reader must also understand that written words, too, possess an internal phonological structure that is the same as the spoken word. It is phonological awareness and the understanding that the constituents of a printed word bear a relationship to phonemes that allows the reader to connect printed words to the corresponding words in his/her speech lexicon (Pugh et al., 2001).

The phonological deficit hinders children to become aware of phonemes as segments of spoken words. Without awareness of phonemes, letters of written words cannot be mapped on their corresponding phonological segments. More specifically, children with dyslexia have difficulty understanding that spoken words are made up of individual sounds (i.e. phonemes), and that those sounds map to letters in written language. This affects the extraction of grapheme–phoneme rules, which are critically involved in the acquisition of self-reliant word decoding. The difficulty with decoding of novel letter strings is seen as the main hurdle for children with dyslexia in learning to read, and may secondarily affect the build-up of the orthographic word lexicon (Wimmer & Schurz, 2010).

A considerable amount of research has found that children with dyslexia perform significantly worse than typically developing children on measures of phoneme awareness, which requires the ability to make explicit judgements about the sound structure of words. Unlike phonological awareness, phonological processing (such as non-word repetition, RAN) requires the use of speech and is free of metacognitive demands. Children with dyslexia also perform poorly on measures of phonological processing supporting the idea that they have poorly specified phonological representations – difficulties with which the brain codes phonology. Further support for the phonological deficit theory comes from longitudinal studies which suggest that children's early phonological skills and letter knowledge play a causal role in their later reading development. (Snowling, Gooch & Henderson, 2012).

In conclusion, the phonological deficit theory is successful in accounting for the reading failure, the non-word reading deficit and the weak spelling skills, characteristic of individuals with dyslexia. However, some researchers have identified a range of difficulties associated with dyslexia not easily accounted for by this theory (Snowling, Gooch & Henderson, 2012). Developmental dyslexia is thus currently best conceived as a subtle linguistic deficit that involves an impairment in the representation of the phonological structure of the speech signal in the brain (Goswami, 2015).

5.2. ALTERNATIVE CAUSAL THEORIES OF DYSLEXIA

Some researchers have identified a range of difficulties associated with dyslexia not easily accounted for by the phonological deficit theory. Proponents of the **double-deficit hypothesis** of dyslexia (Wolf & Bowers, 1999), suggest that some children with dyslexia have impairments in phonology, others have problems in temporal processing and perceptual speed and a third group has impairments in both. The **magnocellular deficit hypothesis** (Stein, 2001) suggests that individuals with dyslexia have impairments in processing rapidly presented auditory and visual stimuli resulting from impairments in the magnocellular pathway in the brain.

Other researchers (Nicolson & Fawcett, 1995) argue that the apparent link between reading disability and timing deficits is associated with abnormal cerebellar activation and

functioning; this has been termed the **automatization deficit/cerebellar deficit** hypothesis. This theory suggests that children with dyslexia have problems automatizing cognitive/motor skills and impaired time perception – difficulties that originate from mild cerebellar dysfunction. In support of this, the cerebellum has been implicated in motor activities, balance, skill automatization and adaptive learning, and in perceptual tasks that require the precise representation of temporal information (Snowling, Gooch & Henderson, 2012).

6. THE CHARACTERISTICS OF DYSLEXIA

Dyslexia characteristics are broad and abundant. It is important to note that a child should have multiple signs of dyslexia that persist over a prolonged period with some sort of pattern (Huffman, Shaw & Thompson, 2020).

The manifestation of dyslexia comprises of two types of signs – *primary* and *secondary*. Primary signs are the core ones that are present in nearly 100% of the cases. Secondary signs are not as frequent, but are more prevalent among individuals with dyslexia than compared with normal readers and spellers (Tønnessen, 1997). Additionally, researchers and practitioners alike recognize the potential for dyslexia to occur along a continuum of severity. Dyslexia characteristics can range from very mild to severe and overlap with other disorders (such as dyspraxia, attention deficit disorder etc.) (Stein, Talcott & Witton, 2001; Milani, Lorusso & Molteni, 2010; Brady, 2019; Odegard, 2019).

6.1. THE PRIMARY SIGNS OF DYSLEXIA

Difficulties to read and spell accurately and fluently separate words are the *main primary difficulties* faced by children with dyslexia in school years (Milani, Lorusso & Molteni, 2010).

Dyslexia is a *developmental disorder* and the manifestation of dyslexia changes as the child develops. The behavioural profile of dyslexia depends not only on age, but also on severity of the disorder, from a pattern of difficulties of phonological awareness and letter-sound connections in the pre-school years to the more specific profile of reading and spelling

difficulties in the school years (Snowling, 2005; Snowling, Muter & Caroll, 2007). In addition, the profile of dyslexia difficulties differs due to the *written print system* used to learn reading and writing skills, the *teaching method* and *intervention strategies* used to compensate for the dyslexia difficulties (Gedutienė, 2017).

The main difficulties of dyslexia in children aged 6 to 10 include:

I.Difficulties in phonological awareness

II. Difficulties in acquisition of letter-sound connection

III. Difficulties in accurate and fluent reading

IV. Difficulties in spelling and writing

DIFFICULTIES IN PHONOLOGICAL AWARENESS

- Difficulties breaking down words into sounds
- Difficulties to play phonological games

DIFFICULTIES IN ACQUISITION OF LETTER-SOUND CONNECTION

- Difficulties learning the names and sounds of letters
- Difficulties associating letters with sounds

DIFFICULTIES IN ACCURATE AND FLUENT READING: Reading errors

Students with dyslexia will often read words one at a time in isolation, laboriously, very slowly, monotonically, with no expression and with a high degree of inaccuracy (Snowling, 2005; Huffman, Shaw & Thompson, 2020). Inaccuracies could include:

- misreading: omissions, substitutions or additions of letters, syllables and small function words
- reversals, confusions of letters: *b–d*, *u–n*, *n–v*, *p–b*, *m–n*
- inversions, sequential errors, confusion the order of letters in words: *was* for *saw*, *dog* for *god*, *huose* for *house*

- limited sight-word recognition of familiar words
- difficulties to read unfamiliar words
- guessing the end of the word
- reading letter by letter or by syllable
- ignorance of the punctuation symbols while reading
- skipping words or losing reading place (words, lines) while reading (using a finger)

Difficulties with spelling is typical characteristic of dyslexia (Huffman, Shaw & Thompson, 2020).

DIFFICULTIES IN SPELLING: Spelling errors

- omissions, substitutions or additions of letters, syllables and words
- inversions, sequential errors, confusion the order of letters in words
- phonetic spelling
- many pauses while writing words or copying it from the board
- poor handwriting
- very slow/slow speed of writing
- poor organization of written text

The **main differential characteristics of children with dyslexia** are the number of typical, specific reading and spelling errors and slow, laborious, not automatized reading and writing, compared to other children (Odegard et al., 2008; Vellutino et al., 2004; Hudson et al., 2007).

After reading or writing for only a short time, children with dyslexia could become visibly tired from working so hard. To read and spell accurately and fluently separate words are activities that require huge cognitive efforts. Because of spending so much time and energy on decoding the words, secondary consequences may include problems in reading comprehension and reduced practice reading (Shaywitz, 2005; Corona et al., 2012). This does

not mean that the students with dyslexia have a comprehension problem; therefore, students with dyslexia often do very well with listening comprehension, as they are not spending the energy having to decode words (Huffman, Shaw & Thompson, 2020). The slow and not automatized writing of separate words affects the writing of coherent and comprehensive text.

Children with dyslexia typically are trying to avoid reading and writing whenever is possible (Warnke, 1999; Høien & Lundberg, 2000; Williams, 2006; Fawcett & Nicolson, 2008; Roundy & Roundy, 2009; Huffman, Shaw & Thompson, 2020).

Students with dyslexia especially avoid writing, finding it stressful and exhausting; written work may take a long time and be illegible, full of spelling errors, with little punctuation and poor organisation. Many students with dyslexia have poor fine motor skills and handwriting is slow, laboured and non-automatic, lacking fluency. They may be unable to write continuously without frequent rests. There may be unusual spatial organisation of the page with words widely spaced or tightly squashed together with margins ignored and writing off the line. Messy written work may result in a reader assuming carelessness and content that matches presentation – which is not necessarily the case for many students with dyslexia who have done the best they can (Thomson, 2008).

It is important to remember that children identified at different ages may have differing patterns of cognitive deficit, for example, word decoding and spelling difficulties predominate in the early school years. Generally, reading and spelling difficulties are persistent and do not disappear with time, although they can clearly be alleviated to a certain extent if appropriate corrective therapy is given. When associated with high IQ, compensation of accurate reading, but not spelling, by the child until the fourth grade or later often occurs (Warnke, 1999). Many students, who compensate reading skills, still have great difficulty encoding. These students even have difficulties spelling high frequency words. However, during adolescence and adulthood, individuals who have compensated early reading difficulties still face problems with spelling or written expression (Snowling, 2005; Helland, Plante & Hugdahl, 2011; Huffman, Shaw & Thompson, 2020).

6.2. THE SECONDARY SIGNS OF DYSLEXIA

Dyslexia is not just a difficulty to read and write accurately and fluently separate words; most children with dyslexia have other additional difficulties (Stein, Talcott & Witton, 2001). Difficulties are often experienced with other symbol systems, e.g., numbers and musical notation (Frauenheim & Heckerl, 1983). Up to 50 per cent have some mathematical difficulties (Ott, 2007).

DIFFICULTIES OF SHORT-TERM AND LONG-TERM VERBAL MEMORY

Most children with dyslexia experience difficulty in remembering lists of information, even short lists, or short instructions (Pollock, Waller & Pollit, 2004; Reid, 2011). Children with dyslexia have trouble with long-term verbal learning. This problem may account for many classroom difficulties, including problems memorizing the days of the week or the months of the year, mastering multiplication tables, and learning a foreign language (Snowling, 1998). Children with dyslexia usually face difficulties regarding their verbal short-term memory because they possess a smaller information storage capacity than others (Hachmann et al., 2014); it is difficult for them to memorize linguistic information (Guardiola, 2001) or remember numerical facts, date and time, learn the multiplication table (Miles, 2009). Most people with dyslexia have trouble remembering sequential information (Hachman et al., 2014).

Hackmann and colleagues (2014) research results indicate that dyslexia is related to a specific impairment in short-term memory for sequential order, but not item information. Individuals with dyslexia performed worse than controls in serial order tasks across verbal or nonverbal material and this specific impairment may lead to the language problems that are characteristic for dyslexia. Assuming that a deficit in serial order processing and sequence learning leads to impaired acquisition of orthographical as well as phonological word form representations, the integration of written language as a format for representing linguistic knowledge that is characteristic for a normal development is hindered. Unstable encoding and consolidation of long-term knowledge will in turn result in a lack of automatization and a delay in reading development and subsequently lead to insecurity about orthographic word forms to individually varying degrees.

For example, most individuals with dyslexia tend to have *poor sequencing* in general so that they find it difficult to recite the days of the week or the months of the year in the correct order, particularly backwards (Frauenheim & Heckerl, 1983; Griffiths, 2007; Stein, Talcott & Witton, 2001).

Individuals with dyslexia also have some difficulty organizing and expressing their ideas, especially in structured situations where a relatively specific response was required. This tendency was less noticeable in conversation situations. Subtle word finding problems are evidenced along with syntactical errors. Language usage tends to be concrete (Frauenheim & Heckerl, 1983).

DIFFICULTIES ASSOCIATED WITH TIME AND ORIENTATION

Some children with dyslexia have a poor sense of time as well as poor language associated with time. Words such as "today", "tomorrow", "yesterday" are challenging and cause confusion (Ott, 2007). Reading a clock and telling the time can be problematic for some individuals with dyslexia. The language associated with the time can be confusing. Individuals with dyslexia also have difficulties with calculating or estimating how long it will take to do something (Ott, 2007).

Children with dyslexia have difficulty acquiring and expressing concepts of time, dimension, quantity, directional and geographical information. For instance, they have difficulty learning the names of the months in sequence, associating months with seasons, or holidays with months. Many of individuals with dyslexia show mixed handedness and left/right confusion (Stein, Talcott & Witton, 2001).

MOTOR DIFFICULTIES

It is also noticeable, that some individuals with dyslexia have problems with their motor skills, motor coordination and balance, such as general clumsiness, difficulties throwing and catching the ball, learning to ride a bicycle, jumping, dancing, clapping a certain rhythm, multitasking, maintaining balance, etc. (Nicolson & Fawcett, 1995; Ott, 2007; Fawcett & Nicolson, 2008; Brookes et al., 2010). Some children with dyslexia have problems with motor skills and they frequently regarded by others as clumsy (Ott, 2007). Some children are slow at

dressing, especially at doing up shoelaces or buttons. Some children with dyslexia have problems with motor skills including balance.

6.3. THE STRENGTHS OF DYSLEXIA

Dyslexia is not only a combination of certain difficulties; it includes a range of specific abilities, which related to the activity of the right hemisphere of the brain (Thomson, 2008). Disparity between learning difficulties and exceptional abilities is often noted in students with dyslexia profile (Thomson, 2008).

Children with dyslexia have a different and individual way of processing information. Children with dyslexia usually have a visual, right-brained global information processing style (Reid, 2011; Bacon & Bennett, 2013). More pupils with dyslexia displayed a preference for a right hemisphere thinking style (either cause or consequence of dyslexia) which is reflected by reduced left-hemisphere involvement during reading in Vlachos and colleagues (2013) study. Some parts of the brain responsible for the visual-spatial processing become more active when a person with dyslexia is reading. Singleton with colleagues (2009) mentioned studies in which children and adolescents having dyslexia score significantly higher on visual processing tasks. Results of various studies show that most of the students with dyslexia have good visual and spatial abilities, excellent memory of colors, spatial imagination, and they able successfully operate with images in three-dimensional space. For example, Everatt and colleagues (1999, cit. Everatt et al., 2008) found that adults with dyslexia produced higher scores on a drawing creativity task compared to matched non-dyslexics.

Some students with dyslexia have been found to have exceptional abilities such as creative and artistic talents, discovery of unexpected logical connections, the ability to see the “whole“ picture, the ability to solve problems creatively, extraordinary determination and dedication to hard work. This allows students with dyslexia to achieve great results in fields such as architecture, mechanics, engineering, design, computer technology, and the fine arts (Høien & Lundberg, 2000; von Károlyi, 2001; Bacon & Bennett, 2013). It is well known that many eminent scientists and technicians have or have had clear dyslexic problems. Many people

with dyslexia distinguish themselves in subjects that demand creativity and new ideas (for example, architect Richard Rogers, businessman Richard Branson etc.) (Høien & Lundberg, 2000; Ott, 2007). Students with dyslexia combine and use all of their senses to learn and solve problems, often providing original and creative solutions. Moreover, they usually characterized by others as having insight, intuition and higher sensitivity to the environment and empathy to other people (Høien & Lundberg, 2000).

Thomson (2008) claimed that students with dyslexia may be talented in performance-related activities or gifted academically (e.g. they may be superb athletes, have good problem-solving skills or strongly developed spatial awareness), but they often fail to achieve at a level commensurate with their ability because of their dyslexia, perhaps even appearing to lose interest, becoming frustrated or bored and disruptive.

However, the relationship between dyslexia and creativity is still an unresolved issue. Although little empirical research has been done to establish this relationship, several assumptions can be proposed in explaining the nature of the hypothetical association between dyslexia and creativity (Wolff & Lundberg, 2002):

1. Good visual skills and creativity might represent a compensation contributing to the evolutionary resistance of the dyslexic genes.

2. There might be a more general factor, which has caused both dyslexia and creativity without any direct causal connection between the two conditions.

3. The association between dyslexia and creativity might reflect compensation for early failure in highly valued skills in school. Thus, children with dyslexia tend to look for opportunities to succeed in other areas.

4. The difficulties experienced with reading and writing and the resulting frustration may activate original and unconventional coping strategies and modes of thinking.

5. The association might be an illusion based on the discrepancy between literacy achievement and artistic talent. Such talents might be equally distributed among non-dyslexics and dyslexics, but they are just more visible among individuals with dyslexia. Individuals without dyslexia have their doors wide open to any field whereas

talented individuals with dyslexia are restricted to non-verbal domains, such as art, design and crafts.

A deeper understanding of the nature of the connection between dyslexia and a range of specific abilities might be obtained by more detailed and neuro-biologically oriented studies.

7. THE PREVALENCE OF DYSLEXIA

The prevalence of dyslexia depends on the precise definition and criteria used to define it in different countries. Research suggest that dyslexia represents the low end of a normal distribution of word reading ability. Thus, to assess the disorder a somewhat arbitrary cut-off must be set on a continuous variable. A common definition sets the cut-off for reading achievement 1.5 standard deviations below the mean for age and identifies 3 – 17.5 % of the population as having dyslexia (Snowling, 2005; Peterson & Pennington, 2012; Snowling, 2013).

7.1. THE PREVALENCE: DIFFERENT PRINT SYSTEMS

Dyslexia is found in all languages studied so far, although its manifestation differs with orthography (Goswami, 2015). Dyslexia has been reported as a disorder associated not only with alphabetical or syllabic characters, but also with those of a logographic nature (Benitez-Burraco, 2010). In the case of alphabetical systems, the prevalence of dyslexia depends on the specificity of orthography – how is transparent writing system is. The orthographies of alphabetical languages can be described as transparent and opaque, so the prevalence of dyslexia varies by languages and countries (see Table 1). Among alphabetic languages, English is especially difficult to learn because the mapping between letters and sounds is less consistent than in most other languages.

Table 1. The prevalence of dyslexia in different print systems

Print system	Language	Percentage	Country: authors
ALPHABETICAL PRINT SYSTEM			
TRANSPARENT	Italian	3.2–35	Italy: Stella, 2004; Barbiero et al., 2012
	Flemish	3	Netherlands: Hellendoorn & Ruijssenaars, 2000
	Spanish	3.2–5.9	Spain: Soriano-Ferrer & Echegaray-Bengoa, 2014
	French	3.5–5	France: Le Jan et al., 2011; Leonova, 2012
	Swedish	5	Sweden: Andersson, 2004
	Russian	~5–10	Russia: Kornev, Rachlin & Grigorenko, 2010
	German	3–8 ~14	Germany: Döhla & Heim, 2016; Branderburg et al., 2015
	Czech	~8	Czech Republic: Zelinkova, 2004
	Greek	~9	Greece: Padeliadu & Sideridis, 2000
OPAQUE	Danish	3–7 ~12 (adults)	Denmark: Jandorf, Haven & Nielsen, 2004; Elbro, Moller & Nielsen, 1995
	English	5–10	UK: Taylor & Walter, 2003; Undheim, 2009
		10–12	UK, USA, Australia: Wydell, 2012
		5–17,5	USA: Vellutino et al., 2004; Helland et al., 2011; Eicher & Gruen, 2013
NON-ALPHABETICAL PRINT SYSTEM			
Chinese		4–8 3,9	China: Meng & Zhou, 2004; Sun et al., 2013
Japan print systems		3–4 Kana 5–8 Kanji	Japan: Todo, 2004; Ogino et al., 2011

Persian	5,2	Iran: Pouretemad et al., 2011

7.2. THE PREVALENCE OF DYSLEXIA: GENDER DIFFERENCES

There is a controversy within the research literature concerning whether boys are more likely than girls to experience reading and writing difficulties (Berninger et al., 2008; Wheldall & Limbrick, 2010). Most data from population based (epidemiological) studies provides results in a consistent fashion: boys face a greater risk of dyslexia than girls do. However, the ratio of boys and girls affected by learning difficulties varies from country to country, ranging from 1,2:1 to 6,78:1 (Berninger et al., 2008; Hawke et al., 2009; Liederman, Kantrowitz & Flannery, 2005; Raskind, 2001; Rutter et al., 2004; Quinn & Wagner, 2015). The results indicate higher gender ratios with increasing severity of the disorder, especially when it comes to spelling difficulties (Hawke et al., 2009; Berninger et al., 2008; Landerl & Moll, 2010).

Findings from several recent studies confirmed that more boys than girls experience reading problems, but these differences in incidence may be more modest than previous research has suggested; for example, Wheldall and Limbrick (2010) analysed the evaluations of nearly one and a half million Australian children‘s reading abilities between 1997 and 2006. They concluded that the average ratio was 1,77:1. Similarly, after analysing the reading skills of nearly half a million second graders, Quinn and Wagner (2015) found the ratio to be 2,11:1.

There is no direct answer as to why boys happen to have more reading and writing difficulties than girls. Gender difference may be due to a higher likelihood for boys to be identified. More boys than girls had been referred for assessment, suggesting that boys with dyslexia difficulties come to the notice of teachers more frequently than girls, perhaps because they compensate less well or behave more disruptively. Boys tend to express frustration and tension more by behavioral difficulties (e.g. aggressive behavior) (Fink, 1998; Shaywitz, 2003; Liederman et al., 2005; Snowling, 2005; Quinn & Wagner, 2015). At the same time, a portion of girls facing dyslexia remains undiagnosed and they are not able to receive the necessary help (Liederman et al., 2005). For example, the results of Quinn and Wagner (2015) research showed that correspondence between identification as an impaired reader by their

study criteria and school identification as learning disabled was poor overall and worse for girls; only 1 out of 4 boys and 1 out of 7 girls in their study were identified as reading impaired in school.

In conclusion, the prevalence of dyslexia among the genders differs. To some extent, it could be explained that boys tend to be more vulnerable to the genetic, neurobiological, and environmental factors than girls. However, the boys' vulnerability to the aforementioned factors is still an open discussion so the question regarding males being more prone to dyslexia needs to be solved in the context of the multidimensional studies.

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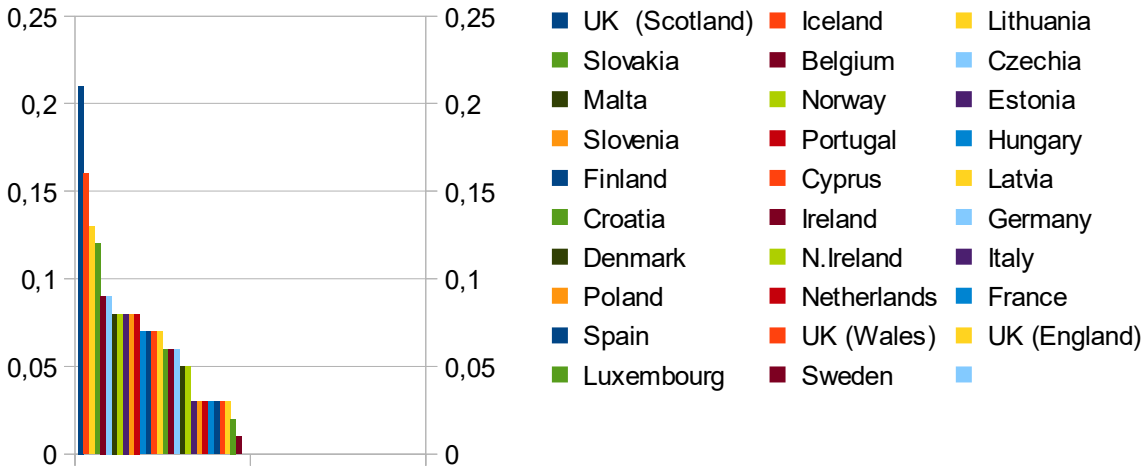
CHAPTER 3: EARLY IDENTIFICATION OF LEARNING DISABILITIES

INTRODUCTION

From time to time everyone might be struggling with learning and behavior issues. As we live in the world that is changing rapidly every single day, this fact is actually nothing surprising. However, if the problems persist for a longer time and start causing other difficulties, they might be a sign of an underlying learning disability (LD) or attention deficit disorder (ADHD). Inconsistent progress or delays in mastery of skills and behaviors, even in children as young as 4 or 5, should not be ignored. It is important for parents, educators, and other caregivers to monitor closely and share concerns with each other so that targeted screening or assessment can take place. Then students can get the help they need as soon as possible - before they experience self-doubt, frustration, and failure. Because of the stereotypical thinking that proposes: my child will grow and everything will fall into right places – there is a possibility to miss that early intervention point which is extremely significant.

Worldwide, approximately 800 million young children are affected by biological, environmental and psychosocial conditions that may limit their cognitive development. In Europe, the number of children with special educational needs (SEN) is 15 million, according to recent estimates. Estimates suggest that dyslexia, a learning disability that affects the ability to read, affects around 6 per cent of the European population, while the prevalence of autistic spectrum disorders (ASDs) is also higher than previously thought. According to researches done by the Autism Spectrum Disorders in Europe, the data shows that within eleven EU Member States that took part in the statistical survey, as many as 1 child in 89 may be affected by ASD. (European Comission, 2018)

Fig.1. Percentage of children with SEN within the whole school population by country



Statistical data (Fig.1.), gathered and published by European Agency for Special Needs and Inclusive Education, give an insight into the percentage of children with SEN within the whole school population in each country (European Agency for Special Needs and Inclusive Education, 2018). Although he numbers might not seem troubling or concerning, unfortunately they are increasing.

Children with SEN often leave school with low qualifications and are at much higher risk of becoming unemployed or economically inactive. According to European Parliamentary Research Service, at European Union (EU) level, only 50.6 % of persons with disabilities are employed, compared to 74.8 % of persons without disabilities. The unemployment rate of persons with disabilities in the EU, aged 20- 64, is 17.1 % compared to 10.2 % of persons without disabilities, and the EU activity rate of persons with disabilities(percentage of active personsin relation to the comparable total population) is only 61.0 % compared to 82.3 % of non-disabled people. (Anglmayer I, 2017)

In addition to these concerns, parents of children with SEN experience a lot of stress. If they are not adequately supported, not only does the child's development suffer, but the whole family unit can be put under considerable strain. (National Center of Learning Disabilities, 2020) That is why, one of the most effective ways to ensure success is to involve families in their children's education. While family involvement benefits all students, children with disabilities often require a higher level of parental involvement and advocacy than peers without disabilities in order to receive the same level of instruction as the general student

body. Children with disabilities often face multi-faceted challenges in the classroom that require special attention from teachers and active engagement from their families.

Educators also experience challenges when thinking on how best to engage families in caring for children with disabilities. Although many educators are aware of the value of engaging families, they may lack training on how to go about it, especially when trying to include families in daily instruction or the Individualized education program. Early childhood years are extremely important. That is why an educator might be the person who notices and addresses the issues. According to Virginia Commonwealth University researchers Carol and James Beers, early identification and intervention provides teachers with the opportunity to work with both parents and children before everything influences further development. (Beers, C., & Beers, J., 1980)

There are a lot of challenges, however, the greatest part of them can be overcome. Early intervention, strong home-school partnerships based on ongoing dialog and engagement can help to solve many of the concerns of both families of children with disabilities and educators Undoubtedly, early recognition of warning signs, targeted screening and assessment, effective intervention, and ongoing progress monitoring are critical to helping children with LD succeed in school, work and life.

1. THE IMPORTANCE OF EARLY IDENTIFICATION

While the world is developing in a lot of aspects, like technologies and security matters, it might seem that we are heading towards well-being and prosperity. Of course, it could not be doubted for all 100%; however, if we think about people, especially children, the development might go the other way. There is a worldwide increase in the prevalence of children being diagnosed with learning disabilities (Koegel, Lynn & Koegel, Robert & Ashbaugh, Kristen & Bradshaw, Jessica. (2013)). Thus, intervention as well as identification programs are crucial because of numerous aspects.

Researches show that children's earliest experiences possess a critical role in brain development. The Center on the Developing Child at Harvard University (2008) has summarized this research:

• Neural circuits, which create the foundation for learning, behavior and health, are most flexible or "plastic" during the first three years of life. Over time, they become increasingly difficult to change.

• Persistent "toxic" stress, such as extreme poverty, abuse and neglect, or severe maternal depression can damage the developing brain, leading to lifelong problems in learning, behavior, and physical and mental health.

• The brain is strengthened by positive early experiences, especially stable relationships with caring and responsive adults, safe and supportive environments, and appropriate nutrition.

• Early social/ emotional development and physical health provide the foundation upon which cognitive and language skills develop.

• High quality early intervention services can change a child's developmental trajectory and improve outcomes for children, families, and communities.

• Intervention is likely to be more effective and less costly when it is provided earlier in life rather than later.

Taking into account these aspects, it is clear that early intervention has an extremely important role not only in the development of a child, but has an effect on his / her whole life. If there is a delay in identification, it will be much harder to interfere later. Research has shown that at 9 months of age, only 9% of children who have delays that would make them eligible receive services; at 24 months of age only 12% of children who would be eligible receive services. (Feinberg, E., 2011)

Early intervention is aimed for children from birth to three years of age, and has four primary goals:

1) to support families in supporting their children's development;

2) to promote children's development in vital domains;

3) to promote children's coping confidence; and

4) to prevent the emergence of future problems. (National Children's Bureau, 2004)

Research shows that learning disabilities, when identified early, can be corrected, which helps improve outcomes for affected children as their minds continue to adapt to newly acquired skills. (Learning Center, 2019) Early identification of learning disabilities in a child can help specialists develop methods to improve communication and behavior management that will help the child get along better with other children. As a result, a child's ability to reach his or her academic potential improves when he or she is enrolled in regular education classes. Unfortunately, a great number of early school leavers, are with disabilities which were not identified before and thus created a base for children not to become educated.

The Early Childhood Systems Work group, composed of national leaders from policy and research organizations in the United States, has established a common conceptual framework that recognizes the need for a systemic approach to early childhood development, depicted in the figure below. (Bruner, C, 2019)

It is clear that all services seen in this graph must be available, affordable, of outstanding quality, and accessible to all in need. Their overlap emphasizes that providers in each oval must be able to connect young children and their families with services outside their professional jurisdiction, coordinate with other providers when serving the same child and family, and help other providers play an appropriate role in responding to the needs of children in all dimensions. According to the British Institute of Learning Disabilities (2004), 'research and practice have proven that Early Intervention produces immediate and long-term benefits for children with disabilities, their family and society'.

This topic has been widely discussed not only in Europe or the USA. Learning difficulties can become an issue for all people not regarding their age, race, sex or region. According to the group of child psychologists in Australia (2021), early intervention helps to:

- Address learning difficulties before they become entrenched and lead to other issues such as behavioural and emotional problems.

- Teach specific skills and strategies to focus on strengths and minimise, improve or work around weaknesses.

- Improve performance and educational outcomes.

Basically, it helps children reach full potential as learners. However, intervention programs should be developed according to each child's learning profile.

Children who are initially thought to have lower intelligence than their peers may have normal intelligence but have a learning problem that prevents them from reaching their potential. Failure to recognize the reasons why young children struggle in school will prevent them from getting the help they need to reach their potential, then and later.

Learning disabilities do not disappear. Instead, they tend to become more problematic over time. Falling behind in third grade may not seem like a big problem. By the time they reach fourth and then fifth grade, the effects of the learning disabilities become more apparent, but the children have already fallen far behind. At this point, children feel a lack of self-confidence and become increasingly frustrated, sometimes causing them to snap. On the other hand, if the learning disability is identified early, steps can be taken to help children gain the life skills needed to succeed in adulthood.

Sending a child with a learning disability to a special school can eliminate a number of additional problems. Children with learning disabilities are often held back because they are unable to meet the academic requirements to move on to the next grade. Behavioral problems can occur, and those who make it to high school are more likely to drop out if they do not receive treatment for their learning disability. The earlier learning disabilities are diagnosed and treated, the more likely it is that children will be able to reach their potential. Early diagnosis not only improves the child's ability to reach their academic potential, but also prevents the development of low self-esteem and behavioral problems that further impair the child's ability to learn. Without early diagnosis, the potential to develop the skills they need to live a normal, successful adult life can be severely limited.

2. EARLY WARNING SIGNS OF LEARNING DISABILITIES

Learning to recognize the warning signs of learning disabilities and having children the support they need as soon as possible can be critical to a child's potential success. Although learning disabilities may be detected at all ages, from preschool to high school, it is always best to make the diagnosis as soon as possible.

Every child learns in their own unique way. It is important to understand that disabled children simply interpret information in a particular way. A child's ability to read, write, talk, do math, and form social relationships may all be affected by a learning disability.

Developmental delays in any of the following can suggest the potential for learning disabilities:

- Gross Motor - Large muscle movements such as standing, walking, or pulling up.
- Fine Motor - Small muscle movements such as grasping objects, moving fingers and toes.
- Communication - Ability to understand language or to use speech.
- Cognitive Skills - Ability to think and solve problems.
- Social/Emotional - Ability to interact appropriately with others and show appropriate emotional responses. (University of Michigan, 2010)

During the primary school years, children begin to grow at various rates. Children should be able to read basic chapter books at grade level, write simple sentences, add and subtract, solve simple word problems, and begin to multiply by the time they join third grade. Learning conditions are caused by a variety of factors that are unknown. Genetics and environmental factors, on the other hand, can increase child's chances of having learning disabilities. Learning disorders are not triggered by cultural or linguistic differences, insufficient or improper teaching, socioeconomic status, or a lack of motivation, however these factors can influence child's obstacles.

While developmental milestones are achieved at predictable rates, minor variations in development between children are common. As a result, minor delays aren't necessarily indicative of a crisis. It's crucial to understand normal growth patterns for early childhood so you can spot any potential delays. Nobody is to blame for a learning disorder. Knowing about one's own learning style and appreciating the fact that everyone has different areas of strength is beneficial to all children.

Learning disorders are difficult to diagnose and there is no one-size-fits-all set of symptoms that applies to all children. Furthermore, many children attempt to hide the issue. However,

keep in mind that these warnings signs vary with each child and all signs may not be present. A very strong warning sign is any family history of learning disabilities/difficulty – they are genetic.

This table below presents development milestones covering the following aspects:

- **Motor skills**

There are two categories within the area of motor skills: gross motor and fine motor. Gross motor skills deal with large muscle groups such as walking. Fine motor incorporate the small muscles such as writing

- **Play and Social skills**

Play is voluntary engagement in self motivated activities that are normally associated with pleasure and enjoyment. Play may consist of amusing, pretend or imaginary, constructive, interpersonal (play with others) or intrapersonal (solitary play) interactions. Play is the way that children learn about the environment, their bodies and their place in the world around them.

Social skills are the skills we use everyday to interact and communicate with others. They include verbal and non-verbal communication, such as speech, gesture, facial expression and body language. A person has strong social skills if they have the knowledge of how to behave in social situations and understand both written and implied rules when communicating with others.

- **Phonological Processing and Language skills**

Phonological awareness (sometimes referred to as 'sound awareness') is the awareness of what sounds are and how they come together to make words. Skills include the ability to rhyme, segment words into syllables and single sounds, blend sounds together, identify sounds in different positions in words and manipulate sounds within words

- **Visual – Spatial skills**

Visual perception refers to the brain's ability to make sense of what the eyes see. This is not the same as visual acuity which refers to how clearly a person sees (for example "20/20

vision"). A person can have 20/20 vision and still have problems with visual perceptual processing. Good visual perceptual skills are important for many every day skills such as reading, writing, completing puzzles, cutting, drawing, completing math problems, dressing, finding your sock on the bedroom floor as well as many other skills. Without the ability to complete these everyday tasks, a child's self esteem can suffer and their academic and play performance is compromised

- **Mathematical Competences**

Children begin studying math as soon as they begin to explore the world. Every skill they learn builds on what they already know, from identifying shapes to counting to recognizing patterns. There are a few math milestones that most children reach about the same time. It's important to remember that children learn math skills at various rates. This is how children's math skills usually improve as they grow older.

Motor Skills	Play and Social	Phonological	Language	Visual / Spatial	Mathematical
3-4 years old child should be able to do the following:					
GROSS MOTOR runs around obstacles; walks on a line; balances on one foot for five to ten seconds; hops on one foot; pushes, pulls, steers wheeled toys; rides tricycle; uses slide independently; jumps over six inch high object and lands on both feet together; throws ball overhead; catches a bounce ball	Treating dolls or teddies as if they are alive. Playing beside other children. Using symbols in their play such as a stick becoming a sword. Engaging in play themes which reflect less frequently experienced life events (e.g. visiting the doctor). Playing with mechanical toys. Taking turns with other children. Playing with 2 or 3 children in a group. Engaging in play themes	Ability to produce rhyme emerges at 30-36 months The child may struggle with recognising similarities in letter patterns	Follows 3 part instructions (e.g. point to the cat, the dog and the monkey Understands longer, more complex sentences By 4 years uses nearly 1500 words Tells you what they are doing Tells you the function or use of an object Begins to talk about past events Understands **Who** que stions	Assembling puzzles Recognising colours Recognising shapes Counting 1–10 Recognising the numbers 1–5 Recognising their own name Drawing a picture with detail (head, body, limbs, facial features) Copying block designs of up to six blocks Threading a sequence of small beads Tracing thick lines	Recognize shapes in the real world Start sorting things by color, shape, size, or purpose Compare and contrast using classifications like height, size, or gender Count up to at least 20 and accurately point to and count items in a group Understand that numerals stand for number names (5 stands for *five*) Use spatial awareness to put puzzles together Start predicting cause and effect (like what will happen if they drop a toy in a tub full of water)

FINE MOTOR builds tower of nine small blocks; drives nails and pegs; copies a circle; imitates cross; manipulates clay material (rolls balls, snakes, cookies)	which expand beyond personal experience (e.g. fireman rescuing people). Talking about their feelings. Feeling shame when caught doing the wrong thing.				

4-5 years old child should be able to do the following:					
GROSS MOTOR walks backward toe-heel; jumps forward 10 times without falling; walks up and down stair independently, alternating feet; turns somersault FINE MOTOR cuts on line continuously; copies cross; copies square; prints some capital letters	Begins taking turns and negotiating Plays together with shared aims of play with others Usually prefers playing with other children than playing by themselves Plays imaginatively (e.g. playing in the home-corner, dressing up, cooking) Enjoys playing games with simple rules (e.g. hide and seek) May change the rules of a game as the activity progresses May have difficulties socialising May struggle to copy and learn from others due to poor understanding and attention May have difficulties expressing wants, needs, thoughts and ideas May lead to poor self-esteem due to difficulties interacting with other children	Clapping/counting syllables in words (e.g. computer- **com-pu-ter**). Recognises/produces words with the same beginning sound (e.g.**cat**–**c**up) Segments/blends words by onset/rime (e.g. s+un= **sun**) OR given sounds, can blend them into a word Counts sounds in words (e.g. dog- **d-o-g = 3 sounds**). [Note: 50% of children achieve this by age 5]	Follows the meaning of others' conversations Continuing to expand Can generally understand colour and shape words (e.g. red, square) Can sort objects into simple categories (e.g. animals, food) Minimum of 4-5 word sentences Understands How questions Asks meanings of words Talks about past and future events		Add by counting the fingers on one hand — 1, 2, 3, 4, 5 — and starting with 6 on the second hand Identify the larger of two numbers and recognize numerals up to 20 Copy or draw symmetrical shapes Start using very basic maps to find a "hidden treasure" Begin to understand basic time concepts, like morning or days of the week Follow multi-step directions that use words like *first* and *next* Understand the meaning of words like *unlikely* or *possible*

5-6 years old child should be able to do the following:

GROSS MOTOR runs lightly on toes; walks on balance beam; can cover 2 meters hopping; skips on alternate feet; jumps rope; skates **FINE MOTOR** cuts out simple shapes; copies triangle; traces diamond; copies first name; prints numerals 1 to 5; colors within lines; has adult grasp of pencil;	Plays with other children with shared aims within play. Plays imaginatively for instance playing in the home-corner, dressing up and cooking. Engages in games with simple rules (e.g. hide and seek). Engages in play which includes themes never personally experienced (e.g. going to space). Negotiates during play. Engages in well-organized play.	Able to recognize words that rhyme and determine the odd word out (e.g. cat – hat – **big**) Identifies first sound in a word (e.g. What's the sound at the start of 'dog'? **d**) Identifies last sound in a word (e.g. What's the sound at the end of 'dog'? **g**) Lists words that start with the same sound (e.g. pet, pin) Tells which of three words is different (e.g. sit, sit, sat) Blends 3 – 4 sounds to make a word (e.g. h – a – n – d = **hand**) Segments sounds in words that have 3 – 4 sounds	Follows the meaning of others' conversations Follows multi-step instructions Vocabulary comprehension increases Uses more complex sentences Uses imaginative language in play – likes to pretend and act out stories Tells several attributes about an object Time: yesterday, tomorrow, morning, afternoon, later Uses How and	Writes their name Copies block patterns Builds a six-cube pyramid Completes difficult jigsaws (20 piece)	Counts to 30 and are able to tell the number of a certain object (e.g. there are four pencils on the desk). Groups objects into sets and learn to - count in ones to uncover the size of each set. Uses subtraction by removing items from a group of objects. Uses ordinal numbers and determine which object comes first, second, last and second last in a race. Models multiplication and division by using objects to form equal groups as well as dividing amounts evenly. *Recognizes* different coins and notes and understand their value Increasingly uses

had handedness well established; pastes and glues appropriately		(e.g. hand= **h – a – n – d**:4 sounds)	Where questions		mathematical language and link their mathematical ideas together. Counts backwards from ten. *C*an recognize numbers from 1 to 100. Children aged six should be able to count up as far as 100 in groups of 10s, 10, 20, 30, 40 etc.

3. TOOLS AND SERVICES OF EARLY IDENTIFICATION

Learning is a dynamic task, and although it is difficult to measure, research into learning disabilities has contributed to a better understanding of the mechanisms that could be involved. Learning difficulties are a group of disorders that affect the acquisition, organization, retention, comprehension, and application of verbal and nonverbal knowledge. (Lerner JW, 2000) Reading problems, success on verbal and nonverbal IQ tests, as well as difficulties in oral and written speech, may all be used to diagnose certain disorders.

According to the European Agency (2021), many European countries practices the following system: The appropriate medical committee of the national health system issues a certificate certifying the condition and, as a result, the right to receive the assistance provided by the current legislation. This document is required before the administrative procedures for school inclusion can begin. Following the impairment assessment, a functioning profile is created based on the parameters of the bio-psycho social model of the World Health Organization's International Classification of Functioning, Disability, and Health (ICF) (WHO). Following that, support measures for disabled students are chosen based on the functional profile and the individual education plan. The following people make up the multi-disciplinary assessment unit that creates the working profile:

- a specialized doctor or an expert in the health conditions of the individual pupil;
- a child neuropsychiatrist;
- a rehabilitation therapist;
- a social assistant or a representative of the relevant local authority which is responsible for the subject concerned.

The working profile is created in collaboration with the pupil's parents and a school representative (preferably an educator from the pupil's school).

When a child does not perform as intended, the normal protocol is to use test batteries. A research conducted in school diagnostic centers across Europe in 2001 found that psychologists used standardized psychometric test batteries to assess special needs conditions on a regular basis. (Muñiz et al., 2001). In 2010, a study conducted in Sweden, Portugal, Hungary, Belgium, Romania, Norway, and the Virgin Islands (Lebeer et al, 2011) revealed

that the Wechsler scales are still the most commonly used test batteries in the assessment of students, well outnumbering all others. The use of standardized developmental scales is also widespread.

Assessment of learning academic skills

Curriculum-based assessment of reading, mathematics and writing

Curriculum objectives and the cognitive processes involved in learning them should be considered in a curriculum-based dynamic assessment (Lidz, 1991; Snnesyn, 2011). While traditional dynamic assessment focuses on underlying cognitive processes, academic learning objectives are also included in this field. The Application of Cognitive Functions Scale was developed by Lidz and Jepsen (2007) and has been validated for children aged 3-5 years in a variety of countries and cultures.

The USA effectively implement response to Intervention (RTI) approach that is is a multi-tiered approach to identifying and supporting students with learning and behavior problems early on. RTI starts with high-quality teaching and universal screening of all students in general education classes. Struggling students are given strategies with increasing levels of pressure to help them learn faster. It can be delivered by a range of staff, including general education teachers, special educators, and specialists. Progress is closely monitored to determine both the learning rate and level of success of individual students.

Individual student responses to instruction are used to inform educational decisions about the intensity and length of interventions. RTI is intended to be used in both general and special education decisions, resulting in a well-integrated method of instruction and intervention that is driven by child outcome results. The following basic components must be implemented with fidelity and rigor in order for RTI to be successful:

1. Classroom teaching that is of high quality and scientifically informed. In the general education classroom, all students receive high-quality, research-based instruction.

2. Ongoing evaluation of students. Universal screening and progress tracking provide data on a student's rate of learning and level of achievement, both personally and in relation to their peers. These information is then used to determine which students need additional supervision or intervention. Student development is closely tracked during

the RTI process in order to assess student success and evaluate the efficacy of the program. Multiple data points taken in context over time are used to make decisions about students' instructional needs.

3. There are different levels of training. To effectively separate instruction for all students, a multi-tiered approach is used. The model integrates increasing levels of instruction while also providing unique, research-based approaches that are tailored to the needs of the students.

4. Parental participation is significant. RTI-implemented schools educate parents about their child's success, the curriculum and strategies used, the personnel providing the instruction, and their child's academic or behavioral objectives. (National Center for learning disabilities)

When it comes to how students with disabilities should engage in daily school, traditional studies often leave out key details:

- A qualitative account of a student's learning style, including modalities, interests, and motivations.
- A list of the student's assets (talents)
- What is the student's passion?
- Is the student modifiable, in the sense that he can exhibit new behaviors when I try to teach him something?
- What do I (the teacher) need to do to get the student to learn?
- How does the student respond to instruction?
- What is the student's world like: family, school, peers, support staff, and how do they act?
- Are there any other tools that could be found? (Lebeer, J, 2010.)

In other words, although psychometric tests may be accurate in detecting dysfunction, their accuracy in assessing educational needs is debatable.

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CHAPTER 4: TEACHING STUDENTS WITH LEARNING DISABILITIES

INTRODUCTION

Young children with learning disabilities have diverse, complex and interrelated difficulties, often hidden or subtle, that affect their learning across the lifespan. While there is great variability among children with learning disabilities, they are generally described as individuals of at least average intelligence who have difficulties processing information and who experience unexpected difficulties in learning areas. These young children exhibit strength and success in other learning and processing areas. In addition, it should be considered, that at the stage of early development (children in primary education), children may differ in basic skills related to the learning and assimilation process. Some may have weak language skills and experience their greatest difficulties in reading and written language. Some may have strong oral language skills and experience their greatest difficulties in written expression, including the physical act of handwriting, the organization of ideas and mechanics. Others may be successful in the acquisition of literacy skills but experience difficulties with nonverbal problem solving, arithmetic and social interactions. (www.learnalberta.ca) It`s impotrant to remember that learning disability does not mean that the person cannot learn; it means that they learn differently. Many instructional strategies which are helpful to children with learning disabilities benefit all young students (www.ws.edu).

1. STRATEGIES FOR YOUNG CHILDREN WITH LEARNING DISABILITIES

Treatment consists initially of defining the disorder, advising parents, and possibly also advising teachers. Advice for teachers serves to explain the student's psychological stress and provides an opportunity to consider together how the young children can become better integrated at school (Schulte-Körne, 2010). Learning aids/strategies facilitate the acquisition, manipulation, integration, storage, and retrieval of information across situations and settings. They help us understand and learn new material or skills, integrate this new information with what we already know in ways that makes sense, and recall the information or skill later. There are two types of learning strategies: cognitive and metacognitive.

Cognitive strategies assist a student with processing and manipulating information (i.e., taking notes, asking questions). In other words, these strategies function to produce learning (www.jobcorps.gov).

Orienting strategies are basic to teaching and learning. They direct children's learning to a task. The student's attention is drawn to a task through teacher input such as a cue, material that is highlighted, and/or children self-regulation.

Orienting strategies are helpful to students because they direct attention to important information. As young children learn to use their own orienting strategies, they become more independent in their learning. As you point out significant information to children, and then teach them to determine what information is significant, you address their basic learning question, "Do I need to remember this?" Using the words, "Listen carefully…" is a good example. This verbal cue alerts the learner that the information that follows needs to be remembered.

There are basically three approaches to orienting information, reflecting who or what is doing the orienting:

- the teacher,
- the material,
- and/or the student.

When the teacher orients the young children to something important, he/she cues the student that the information that follows is important and should be remembered. Verbal cues such as "Pay attention to this" or "This is on the test" orients the student to key information. Visual cues such the teacher writing certain information on the board and/or pointing to information also orient the learner.

The material can have orienting characteristics that draw attention to certain points. Italics, boldface, and text set apart (such as definitions) are orienting characteristics.

Finally, as the young children learn to self-orient to information, he/she grows in his/her independence as a learner. In the case of printed information, the student self-orients by scanning information to determine what is important to remember, and then taking some

action such as highlighting, underlining, or taking notes to emphasize important information. In the case of verbal information, the children self-orients by listening to determine what is important to remember (including using "cues" given by the speaker), and then taking some action such as taking notes or using verbal rehearsal to remember important information.

A rehearsal strategy uses repeated practice of information to learn it. When a young child is presented with specific information to be learned, such as a list, often he will attempt to memorize the information by repeating it over and over. He may say the words out loud, or he may sub vocalize the information (say it to himself). The repeated practice increases the children's familiarity with the information. Rehearsal strategies can be used to learn relatively brief amounts of information, and is good for learning "foundation information." Foundation information is necessary to learn before more complex learning can take place. For example, learning that a+b=b+a, or the commutative property of addition, is essential to doing more complex work in algebra. One of the most important concepts we will teach children about rehearsal strategies is evaluating when a rehearsal strategy is just right, and when a different strategy is needed. For certain information, (for example the telephone number we need to memorize until we can write it down or make the call), verbal rehearsal of the numbers is a fine strategy; no more complex approach is necessary. However, memorizing long lists of information may require a different strategy to yield better results. Attaching a multisensory experience to the rehearsal may also assist the learners. For example, many children can only "say" their alphabet when they sing the "ABC song". You may find that some learners do better with rehearsal strategies when they can attach sound or movement to the items to be learned.

An elaboration strategy is where the young children use elements of what is to be learned and expands them. The child expands the target information by relating other information to it (ex. creating a phrase, making an analogy). Elaboration strategies connect information to be learned with information that children already know. This connecting takes stress off of working memory, because connections create efficiency of learning and memory. Because elaboration strategies create connections, or bridges, to information to be learned, they can be powerful instructional tools for a classroom. The confidence that young children have in already knowing the connected information can support their learning of new information.

Imagery strategies involve activating the memory by taking what is to be learned and creating meaningful visual, auditory, or kinesthetic images of the information. Imagery

strategies are helpful when a child has some grasp of the information to be learned. Creating images of the information allows for efficient access, and personalizes the learning for the student.

Imagery is a highly effective strategy for increasing comprehension. An advantage of imagery is that the learner can use it in a highly individualized manner. Some students will develop imagery strategies on their own. For many students, however, specific instruction on how to develop images will be needed. A visual imagery strategy for reading comprehension is **RIDER**:

R= Read a sentence

I= Image (make an image)

D= Describe how the new image is different from the last sentence

E= Evaluate (as you make the image, check to be sure it contains everything necessary)

R= Repeat (as you read the next sentence, repeat the steps to RIDE). Each letter of RIDER is a cue for a specific action that would be appropriate for the student to take in a classroom (www.specialconnections.ku.edu).

Metacognition Strategies assist children in "thinking about thinking." Metacognition is an important concept in cognitive theory. It consists of two basic processes occurring simultaneously:

1. Monitoring your progress as you learn.
2. Making changes and adapting your strategies if you perceive you are not doing so well.

Metacognition, or awareness of the process of learning, is a critical ingredient to successful learning. Learning how to learn and developing thinking processes that can be applied to solve problems, is a major goal of education. When life presents situations that cannot be solved by learned responses, metacognitive behavior is brought into play. Guidance in recognizing and applying metacognitive strategies will help young children successfully solve problems throughout their lives. Metacognitive learners ask themselves and answer questions like: "Are things going well? Is there something I don't understand? Am I learning this material? Are there any gaps in my knowledge or understanding? If I do find a gap in

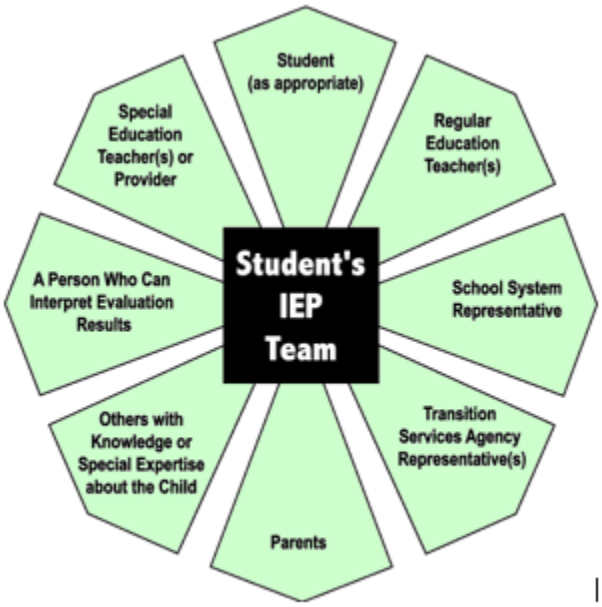
my knowledge, do I know what to do about it? Can I repair the gap so that my understanding is complete?" Children who use metacognitive strategies are aware of the cognitive resources they have to accomplish a goal, they check the outcome of their attempts to solve problems, they monitor the effectiveness of their attempts, they test, revise and evaluate their strategies for learning, and they use compensatory strategies when comprehension breaks down. These compensatory strategies restore understanding and learning (Janice at al., 2009).

Over time, the acquisition and use of metacognitive strategies help young children build confidence about their ability to learn. As this confidence builds, independent learning is fostered.

It is important to understand the relationship between metacognitive and cognitive strategies. The metacognitive activities like self-questioning usually occur before or after a cognitive activity. An example of the relationship between the metacognitive and cognitive strategies is a learner who uses self-monitoring when reading. He/she knows that they do not comprehend what they have read (metacognitive) and recognize that they will understand the text better if they create an outline (cognitive). (jobcorps.gov)

2. INDIVIDUALIZED EDUCATIONAL PLAN (IEP)

The Individual Education Program (IEP) is the basic component of special education programs for children with learning disorders and other types of disabilities. It is made up of individual parts that act as a road map, establishing where your child is, where you want her/him to go, and how she/he will get there (verywellfamily.com). The IEP is generally updated annually by a team that often includes: the special education teacher, regular education teacher, specialists such as speech, occupational, and physical therapists, as well as a school nurse and parents (thoughtco.com)



Student`s IEP Team, *Guide to the Individualized Education Program*, U.S. Department of Education.

These people must work together as a team to write the student's IEP. A meeting to write the IEP must be held within 30 calendar days of deciding that the student is eligible for special education and related services. Each team member brings important information to the IEP meeting. Members share their information and work together to write the child's Individualized Education Program. Each person's information adds to the team's understanding of the student and what services the their needs.

Parents are key members of the IEP team. They know their child very well and can talk about their child's strengths and needs as well as their ideas for enhancing their child's education. They can offer insight into how their child learns, what his or her interests are, and other aspects of the child that only a parent can know.

Teachers are vital participants in the IEP meeting as well. At least one of the child's regular education teachers must be on the IEP team if the student is (or may be) participating in the regular education environment. The regular education teacher has a great deal to share with the team the aids, services or changes to the educational program that would help the young children learn and achieve.

The young children's special education teacher contributes important information and experience about how to educate children with disabilities. Because of his or her training in

special education, this teacher can talk about the supplementary aids and services that the student may need to be successful in the regular classroom and elsewhere. He or she can tell how to modify the general curriculum to help the student learn and how to modify testing so that the child can show what he or she has learned.

Another important member of the IEP team is the individual who can interpret what the student's evaluation results mean in terms of designing appropriate instruction. This IEP team member must be able to talk about the instructional implications of the student's evaluation results, which will help the team plan appropriate instruction to address the student's needs.

The individual representing the school system is also a valuable team member. This person knows a great deal about special education services and educating students with disabilities. He or she can talk about the necessary school resources. It is important that this individual have the authority to commit resources and be able to ensure that whatever services are set out in the IEP will actually be provided.

The IEP team may also include additional individuals with knowledge or special expertise about the student. The parent or the school system can invite these individuals to participate on the team.

And, last but not least, the student may also be a member of the IEP team. If transition service needs or transition services are going to be discussed at the meeting, the child must be invited to attend. More and more children are participating in and even leading their own IEP meetings. This allows them to have a strong voice in their own education and can teach them a great deal about self-advocacy and self- determination (U.S. Department of Education, 2019).

An IEP must cantain some information about the young children and about the educational program designed for him. One of the most important elements is the portion called present level of performance (PLOP), which describes in details how the child is dealing with education at the moment. PLOP should be conducted each year and includes a detailed description of child’s current abilities and skills, with attention given to their weaknesses and strengths and how these characteristics will impact their education.

In addition to the academic concerns or intellectual functioning, PLOP also looks at children's current physical condition, including their mobility status and any disabilities they may have. Social performance is also evaluated, including child's relationships with other children and adults. It also identifies the development level of skills they will need for independence (verywellfamily.com).

The IEP must contain information about children's goals, which need to be updated at least once a year. Goal statements specify what a child is expected to learn in the coming year, including academic skills and any relevant functional skills (verywellfamily.com). Long-term goals (for example, longer than a school term) are specific statements describing the expected behaviour or skill to be achieved within an agreed timeline, for example, by the end of the school year. Short term goals identify the sub-skills that are required for a child to achieve a long term goal. Short term goals specify what should be achieved within a certain timeframe, from a week through to a month or a term. It is highly recommended that short term goals are SMART (Specific, Measurable, Attainable, Relevant and Time-bound). (education.vic.gov.au)

The goal should be specific in naming the skill or subject area and the targeted result. For example, a goal that is not specific might read, "Adam will be a better reader." Such a goal fails to provide any details.

You should be able to measure the results using standardized tests, curriculum-based measurements or screening, work samples, or even teacher-charted data. A goal that is not measurable might read, "Joe will get better at solving math problems."

A lofty goal that is not attainable can discourage both teacher and pupil. A goal that is not attainable might read, "Frank will go to the nearest neighborhood shop without getting lost." If Frank has never gone with his mum to the public neighborhood shop before, this goal is likely out of reach.

The goal should clearly spell out the expected result. A poorly worded goal might read, "Margie will increase her eye contact with others." There's no way to measure that and no indication of what the result might be.

The goal should state specifically by what date the child is expected to accomplish it. A goal lacking a time expectation might read, " Joe will clean his room." (thoughtco.com). He might want do it, because he doesn't know how much time does he have to clean the room.

The IEP must contain an explanation of how progress toward goals and objectives will be measured. It should also describe how that information will be reported to parents. This gives parents a clear idea of how their child's advancements will be evaluated. It also serves as reassurance that you will receive the progress reports so you can maintain a role in their education (verywellfamily.com).

The IEP must contain a description of all specific special education and related services, including individualized instruction and related support and services to be provided (e.g., occupational, physical and speech therapy; transportation; recreation). This includes the extent to which the young children will participate in regular educational programs (autism-society.org). Specially Designed Instruction (SDI) refers to the teaching strategies and methods used by teachers to instruct children with learning disabilities and other types of learning disorders. To develop specially designed instruction for each child with a learning disability, educators and parents work together to analyze his work, evaluation information, and any other available data to determine the student's strengths and weaknesses. Based on the children's unique learning needs, strategies are developed. Teachers continue to measure the child's progress and make changes in instruction as needed (verywellfamily.com).

The IEP must include a projected beginning and end date of any services the IEP team proposes. This includes details on the frequency of the services and where they will be delivered. The intent is to ensure that everyone understands exactly when and where your student's individual program will take place.

IEP can be used for children for early school. IEP must include measurable goals for the children's anticipated program. It will also include a description of the services needed for the children to reach those goals.

Transitional goals and services focus on instruction and support services needed to help the children move from the school environment and into a job, vocational program, or other program designed to promote independent living. The goals should also prepare a child to advocate for herself in high school and college (verywellfamily.com).

Once the IEP is written, it is time to carry it out- in other words, to provide the children with the special education and related services as listed in the IEP. This includes all supplementary aids and services and program modifications that the IEP team has identified as necessary for the children to advance appropriately toward his or her IEP goals, to be involved in and progress in the general curriculum, and participate in other school activities. The IEP team must review the child's IEP at least once a year. One purpose of this review is to see whether the child is achieving his or her annual goals (U.S. Department of Education, 2019).

3. TEACHERS' CHALLENGES WITH STUDENTS WITH LEARNING DISABILITIES

Teaching can be challenging at times, but teachers may face additional challenges. Understanding the role of teachers and the challenges they face can help those in the profession, as well as the students they teach.

Teachers work with young children who have a range of disabilities, including learning, mental, emotional and physical disabilities and they should be prepared to meet the needs of each individual child based on that their Individual Education Plan (IEP) (www.ncu.edu). In all classes, we can see children who are at different ability levels, learn in different ways, and understand concepts at different times. Differentiated instruction and individualized teaching practices are challenging for all teachers. It gets even more difficult in a special education, multi-aged classroom (www.friendshipcircle.org).

Chellenging is olso to find proper teaching materials. Teachers need specific books, blackboards for writing, pictures of different drawings, chalk, and dust boards. It happens that they should be creative and find his or her own methods to help the students (Humphrey, 2014).

Another common challenge with teaching young children with learning disabilities is dealing with the behaviors of students. Many of them are with disabilities and can get frustrated with school. Whether it is not understanding material or dealing with emotions they have trouble controlling, these children can be a challenge for their teachers. Every child is different, and

what works with one child may not work with another. Taking the time to learn about the child's disability and figuring out ways for that child to cope can help the student get control over their behavior (www.astate.edu).

There are many behavioral problems among children with learning disabilities. They suffer fidgety (76%), aggression (70%), excess consumption of activity (70%), non-interaction (68%), hyperactivity (66%), continuing changes in sitting (58%), difficulty of dealing with other (48%) and even more (ResearchGate, 2015). Each of these problems occurs in combination with another one. It is really difficult to cooperate with child and follow the schedule.

Unfortunately, not only students can make troubles with collaboration. Most of parents do not accept that their child has a learning deficit. They make excuses for their child's academic setbacks, they may blame on teachers or a spouse instead or, they may accuse the child of being lazy and refuse to allow special education services to be provided (www.verywellfamily.com). On the other hand, there are parents with overly high expectations of rapid changes after their children start school. They expect to see great progress within a very short time. The truth is that young children cannot progress the same way as ordinary student. They need time to learn and to practice. Every child in the class has his or her own difficulties in learning and their learning capability is much different from ordinary pupils. It takes time before a child with developmental disability learns a certain activity. Teachers and parents need to work together to get the best results. Teachers help a child at school, but after school the parents or guardians have to take the responsibility to help their children (Humphrey, 2014).

Teachers have an especially difficult job of not only teaching and managing their students, but also handling the paperwork. As part of the job, special education teachers are responsible for a caseload of children. The Individualized Education Plan (IEP) is the paperwork that lists the child's disabilities, goals, accommodations and testing specifications. For every IEP meeting, information must be gathered from the student's classwork to update each section of the IEP. Every grading period, you must gather information about the child's goals and update them to see if the student is on their way to mastery or needs new goals.

Summarizing, teaching young children with learning disabilities can feel like a thankless and tiresome job sometimes. However, overcoming the challenges of the job and helping students with disabilities reach their full potential and accomplish their goals can make the effort worthwhile (www.astate.edu).

4. RECOMMENDATIONS/TIPS FOR TEACHERS

There are many teaching strategies that you can use to ensure effective and productive learning environments and experiences for all children, including those with disabilities. Accessible Education is the process of designing courses and developing a teaching style to meet the needs of children who have a variety of backgrounds, abilities and learning styles. Just as there is no single way to teach, people learn in a variety of ways; using different instructional methods will help meet the needs of the greatest number of learners (www.accessiblecampus.ca).

To be truly effective, teachers must possess skills in functional behavior assessment and positive behavior support and intervention, defined as a collaborative, assessment-based process to develop effective, individualized interventions for individuals with challenging behavior. Support plans focus on proactive and educative approaches. Many educators know how to observe and gather data on challenging behavior, yet few know how to analyze data and develop plans that are proactive and educative (Fenlon, 2008).

The challenges of teaching the young children with learning disabilities can be mastered by modifying the way in which information is presented. Fewer problems on the page and larger fonts that are easier to see will work wonders for a child with visual processing problems. Observe the child to see how long he can work without becoming fatigued, and then assign the amount of work that he can get done before he becomes too tried. If he can get only 5 problems done, then assign only 5 problems and give him a break. When teaching special education, care should be taken to include rewards for effort as well as achievement. Reinforce the child's effort with supportive, regular, quality, feedback about how he is doing. The feedback will motivate him to keep trying, and the desired achievement will follow as the child gains more skills.

Use diagrams, graphics and pictures to augment what you are saying in words; this strategy benefits the visual and auditory learners at the same time.

If the child loses his place while reading, or uses his finger to point to the words use a colorful piece of plastic under the line to help his eyes return to the right place when he loses focus. A colorful piece of paper will do, but the more durable plastic gives it the status of a "reading aid" that should be valued and kept in his desk with other important learning tools like pencils, erasers, rulers, calculators (www.understanding-learning-disabilities.com).

The most effective teachers know how to use technology to support the participation and progress of children with mild, moderate, and severe disabilities in general education classes and other school contexts (Fenlon, 2008). Computers are powerful tools for children with special needs and should be utilized as often as possible. With the use of technology, students who have difficulty getting their thoughts on paper because of poor handwriting skills, can write their thoughts with the use of a keyboard. A child whose visual processing disorder makes reading difficult can use his stronger auditory skills to listen to a recording of a book. When the visual book is utilized together with the auditory recording, the child receives the benefit of matching the sound with the words. This has the potential of improving his reading skills (understanding-learning-disabilities.com).

Moreover, teachers should have more emotional approach to a child. Remember to accept every children as they are. Young children come to us with packages and baggage. Open and unpack slowly and gently, with kindness, respect, and understanding. Building a relationship with a child takes time and patience - allow it to happen organically. If you push it, shove it, or force it, you'll have to start all over and it may or may not bloom.

Also active listening is a gift. Every day, every child will have a problem - or something they perceive to be a problem. Stop, make eye contact, and listen. Don't offer a solution until invited to do so. Don't minimize their problem, experience, or situation. Don't take their problem to the principal or other administrator until you've given the student time to think it through. Sometimes all they want is to be heard. But sometimes they just want to be loved. Our students want to believe they're the only ones in our class, on our caseload, or in our hearts. A small token of appreciation - a handwritten note, a quiet teacher-student lunch, or our cell phone number - tells that student we care about them and their academics. The importance of building relationships cannot be overstressed. This is extremely important especially for children in 7-10. Children need us to show them that love is always possible.The good relationship should be built from the very beginning of their school-life.

All children come to 1st grade full of hopes, expectations and fears, so they need to feel secure, capable and successful.

When talking with parents, offer specific positives and exact concerns about their child's abilities. Be careful of generalizations like always, never, usually, and sometimes. Give explicit examples and partner with parents to create opportunities for growth. Parents can and want to support teachers - show them how.

Eliminate jargon when talking with parents. Remember all those acronyms? If they must be used, use them sparingly and define each one. Acronyms can aid teachers in communicating with each other, but they build a divide with parents because using them is exclusionary - they're a special language for educators. Building a partnership with parents means having a common vocabulary that inspires, not tires (www.edutopia.org).

Please, remember yourself. Do not assume that you can teach, nurture, feed, clothe, and shelter every child in your class. Before you jeopardize your physical, emotional, and mental health, it's important to ask for support. Your colleagues, consultants, the child's Counselor, disability coordinators, and other staff are ready to help you help your students (www.jobcorps.gov).

Finally, the laugh. There are some days when laughter might be the last thing you're thinking of, but it may just be what you need. Our children come to us from different places - cognitively and logistically - yet a hearty chuckle or shared case of the giggles may help all of us take a step back and start again (www.edutopia.org).

It is a disservice to underestimate the intelligence and potential for success of students with a learning disability and other disabilities. Learning disabilities are not indicative of low intelligence. Some of the most daunting disabilities have been overcome by some of the world's most successful people. Galileo had a visual impairment. Elton John has epilepsy. James Earl Jones had a speech impediment. John

F. Kennedy had a learning disability. Howard Hughes had OCD, as does David Beckham. Winston Churchill and Teddy Roosevelt suffered from bipolar disorder, as do Buzz Aldrin and Jim Carrey (www.theedadvocate.org). A learning disability cannot be cured or fixed; it is a lifelong challenge. However, with appropriate support and intervention, people

with learning disabilities can achieve success in school, at work, in relationships, and in the community (www.ldaamerica.org).

We do not know who will be the next famous individual but as Educators, we can continue to teach our children in ways that they learn best. As you create your next lesson plan, remember to incorporate some of these techniques for your students with learning disabilities (www.theedadvocate.org).

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PART 2: TECHNOLOGIES IN EDUCATION

CHAPTER 1 – TECHNOLOGY IN EDUCATION

Rapid developments in technology have shown their effects in education as well as in all other fields. The fact that newborns are born in a technology-rich environment, digital transformation in societies and the necessity of individuals to be technology literate as a result (Perkovic & Settle, 2011) made it necessary to integrate technology into learning environments. Accordingly, efforts to equip teachers with skills that can integrate technology into learning environments have gained momentum. In this section, framework models that define the skills which teachers need to have in order to use technology in learning environments are emphasized.

1. TECHNOLOGICAL PEDAGOGICAL CONTENT KNOWLEDGE - TPACK

One of the most studied and popular frameworks on technology integration is the Technological Pedagogical Content Knowledge framework. The framework was introduced by Mishra and Koehler in 2006. The framework consists of three main areas; Technological Knowledge, Pedagogical Knowledge and Content Knowledge.

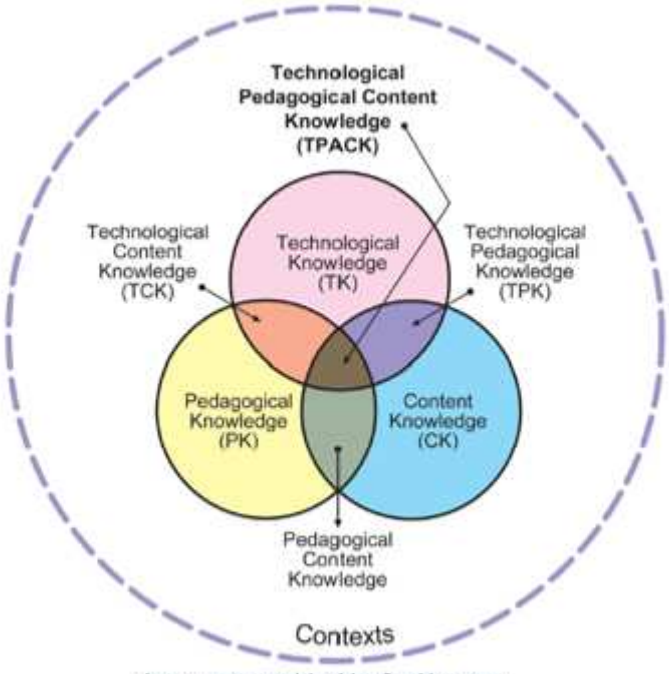


Figure 1. TPACK Model (Mishra & Kohler, 2006)

Content Information refers to the information specific to the trainers' own areas of expertise. Each trainer is equipped with knowledge and skills specific to his / her field of education. For example, one of the aims of this project is to improve the field knowledge of pre-service teachers about learning disabilities.

Pedagogical knowledge, on the other hand, is a wide range that includes the purpose of learning, the recognition of the target audience, the use of the necessary method and techniques for effective teaching, and assessment and evaluation to reveal whether learning is realized (Mishra ve Koehler, 2006).

Technological knowledge, on the other hand, refers to the level of knowledge of trainers regarding standard technologies and advanced technologies; Depending on the development in technology, trainers are expected to keep their technological knowledge up-to-date (Mishra & Koehler, 2006). In particular, the development of Web 2.0 technologies has enabled technological tools to reach more personal users, thus providing a more flexible structure for educators.

The Technological Pedagogical Content Knowledge framework also cares about the relationship between these types of knowledge. It states that each type of knowledge is an area where it intersects with the other type of information.

Pedagogical Content Knowledge is seen as a field where content knowledge and pedagogical knowledge intersect. According to Mishra and Koehler (2006), pedagogical content knowledge means giving the field-specific knowledge with the correct pedagogy. Pedagogical content knowledge, which should not be perceived as field expertise, emphasizes that each field may have some unique methods and techniques or more effective methods and techniques (Mishra & Koehler, 2006).

Technological Content Knowledge refers to the blending of technological knowledge with pedagogical knowledge. Both technological and domain knowledge are needed to decide which technology is suitable for the context. Knowing which of the constantly evolving technologies will be suitable for the content is important for the integration of the right technology into the learning environment.

Technological pedagogical knowledge refers to the blending of technological tools to be used in the learning environment with the correct pedagogy. When the instructional design literature is examined, it is seen that “Media? Method? " The importance of the discussion can be noticed. While the technologies to be used in the learning environment can be considered as media, it is thought that learning can be achieved better with the correct methods and techniques to be used. At this point, the importance of technological pedagogical knowledge emerges.

Technological pedagogical content knowledge, on the other hand, is considered as the intersection of three types of knowledge within the framework and emphasizes that it should be found in educators for a successful technology integration. Accordingly, institutions that train teachers are expected to integrate models that will increase their knowledge level in their pre-service teachers (Yildiz Durak, 2020).

2. SQD

Another framework for successful technology integration seen in the literature is the Synthesize Qualitative Data (SQD) framework. The framework was revealed by Tondeur et al. (2012) as a result of the study of the studies examining the trainings that pre-service teachers received in order to integrate technology into their educational environments. The most important reason for the emergence of this framework is that pre-service teachers do not consider themselves sufficient enough to use technology in educational environments when they enter the teaching life (eg Drent & Meelissen, 2008; Kay, 2006). For this reason, researchers emphasize the need for teachers to know how to integrate technology into learning environments in their education lives.

Accordingly, the framework was revealed by examining nineteen different studies in the literature. The frame consists of 3 different interlocking circles and 12 themes. It is possible to examine 12 themes under two headings: the training of pre-service teachers and institutional measures.

Figure 2. SQD Model (Tondeur et al., 2012)

In order for pre-service teachers to use technology successfully, the 6 themes in the innermost circle should be integrated into the curriculum. The first theme is the "Role Model" theme, which expresses teacher trainers to be role models for pre-service teachers. Therefore, it is emphasized that educators at universities should have a successful technology integration skill.

Another theme is "Reflection" of Attitudes Regarding the Role of Technology in Education. In this theme, it is emphasized that pre-service teachers' attitudes towards the use of technology in learning environments should be changed during their education.

Another theme is "Instructional Design". Instructional design can be simply defined as the effective and efficient use of technological tools, methods, resources and processes in solving instructional problems. In fact, although instructional design processes are a process that every instructor applies for their courses; It is thought that all teacher candidates should know their specific processes.

Another dimension of the education that prospective teachers should receive for technology integration in the SQD model is the theme of "Cooperation". It is stated that the ability of teacher candidates to share their experiences with each other or to create joint products is necessary for a successful technology integration.

While doing these, the importance of providing “Real Technology Experiences” to prospective teachers for a successful technology integration is emphasized.

Finally, the model; With the support of current technological developments, pre-service teachers recommend giving continuous feedback in the process instead of classical assessment methods.

CHAPTER 2 – DIGITAL COMPETENCIES FOR PRIMARY SCHOOL TEACHERS

In addition to a successful technology integration, there have been differences in the competencies that trainers should have in parallel with the development of digital technologies. Today's educational paradigms aim to equip learners with skills appropriate for the 21st century. Consequently, the necessity for trainers to have competencies to develop 21st century skills in learners emerges. Different organizations have made studies to determine the competencies that trainers should have today. Some of these competencies developed within the framework of technology and technology integration have been studied.

1. ISTE STANDARTS FOR TEACHERS

The International Society of Technology in Education is a community that believes in the power of technology in education and that transformation is possible with technology (ISTE, 2021). The community provides recommendations, resources and standards for the use of technology in education. It offers these standards separately for different target audiences. Educator standards are one of them. ISTE gathered the educator standards updated in 2017 under seven different headings. These; It has been specified as Learner, Leader, Citizen, Collaborator, Designer, Facilitator and Analyst. These standards are specified as the standards that every teacher who wants to integrate technology into the educational environment should have.

It is emphasized that “learning” teachers should constantly follow new developments, search for new applications in education, and be open to learning new things. Various tips are also offered to teachers for doing these. For example, it is emphasized that they need to improve

themselves with the training that can be taken in order to apply professional development and different educational methods.

“Leader” teachers are expected to create opportunities for themselves and their students in using new technologies. For this, the importance of keeping the teacher's knowledge and skills up-to-date and following the innovations is emphasized.

The concept of “citizen” refers to the concept of digital citizenship, which is frequently encountered in the literature within the framework of these standards. Teachers are expected to assist their students in becoming digital citizens and keeping up with the digitally transforming world.

The standard of being a "collaborative" teacher serves the purpose of raising individuals who are open to cooperation, who are among the 21st century skills of the International Society of Technology in Education. Teachers who are open to collaboration should both be able to prepare a collaborative working environment for their students and have the ability to work collaboratively with their colleagues.

“Designer” teachers should be able to use different teaching methods and techniques according to changing conditions and student characteristics, and be able to make effective instructional designs by preparing different contents. In doing so, the importance of following up-to-date technologies and current teaching methods and techniques is once again revealed.

The "facilitator" teacher emphasizes in particular the ability of learners to support them in realizing their learning experiences. It should be able to support students with learning problems with different designs and suggestions and make learning easier for them.

An "analyst" teacher focuses on the ability to use and analyse student data correctly in order to evaluate his students and ensure that they can reach learning outcomes. In this way, the learning problem of the learner can be determined correctly and necessary interventions can be made.

In order for the trainer to be able to intervene in the learning environment, he must first be a good learner and have the competencies to recognize his own students and design content that they may be interested in. If necessary, it can decide on the measures to be taken by consulting with colleagues who have experienced similar scenarios and cooperating with them. In this way, it can be an educator that will eliminate learning problems and be a

facilitator for the learner. In addition to these, an individual who is a student in distance education may have responsibilities or jobs to carry out in an institutional sense. In these jobs, they may have difficulty finding a counterpart or they may need counselling. It is up to the trainers to inform the learners about the digital measures to be taken by the institutions and to guide them about these digital measures. For this, it is important that the trainer has developed skills in becoming a digital citizen.

2. DIG COMP EDU

"Digital Competence Framework for Citizens" named DigComp1.0 was developed by the European Commission's Joint Research Center in 2013, with the acceleration of digitalization, it was updated in 2016 in line with the needs and the Digcomp2.0 report was published (Vuorikari, Punie, Gomez, & Van Den Brande,2016). In 2017, Digcomp2.0 report was updated and Digcomp2.1 digital competencies report was published. According to the Digcomp2.1 report, a total of 21 digital competencies were specified under 5 competence areas (Carretero, Vuorikari, & Punie, 2017).

In addition to these competencies, the European Commission has also conducted studies to determine the pedagogical digital competencies of teachers, and classified them as Professional Competencies of Educators, Pedagogical Competencies and Digital Competencies of Learners. The framework in which 6 main titles and 22 competence areas are presented under these three classes is named as DigCompEdu.

The first part of the framework includes areas of competence related to the professional development of teachers. These competencies include Organisational communication, Professional collaboration, Re fl ective practice and Digital Continuous Professional Development (CPD). Organizational communication implies that teachers use digital tools within the framework of collective decision-making with all stakeholders. Professional collaboration means that teachers share their knowledge and experiences with other teachers and share them for their personal development. With Reflective Practice, it is aimed to self-evaluate the digital pedagogies used by teachers. Digital Continuous Professional Development, on the other hand, refers to the continuous and improved use of digital tools by teachers.

Under the pedagogical competence of educators, the first main topic is digital resources. Under this heading, educators are expected to select digital resources suitable for their lessons, to update them where they deem necessary, and to share and protect digital resources within an ethical framework.

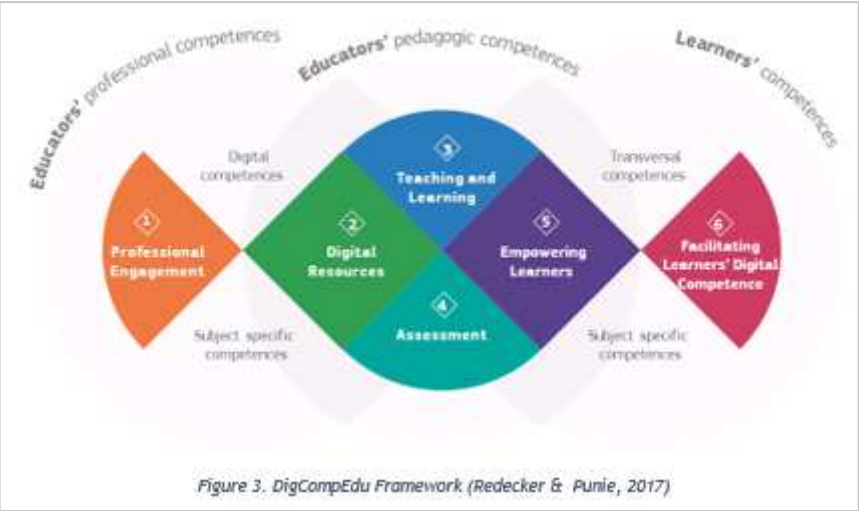


Figure 3. DigCompEdu Framework (Redecker & Punie, 2017)

Another pedagogical competence of educators is the main topic of Teaching and Learning. Under this heading, teachers are expected to design learning environments in which the right digital tools and these tools can be used with the right pedagogies. In addition, learners are expected to guide the use of digital resources outside the classroom and in environments where they can work collaboratively. While doing all these, it is the responsibility of the trainers to ensure that learners work collaboratively and communicate effectively. In addition, learners are expected to develop digital materials that will enable them to learn on their own outside of the classroom.

Another pedagogical competence of trainers is assessment. Here, trainers are expected to employ digital resources for evaluation, to use digital resources to evaluate learners' movements in the process, and to apply correct feedback strategies.

The last pedagogical competence trainers should have is Empowering Learners. Under this competence, trainers play an important role in ensuring the active participation of learners in learning environments. It is important for the educators to be aware of their responsibilities, especially in the participation of individuals who need special education to learning environments. Digital resources can be used to ensure this participation. In addition, digital

preparation of learning resources for individuals to progress at their own learning speed is considered important in terms of personalizing teaching.

The last competence expected from trainers within the framework of DigCompEdu is the development of learner competencies. In this context, it is expected that learners will improve their information and media literacy, ensure that they grow up as individuals who can work collaboratively by using digital resources, enable them to produce digital content, and grow as individuals who can solve problems digitally.

CHAPTER 3 – DEVELOPING MULTIMEDIA MATERIALS FOR LEARNING DISABILITIES

1. INFOGRAPHIC TOOLS

Infographics are Web 2.0 tools to present information visually. The main purpose of using infographics is to present information in a more understandable way. Infographics help highlight salient steps and reduce cognitive load (Egan et al., 2021). The most frequently used feature of infographics is that the designed images create a message conveying effect and are easy to understand. Although using infographics is more attractive than a long text, it is considered as important tools for information transfer (Tsai, Huang, & Chang, 2020). Therefore, infographics can be used to reduce the cognitive load of students with learning difficulties, to facilitate their learning and to present information in a more enjoyable way. Applications such as Piktochart, Easelly, Genial.ly, Canva, Biteable, Mural, Be Funky, Visme, Cacoo are some of the infographic tools. As part of this study, sample applications were prepared using Canva and Easel.ly.

1.1. Canva

1.1.1. Aim of the Tool

Canva is a graphic design platform offering paid and free services that allow you to easily create invitations, graphics, business cards, flyers, posters, infographics, lesson plans, Zoom backgrounds, and more using templates. You can even upload your own photos and add them to Canva's templates using a drag and drop interface.

1.1.2. How to Use

You can subscribe at www.canva.com and use certain templates and features for free for life. The free version will do much for you if you plan to use it for personal use in your workplace or daily life. If you need more professional graphic design work, you may need to use Canva Pro (paid membership) where you want to use the features limited by the free version more widely and freely.You can purchase Canva Pro after logging in or start a 30-day trial period for free. If you give up purchasing after trying Canva Pro, you can cancel your membership within 30 days. So Canva is a free platform for educators and students to do their digital work. Students can quickly log in to Canva with their Google For Education account. In addition, non-profit non-governmental organizations and associations can benefit from all features of Canva free of charge by sharing the official establishment documents they received from the Ministry of Interior with Canva.

1. Click on Canva's home page (www.canva.com) and log in.

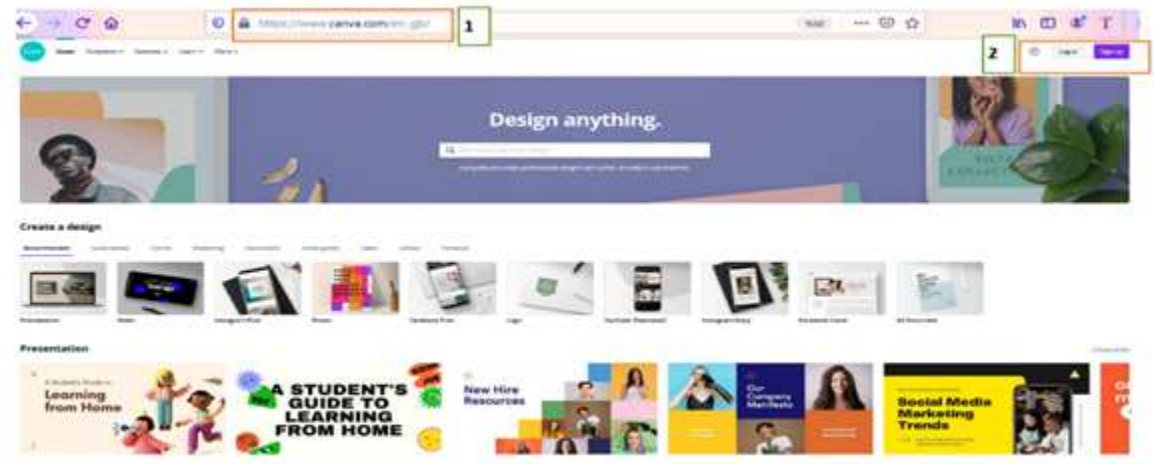


Figure 4. Canva's homepage

2. Canva homepage will be loaded after logging in. If you are using it for the first time (Sign up), you must register using a Google account, Facebook account or a valid email address. (After you become a registered user, you have the chance to access all the designs you have prepared when you log in to Canva from any computer or phone.)

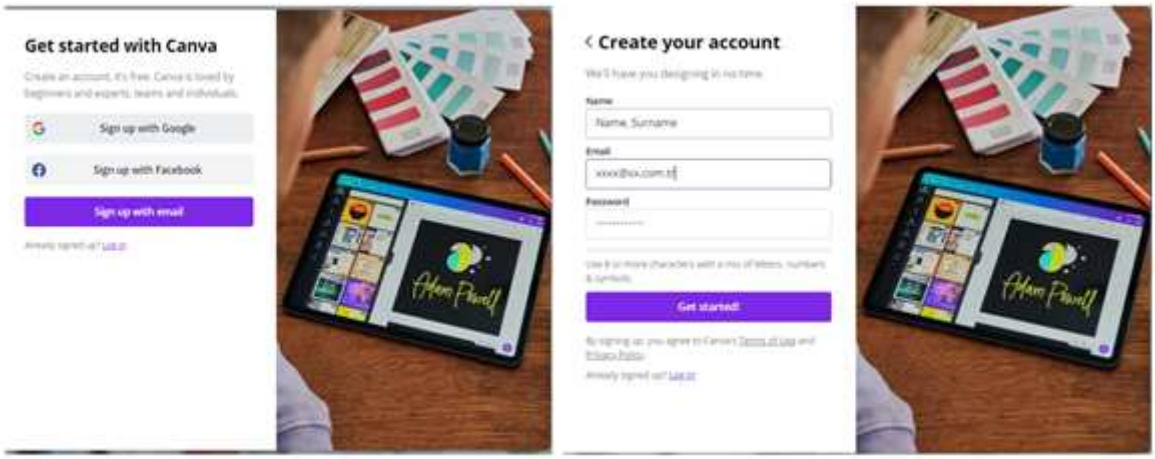


Figure 5. Get started

Your Canva homepage has two main sections, the Side panel (Fig 6, a) and the Designs section (Fig 6, b).

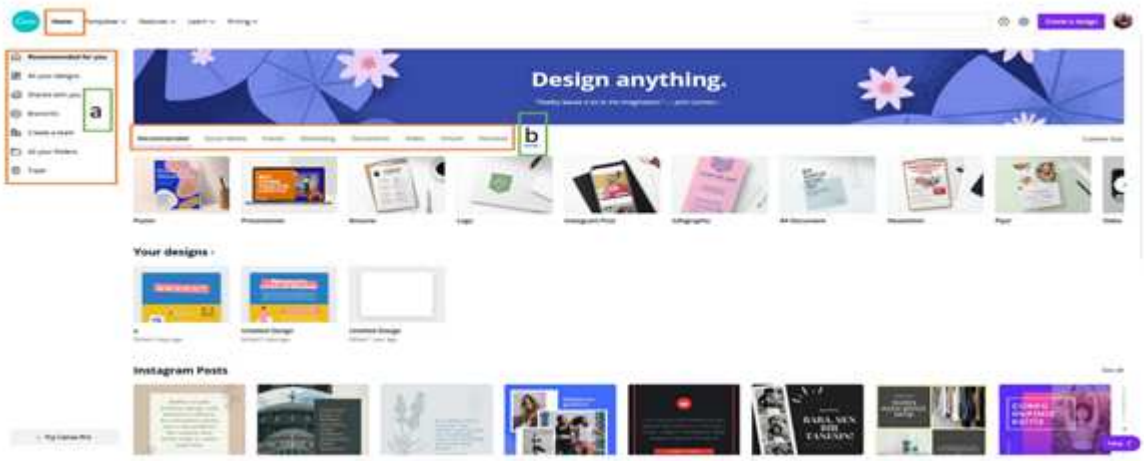


Figure 6. Canvas' homepage sections

Recommended for you: This is the part where you realize how extensive Canva has a wide selection of templates. You may go in to design a poster and find yourself drawing up a weekly lesson plan. Try it out in your spare time.

All your designs: This is the section where you can see your work in Canva as a whole.

Shared with you: This tab shows the designs other Canva users have shared with you. If this your first time creating an account, your Shared with you page may be empty at this point.

Brand kit: Instead of dealing with each design separately, you do the uploads that indicate your brand identity here. Save your fonts, colors, and images in your brand kit.

Create a team: Allows you to include different users in your Canva account and share your designs and folders with them.

All your folders: You can create and work in different folders within the Canva application, just like you do on the computer. All the folders you have created, favorites, purchased, uploaded files and deleted works are located here collectively.

Trash: Use Trash to delete designs you don't need.

Design (Fig 6, b) is the section where sample design templates such as social media, marketing, documents etc are grouped. You can start designing by selecting a design type from this section or clicking on custom dimensions. When you click on the template of your choice or the "*Create design*" button (Fig 7), the following page opens.

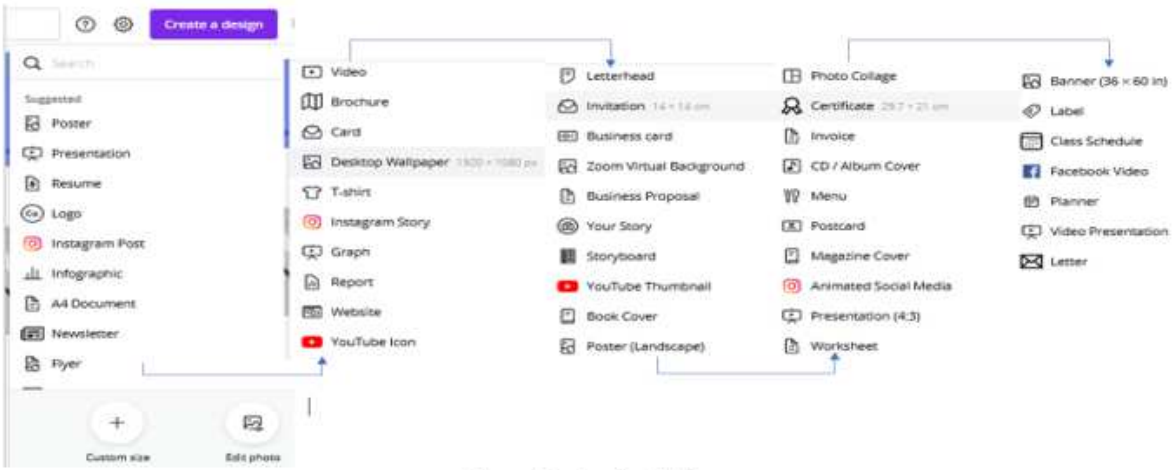


Figure 7. Create design

You can choose any of the options in Figure 7. After the selection, the menus on the left are the same (Figure 8)

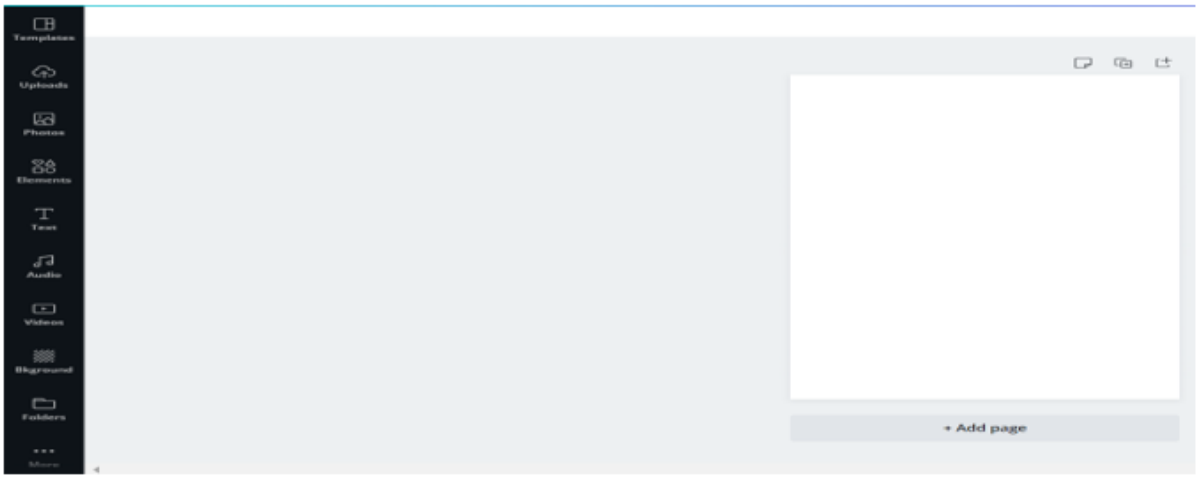


Figure 8. The Canva Workspace

Templates: If you have not yet selected a template or want to change the template you have selected, you can select a new template under this tab. If you think there are too many options and find it difficult to make a decision, you may want to ask for "travel", "food", "questionnaire" etc. You can narrow the results by typing keywords and searching for your field.

Uploads: By clicking this tab, you can upload your own photos or videos and use them in your work. Click the "Upload image or video" button and select and upload the file you want to upload from the folders on your computer or drag and drop directly to the field.

Photos: This is where you can access the photos in Canva's own archive. You can find the photo that will work for you more quickly by entering keywords in the search bar.

Elements: Tables, graphic types and icons that may be useful in your presentations are on this tab. If you want to prepare a cover for your stories that stand out on Instagram with colorful icons, you can use this section.

Text: You can add text to your work from this tab. Just click on the type of text you want to add to the page. There are also text templates where you can see the font families compatible with each other.

Audio: Since This is the tab where you can add short melodies to your works.

Videos: Under this tab, there are ready-made videos that you can use for free. You can click it and add it to your works that you will use in digital environments.

Background: This is the tab where you can change the background of the page you're working on. You can assign color or texture according to your taste.

Folders: You can work with different folders with the "Create a new folder" button on this tab.

Styles: Let's say you choose a template, you want to change its fonts and colors, but you are not sure that you will make harmonious choices. In this case, you can use the color palettes and font groups under the "Styles" tab. As soon as you click on the style you have chosen, your template will be revised accordingly.

More: Here you can find other Canva apps and integrations you want to use frequently. For example, you can link your accounts by clicking the Instagram or Pinterest icon. You can then share your design directly on these media.

1.1.3. Tips for using in learning environments

Canva, as a teaching tool, can help encourage creativity, enhance collaboration, and facilitate study. It contributes to creating effective, interesting and efficient learning environments. For example:

Infographics: You can create infographics to present complex data in the course in an easier, fun and understandable way with graphic support.

Posters: Posters are a great way for students to show off what they have learned. you can schedule events such as classroom rules, procedures, upcoming events, special occasions etc.

Presentations: You can use Canva presentations for lecturing, information, evaluation, etc.

Certificates: Canva certificates can be useful for creating student awards, graduation, thank you documents.

Newsletters: Teachers or students can use it to inform or raise awareness about a topic.

Logo: You can provide classroom motivation by creating a class name and logo. Maybe students can try designing a logo and then submit it to a vote. You can view your logo on your blog, bulletin board, notes, and use it as an avatar if you have class Twitter or Instagram accounts.

Worksheets: You can evaluate the learning processes of students by using worksheets.

Lesson Plans/Class Schedule: With Canva, you can plan the learning process by preparing "lesson plans".

Group Project: Some students enjoy the interactive nature of group projects and even learn better in groups, but more introverted or self-sufficient students may hesitate to learn this way. Canva meets the needs of both types of learner as collaboration can take place face-to-face, virtually, or a combination of both.

1.1.4. Example Practices

You can make any design you want with Canva, taking into account the course outcomes and using your creativity. In Practice1, the "a or b or c" activity was prepared using the infographic template. To do this activity, follow the steps in order.

1. **Design Selection**

After logging into the Canva website, select the Infographic template from the Design.

Figure 9. Design selection

2. **Infographic Selection**

You see the menu where infographic templates are grouped on the left. You can choose the template you want from this menu. Click on the template we marked for this event.You can also use the search bar on the top.

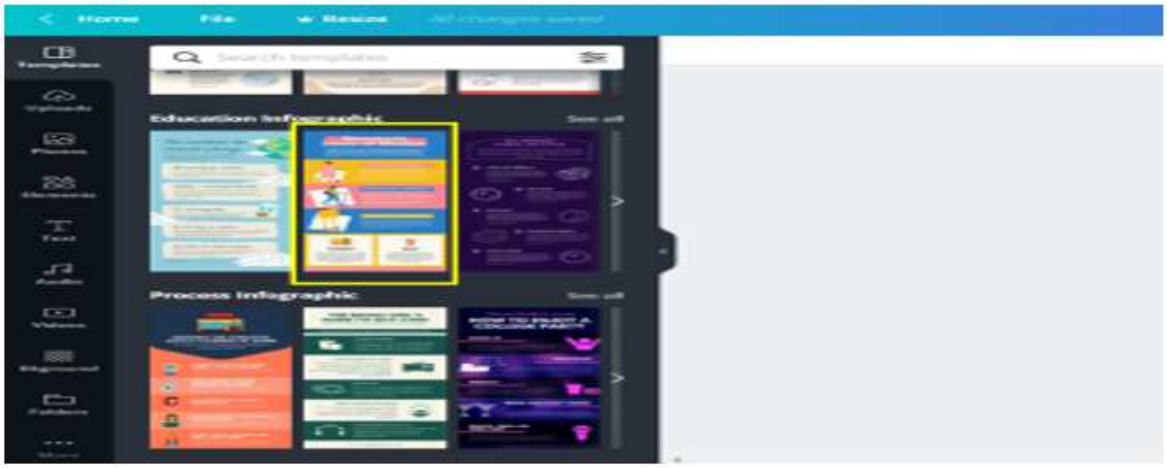


Figure 10. Infographic selection

3. Delete Media and Text

The first thing you need to do is delete the fields you don't need. To do this, click the picture or text you want to delete and press the delete button. Or right click and select “Delete” from menu.

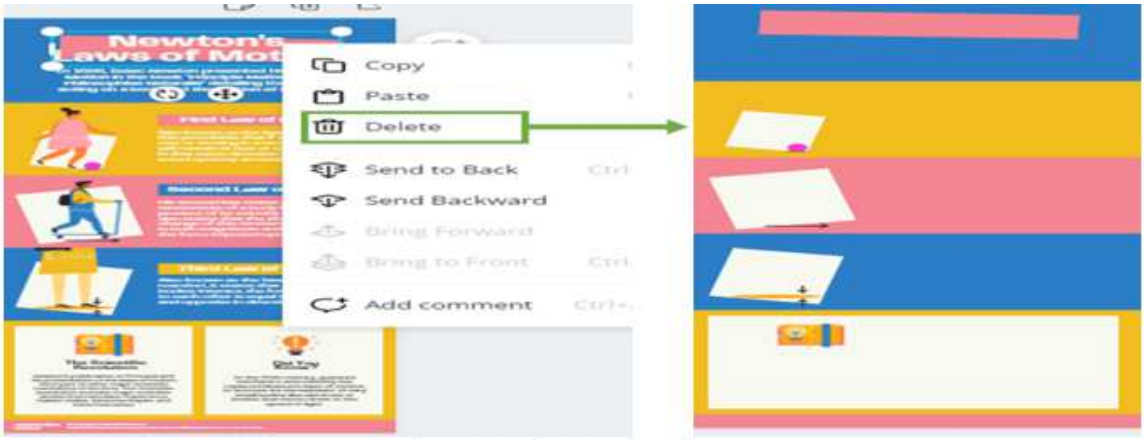


Figure 11. Delete media and text

4. Uploading Media

Now we will upload media. Click on the photos section in the left menu. If the pictures you want are not available in this area, you can use the photos from the internet or on your computer. Photos on the computer are used in this activity. First, open the folder containing the photos. then select the photos you will use. Press CTRL to select multiple photos and click the pictures you will use. Drag the pictures you selected to the menu on the left (Drag & Drop). You will see that your images are included in the Upload. You can add not only photos but also video and audio files. You can even log in to Facebook and access the photos directly on your Facebook account and edit the ones you want.

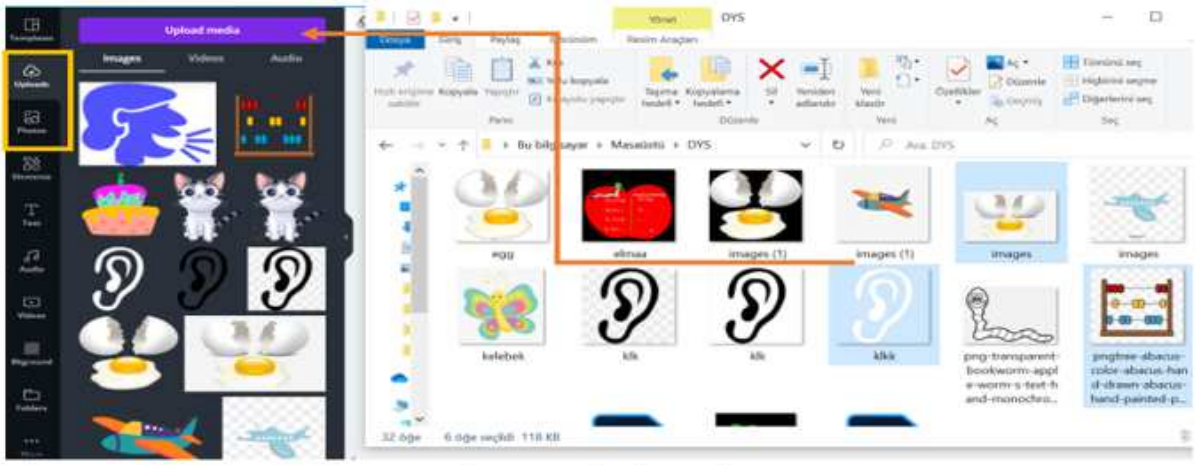


Figure 12. Uploading media

5. Editing Text

There are many features in the text pane, and with a little research, you can access a lot more. The common point of all these features is that they can be applied easily. When you click the "add text" button, a small text box will be added to your design. You can move or scale your texts like any other design component. There are "text fields" at the bottom of the text pane: you can drag and drop correctly designed typography elements and start using them in your designs right away. To find the text field that best fits your photo, scrolls down to the bottom of the text pane and click or drag it into your design. Once you've decided on your message, click inside the text box and start typing

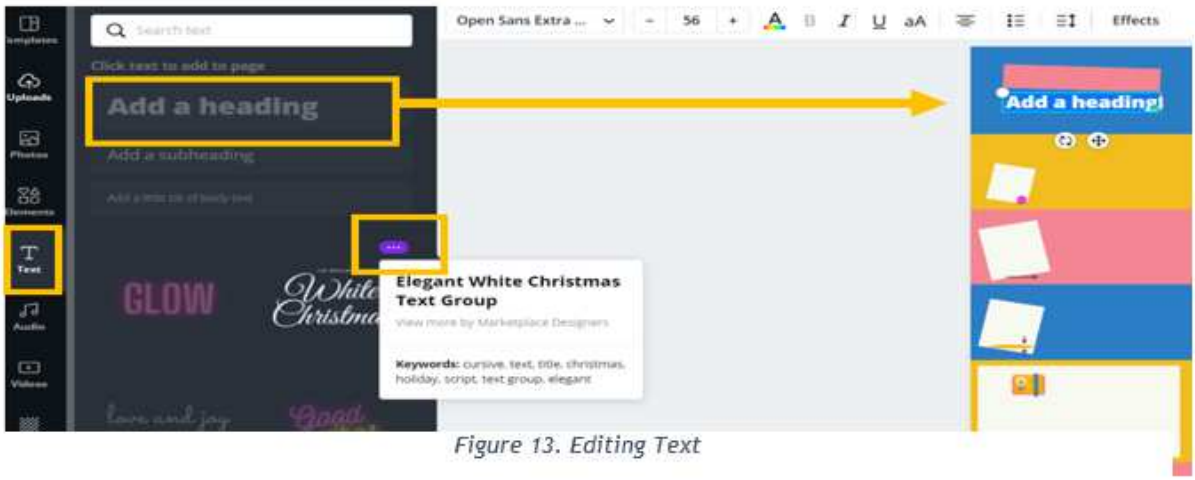


Figure 13. Editing Text

Figure 14. Editing Text1

You can use the options in “a” to change the font of the text. In “b”, you can adjust the size, colour, and thickness of the article. Write "egg" and select the letter "e" and select A in section b. The colour palette will open on the left of the page. Choose yellow colour from this palette. Then select the letters "gg" and repeat the same process, choosing a different colour.

6. Editing Photo

Using the photo editing tool, you can easily do many applications such as correcting, cropping, adding frames and text to photos, speech bubbles, making photos transparent, fading, blurring, etc. Click "Uploads" to access your previously uploaded photos. Select the images you want to use, drag and drop them.

Figure 15. Editing Photo

Congratulations!

You now have an education infographic to hang in your classroom.

1.2. EASEL.LY

1.2.1. Aim of the Tool

Easel.ly is a free Web 2.0 tool for creating posters and infographics. Easel.ly is an application mostly used for preparing comparisons and other informative graphs with statistical data. The design interface offered to its users allows the creation of professional visuals with a comfortable drag-and-drop method. With the thousands of design templates and design objects it contains, you can easily create your visual using it on the web and use it where you need it. You can prepare and publish lesson plans, statistics tables, professional presentations in easel.ly, which educators and students use frequently.

1.2.2. How to Use

1. Click on Easel.ly 's home page (https://www.easel.ly/). If you are using it for the first time click “Create Your Free Account”. Also you must register using a Google, Facebook account or a valid email address. (After you become a registered user, you have the chance to access all the designs you have prepared when you log in to Easel.ly from any computer or phone.)

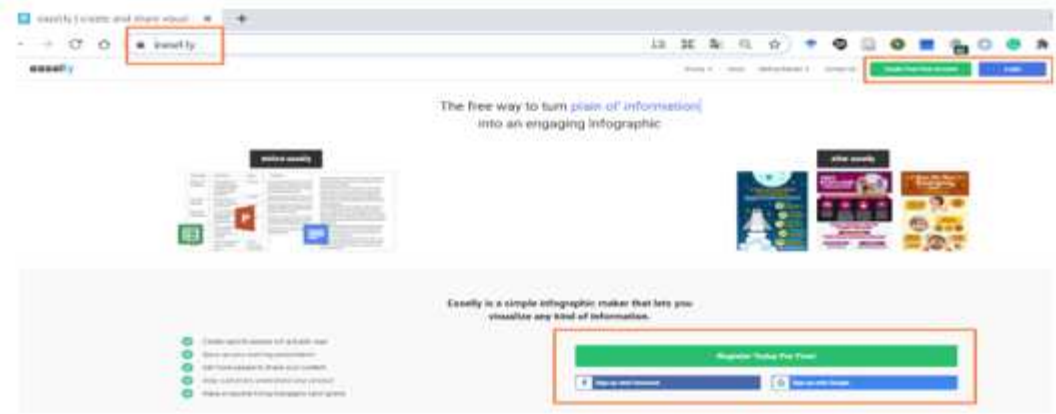


Figure 16. Easel.ly homepage

2. After click on “Create Your Free Account”, enter a valid email address, password and click “Sign Up”.

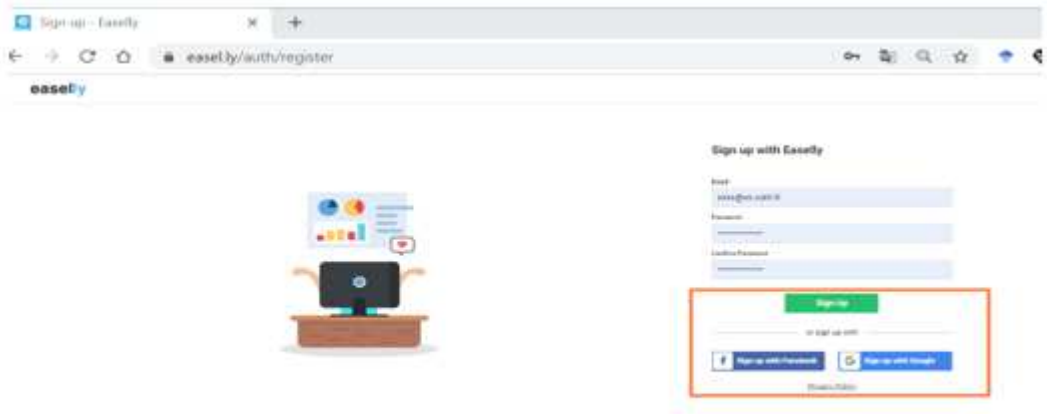


Figure 17. Easel.ly register

3. After completing your membership, you can choose a template suitable for your design on the home page you are directed to, and come to the editing screen where you can adapt it to its own content. In addition, whichever category you are working in, you can choose a suitable template by selecting that category from the field on the right. Click “Blank Template”.

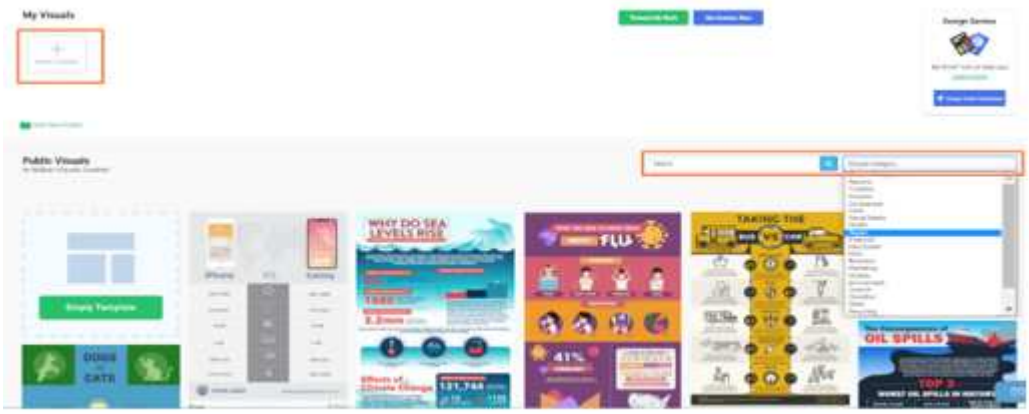


Figure 18. Templates and category

4. On the blank page that opens, you can prepare your infographic as you wish. First, let's explain the marked fields.

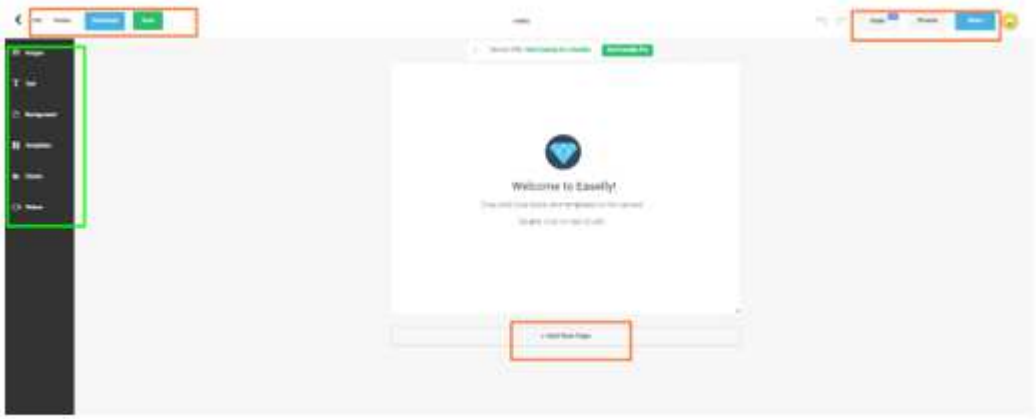


Figure 19. The Easel.ly workspace

File: Operations such as opening, saving, and importing files are performed.

Resize: The document is resized again.

Download: So how can we use the image we create on the web in our own presentations? We can download and use the image we create with the "Download" option, which is one of the options above the design settings, to our computer in low quality, high quality or as PDF.

Images: Adds pictures to the workspace.

Text: Adds text to the workspace.

Backgrounds: Organizes the background of the workspace.

Template: Adds a template to the workspace.

Charts: Adds graphics to the workspace.

Videos: Adds video to the workspace.

Upload: Upload images, videos, etc. from your computer to the workspace. adds.

With "Preview", you can see how your design looks. You can also get a shareable link with the "Share" option, so that the people we share the link with can see this image.

That's it with easel.ly, now it's time to go to easel.ly and create the best fit!

1.2.3. Tips for using in learning environments

Easel.ly, just like Canva, can help encourage creativity, foster collaboration, and make work easier as a teaching tool. It contributes to creating effective, interesting and productive learning environments. For example, with Easel.ly:

- interactive content can be produced,
- sharing can be provided,
- A poster can be prepared to support productivity and creativity,
- The learning process can be supported in an effective time-line province,
- A report describing a subject can be prepared.

1.2.4. Example Practices

You can make any design you want with Easel.ly, taking into account the course outcomes and using your creativity. In Practice 2, the "Find and Paint" activity was prepared using the blank template. To do this activity, follow the steps in order.

1. Import Image

First, drag and drop the picture on your computer to the images section.

Figure 20. Import image

2. Delete Icon and Text

Now clean up your workspace. To do this, select the area with the mouse and press the "Delete" key on the keyboard.

Figure 21. Delete icon and text

3. Editing Photo and Text

For image and text editing, you should use the menu on the left of the page. first drag the pictures one by one and drop them on the page. Then add and edit the text field from the text section.

Figure 22. Editing photo and text

4. Download Practice

Finally, you can save your work from the "Download" Low Quality section.

Figure 23. Download practice

Congratulations!

You now have an education infographic to hang in your classroom.

2. VIDEO AND ANIMATION (MULTIMEDIA)

Video and animation are tools that enable information to be presented in the form of images, sounds, videos, diagrams, etc., instead of plain text. Students' individual learning processes are supported by concretizing soft information with video and animation. Different multimedia applications can be used to present disabled learners to adopt their own style of learning. Learning environments prepared using video and animation help students feel safe in the environment. While a lecture can be extremely informative, a lecture that integrates pictures or video images can help an individual learn and retain information much more effectively. The use of various educational media may help to overcome the academic difficulties of children with learning disabilities. By choosing materials and activities suited to their level of learning and by stimulating their urge to bring out their best, teachers can help the pupils with learning disabilities to turn their difficulties into special opportunities to be model achievers (Raja & Kumar, 2010). Applications such as Piktochart, Easelly, Genial.ly, Canva, Biteable, Mural, Be Funky, Visme, Cacoo are some of the infographic tools. In this study, sample applications were prepared using BrainPOP and Powtoon.

2.1. BrainPOP

2.1.1. Aim of the Tool

BrainPOP is a learning resource that aims to support educators by creating curriculum contents containing animations, games, videos, exercises, activities and concept maps in order to attract students' attention. Course contents offered at BrainPOP are gathered under the headings of science, social sciences, English, mathematics, art and music, health, engineering and technology. When these titles are clicked, the units and subject lists under this title appear, and the related topic includes video, exercise, concept map, movie creation, games, resources and activities. However, to access all of these contents, you must be a paid member.

2.1.2. How to Use

BrainPOP can be used on all computers with internet connection, and you can access it from your phone or tablet thanks to its mobile support. You can continue, change and publish the projects you start on the computer on mobile by logging in from your own account.

1. To use it from computer and mobile, click on BrainPOP's home page (https://www.brainpop.com). If you have already registered, click "Log in". If you are not registered, click "School Trial", and "Yes".

Figure 24. BrainPOP homepage

2. Create your account by filling in the required fields and then Log in.

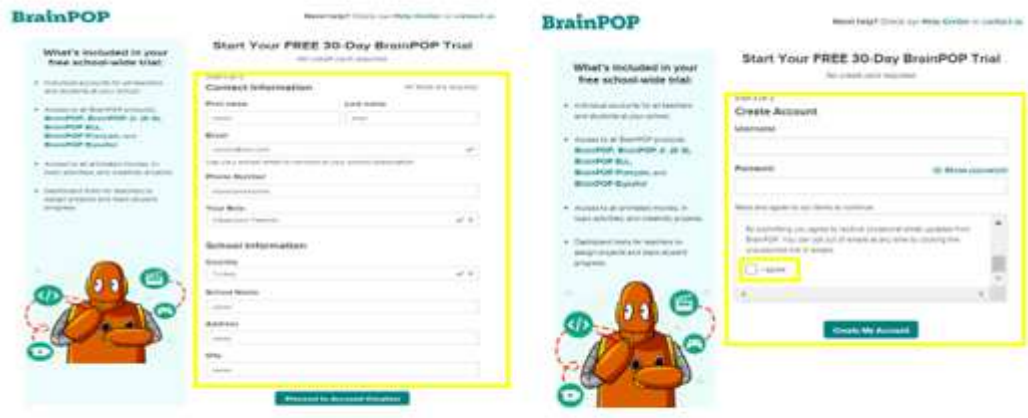


Figure 25. Create Account

3. After logging in, choose one from (BrainPOP, BrainPOP ELL or BrainPOPJr.). BrainPOP has chosen for this study. BrainPOP consists of animations with a few minutes of lecture. It offers interactive tests, concept maps, games and many other interactive activities by transferring science, social sciences, mathematics, technology, health and art topics with fun animations. BrainPOP ELL; It teaches English grammar topics in a story using lively and interesting animations. While taking students to higher levels with rated videos, it also enriches students' vocabulary. BrainPOPJr.; It covers many different subjects with its animations and interactive features. Every subject; It is supported by writing, drawing, interactive games and creating concept maps

Figure 26. Choose BrainPOP

2.1.3. Tips for using in learning environments

- Concept maps suitable for the course contents of all branches; it can be created, saved and printed using videos, images and keywords.
- Students can be provided with fun and educational games on the subject of the lesson to reinforce the subject.
- With the "make a movie" option, students can be made to create their own movies.
- By creating a movie, they may be asked to narrate historical events in chronological order, show a cause and effect related to a historical event, or portray an event in history.

- Using the movie creation tool, students may be asked to voice a movie to improve their language skills.
- In order to improve the student's artistic skills, they may be asked to create a film in which they will tell the life story of an artist and show the works of various artists.
- Exams completed by students can be viewed. In addition, educators can see how the student does the exams after watching the educational films, and how the class as a whole also does the exam. Students' work can be answered and commented in the classroom.

2.1.4. Example Practices

You can make any video, animation you want with BrainPOP, taking into account the course outcomes and using your creativity. To do Practice 3, which name is "Apple on Tree", follow the steps in order.

1. **Select Lesson**

After Log in, select Math lesson and Unit

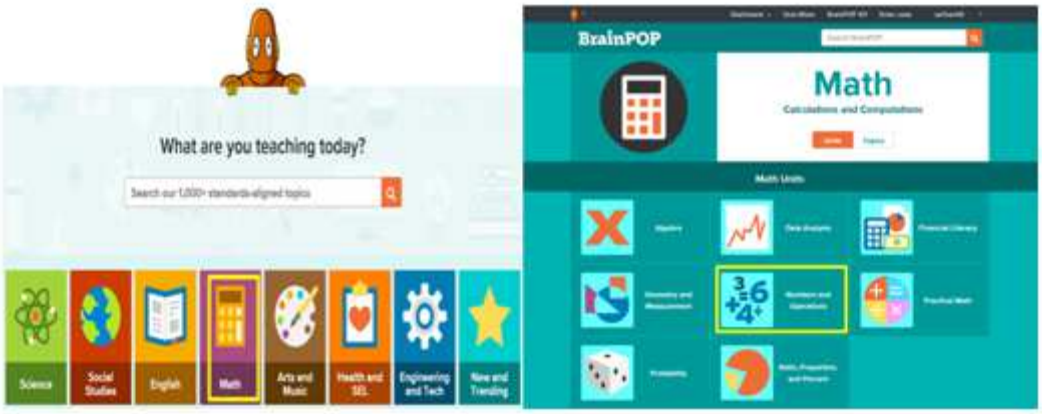


Figure 27. Select lesson

2. **Select one of Teach this topic**

In your lessons and activities, you can create quiz with "Quiz", concept maps with "Make a map", video with "Make a Movie", worksheets with "Worksheet", creating a dictionary with "Vocabulary". "Make a Movie" was used in this practice.

Figure 28. Teach topic

3. Start Movie

First, you will be asked to create a story. You should not exceed 150 characters for free use. Click "Write New".

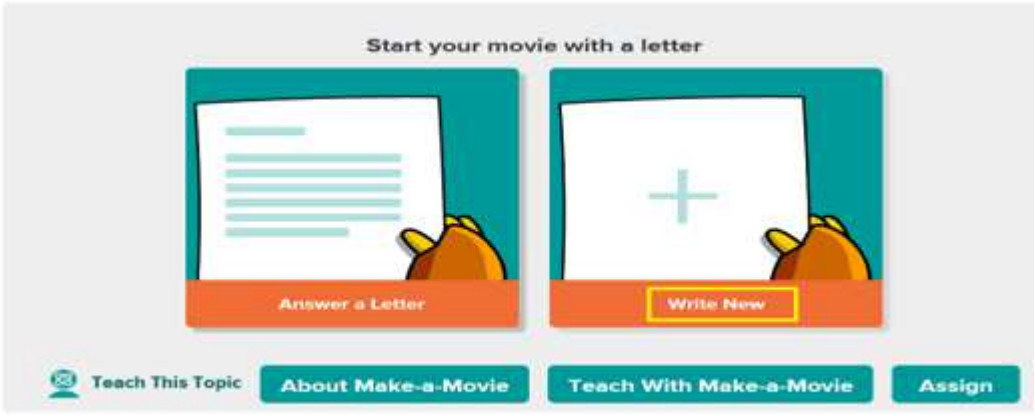


Figure 29. Start movie

4. Workscape

After writing your short story, you move into the workspace.

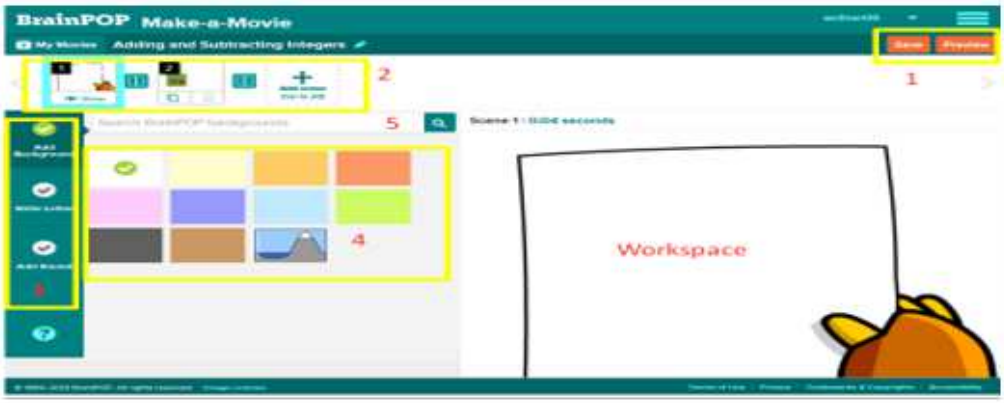


Figure 30. Workspace

(1). Select "Preview" to view your work before it becomes available, or "Save" if you do not make any further changes to your work.

(2). It is the area where the scenes are created. You can copy, move, and delete scenes. You can only create up to 20 scenes in the free version.

(3). Click "Add Background" if you want to add a background to the scene, "Write Letter" if you want to add a scenario, and "Add Sound" if you want to add a sound.

(4).It is the section where the details of the area you selected in number 3 are shown.

(5).When you search by any word, you can find pictures related to it.

5. Click Write Letter

Add background and write your question on the first page, without exceeding 150 characters.

Figure 31. Write letter

6. Add Background and Text

Select Scene2 and add background (boy), text, etc.

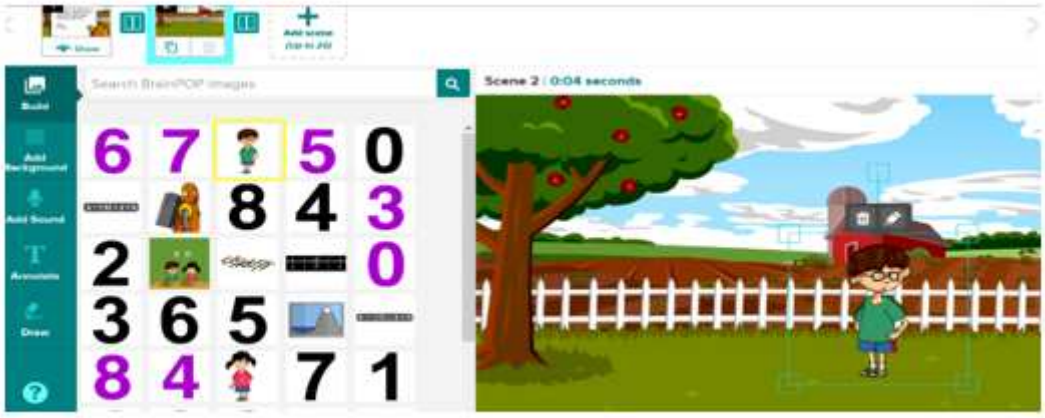
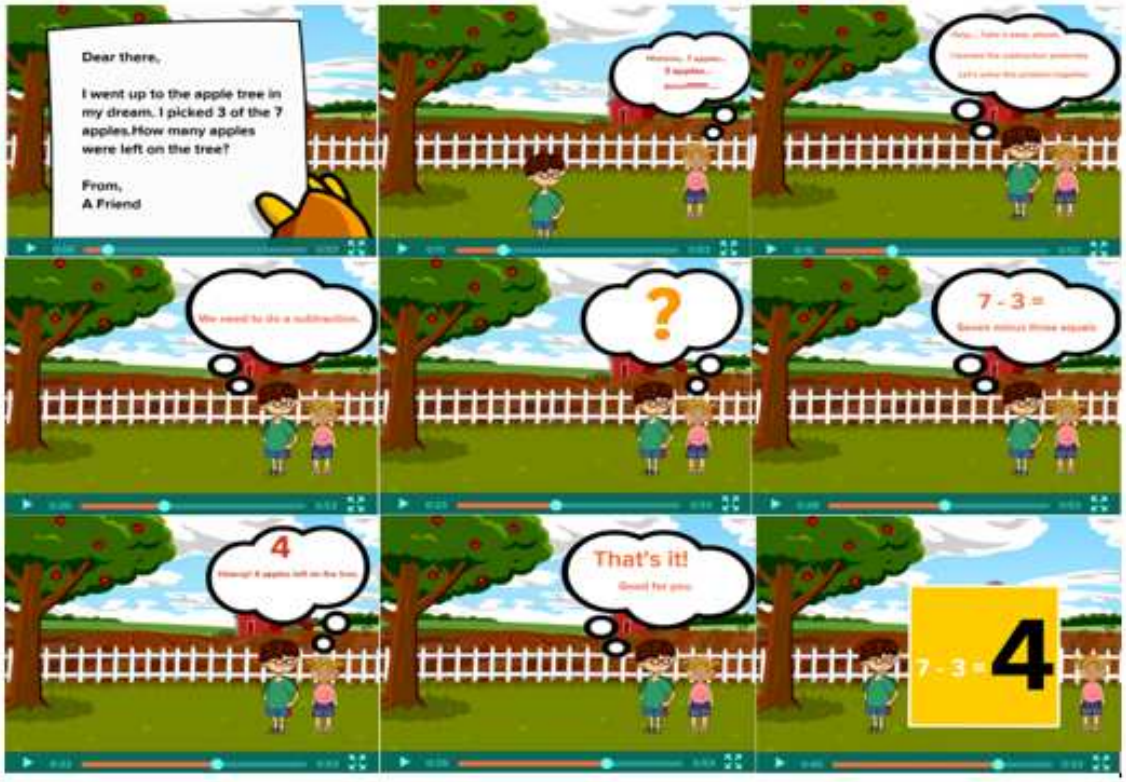


Figure 32. Add background

Add the characters, texts or sound in your story sequentially in the same way.

Congratulations!

Now your video that you can use for your math lesson is ready.



2.2. Powtoon

2.2.1. Aim of the Tool

Powtoon is a tool that allows you to create an animation using speech bubbles, shapes, images, characters and more. Powtoon has both paid and free options. The products you can create for free are also sufficient for your lessons. With Powtoon, you can create beautiful, interesting animations with good planning and using your creativity. Thus, your lessons will be more fun and you will add variety to your lessons.

2.2.2. How to Use

Powtoon is a web 2.0 tool that works online. Therefore, you do not need to install any programs on your computer. Powtoon is a web 2.0 tool that works online. Therefore, you do not need to install any programs on your computer. The free version includes 30 animated characters, 10 music and a basic slide pack. These features are sufficient to prepare an educational material. You can also preview your video before exporting it. Once complete, you can transfer your video to Youtube, Vimeo, Facebook, Wistia and HubSpot. You can also download the finished content as MP4, PDF or PPT file. Powtoon is web-based, so you can access your projects from any computer with an Internet connection.

1. Click on Powtoon's home page (https://www.powtoon.com/) and log in. Then we need to be a member of the system. We click on the “sing up” to become a member.

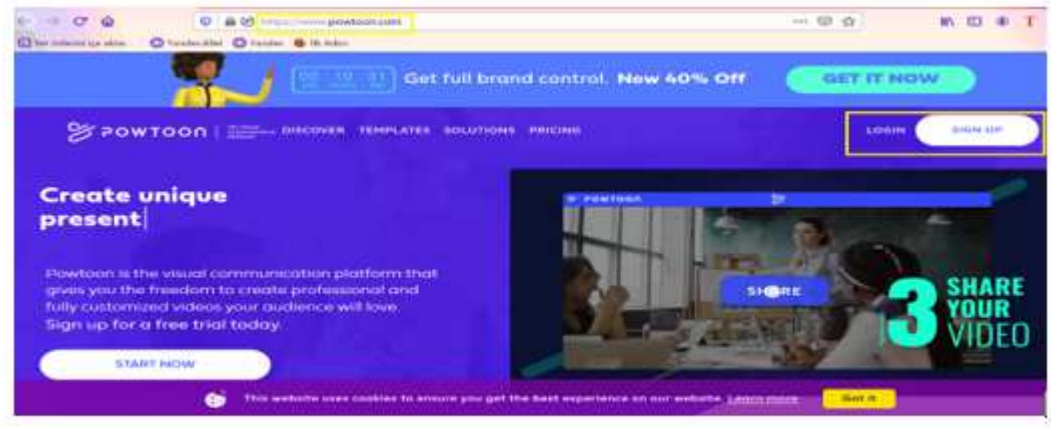


Figure 33. Powtoon's home page

2. On the page that opens, you can log in directly using your Gmail or Facebook account. Or you need to login with a valid e-mail address and fill in the membership information. Make sure you have the correct e-mail address while signing up, because after signing up, an activation email is sent from the Powtoon web 2.0 system. After confirming the activation e-mail, you can login to Powtoon system. To log in to the system, press the "Login" button on the top right corner, type the username and password and click "Login".

Figure 34. Sign up to Powtoon

2.2.3. Tips for using in learning environments

- Effective and entertaining learning can be achieved in the classroom by converting the course contents into animated videos.
- Students may be asked to present their homework by converting them into animated videos. In this way, it can contribute to the development of students' creativity.
- It can be used as an effective way to engage students.
- Animated presentation templates can be used to report homework subjects, deadlines and evaluation criteria.
- It can be used at the end of your lectures to summarize the key points of the topic.

For special days, memorial days and holidays, animations can be created to express the meaning of the day and presented in the classroom.

2.2.4. Example Practices

With Powtoon, you can create a new project, as well as customize and use previously made projects. Template is used in this practice.

1. Create the Workspace

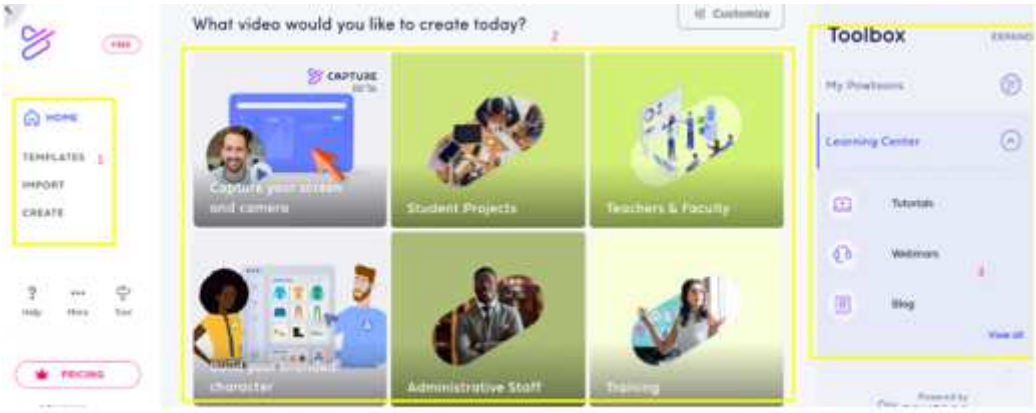


Figure 35. Powtoon workspace

(1) In this HOME section, you can work on the template, create a new workspace or import a document from outside.

(2) In this section, you can choose what kind of video you want to create. For example, you can create a new character, assign students, create course and homework work. In this practice, "Teachers & Faculty" has been chosen.

(3) Your previous work (My Powtoons), resources to support your learning (Learning Center) and applications in different formats and types (Apps & Integrations) are located in the Toolbox area.

2. Edit the Template

Select a template you want and edit the template according to your design. You can easily delete, duplicate and change the location of the scenes listed on the left of the page. By using the toolbox on the right of the page, you can change the background, text, import images, give various effects to your character and use the templates for each option.

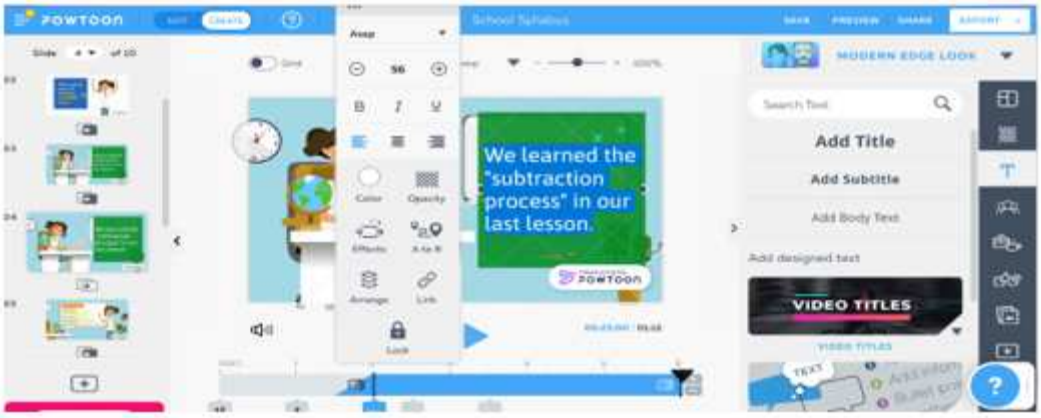
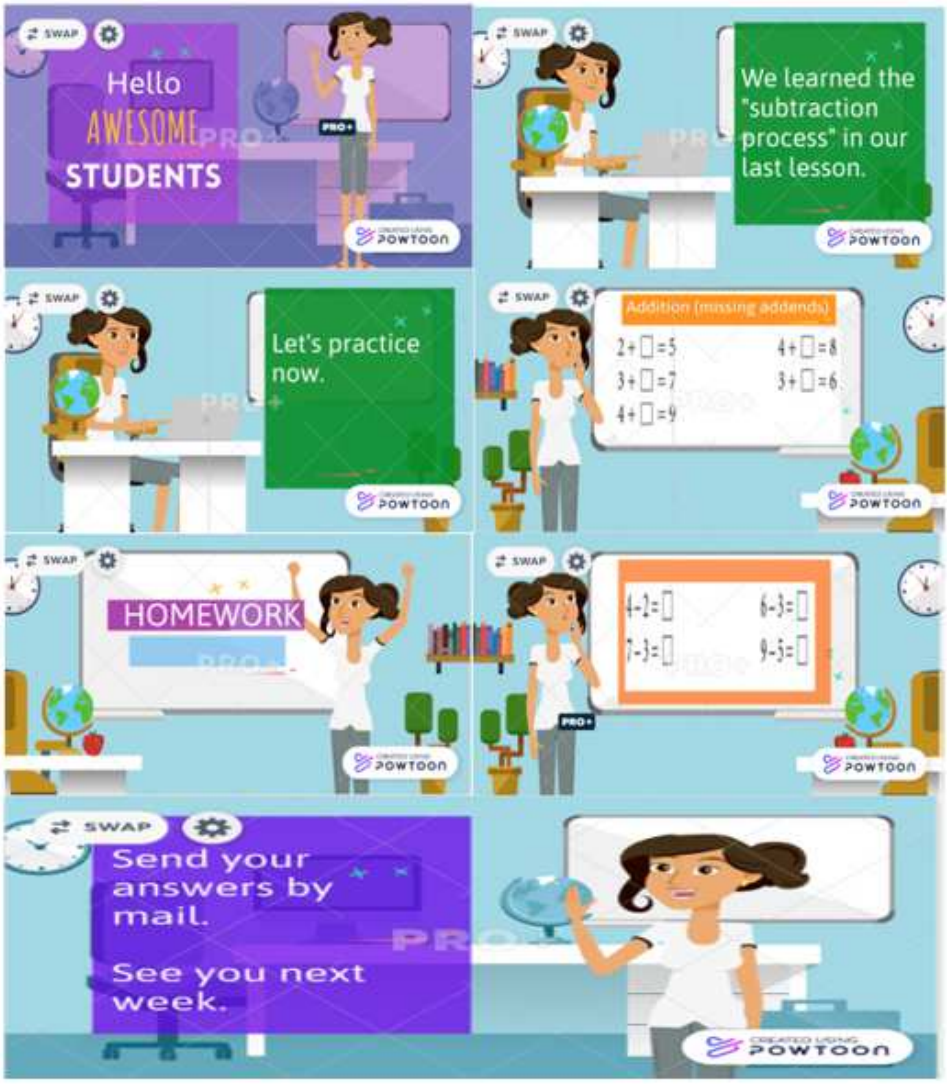


Figure 36. Edit the template

After making your edits on each page, you can preview it and share it on social media.

Congratulations!

You have created a video that you can use in your classroom.



3. AUGMENTED REALITY AND VIRTUAL WORLD TOOLS

Augmented reality is a technology that virtually places information or interactive elements on the image of the information in the physical environment. Virtual worlds, on the other hand, is an interactive environment that allows information to be presented entirely through 3D virtual media. With VW and AR, can easily explore different realities and angles of the thing they are learning; instead of hearing, reading, and just seeing a two-dimensional picture, they get to learn that material through experience. By enabling gamification of learning with AR and VW, learning can be used for students with disabilities, from the basics of language and pronunciation, numbers, and general knowledge to simplifying complex biology, chemistry, and advanced mathematics. AR and VW have been instrumental in curating specialized learning modules for differently-abled children and have also been known to be effective for students with learning difficulties. Aurasma, Animal 4D, Quiver, Taleblazer, Blippar, Augment, Spacecraft 3D, Thinkercad AR and VW tools are some of them. Sample applications were prepared using Blippar and ArtSteps within the scope of this study.

3.1. Blippar

3.1.1. Aim of the Tool

The purpose of the Blippar tool is to enrich our content in the digital environment, and to provide a workspace to design different two-dimensional and three-dimensional contents in all areas, especially in the education field. In this environment, you can add different layers to a photo you have taken with your android and ios operating system device. You can make a more detailed presentation by creating audio, video and three-dimensional objects on the visual.

3.1.2. How to Use

To use the Blippar tool, we must first subscribe to blippar's own site (www.blippar.com). After signing up and logging in, the user is offered two different ways to create a project. One of them enables working in AR environment on the web, and the other enables using web projects as mobile applications. After opening a new workspace in any medium, you can use content provided by blippar or content that you uploaded personally. When your content is ready, you can prepare your content by using 3-dimensional objects, video or

sound on the floors you have determined. Once you've finished, you can publish your content anywhere in the world for a fee, or publish a free test to use with your students. To run the application you have prepared, you need to download the Blippar application and enter the code given for your project in the code section of the mobile application. Then you can open the ground image you have determined, after logging into the Blippar mobile application, you can run your project by holding your phone camera correctly to the relevant layer.

1. Click on Blippar's home page (www.blippar.com) and log in.

Figure 37. Blippar's home page

2. The Blippar home page will load after logging in. If you are using it for the first time (Sign Up), you must register using a valid email address. (After you become a registered user, when you log into Blippar from any computer or phone, you will have access to all the projects you have prepared)

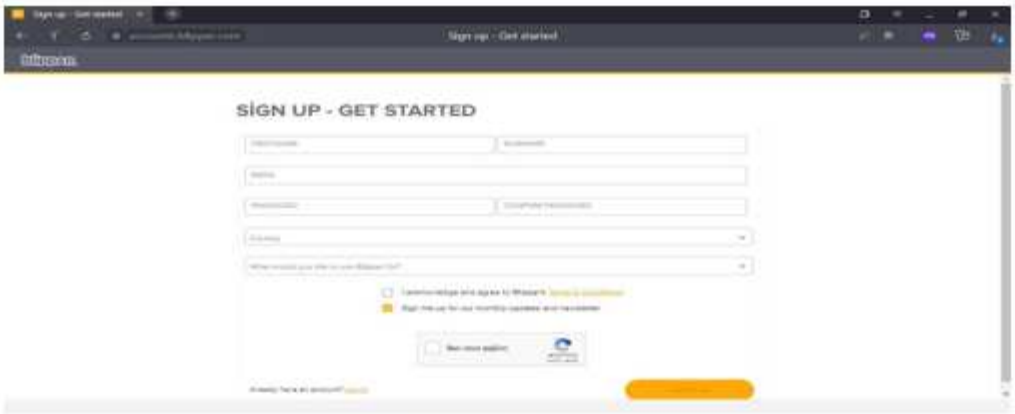


Figure 38. Get started

3. Press the "Start from scratch" button in the window that opens

Figure 39. Start from scratch

4. After logging in, press the "Create Web AR" (1) button for the projects you will create for the web on the "My Blipps" screen or the "Create App AR" (2) button to design with the mobile application

Figure 40. My Blipps

5. Add a floor photo (Fig 41, 2) by typing your project name in the "Give your blipp a name" (Fig 41,1) section and click the "Continue" (Fig 41, 3) button

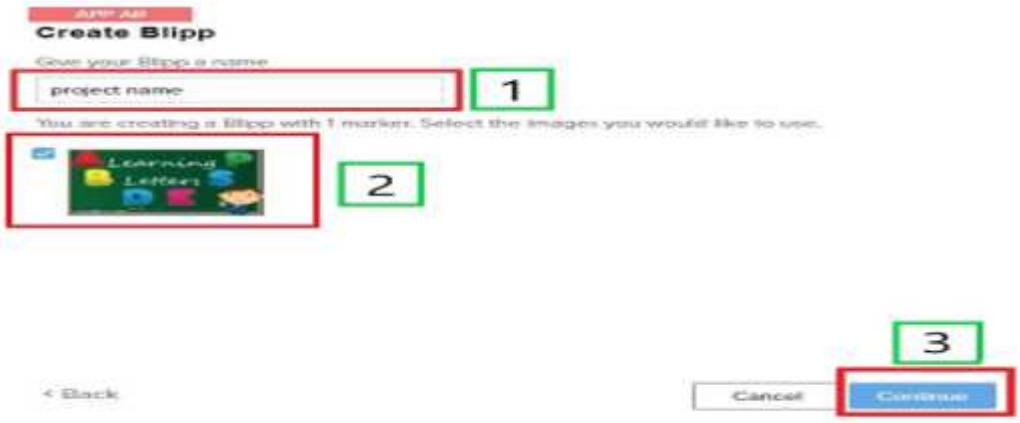


Figure 41. Create Blipps

6. The Blippar project page has four main sections. These are the design section (Fig 6, 1), the side panel section (Fig 42, 2), the features section (Fig 42, 3), and the animation section (Fig 42,4)

- ***Design Section:*** You can make your design with three-dimensional objects, video, sound and two-dimensional images on the floor you have selected in this area.

- ***Side Panel Section:*** In this section, there are tools to be used by the designer. Elements, Widgts and Uploads sections are available here.

- ***Features Section:*** In this section, you can set the properties of the design area. There are sections such as Layout, Action, Basic properties.

- ***Animation Seciton:*** You can use this section to move the objects you have placed in the design area. For this, you can use different effect features by using the Motion Effects panel.

- Side Panel (Fig 43) is the section where add-ons such as elements, widgets and uploads can be used. With the add-ons here, you can customize your work with different tools. You can also customize your design by using blippar ready tools or adding your own content from the uploads section.

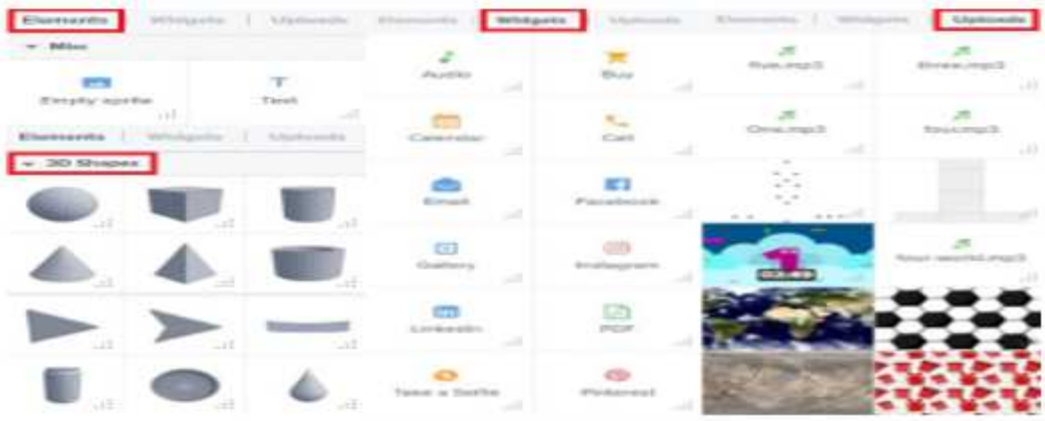


Figure 43. Side Panel Section

Empty sprite: You can upload pictures to your design area from this section.

Text: You can add any text to your design area from this section.

3D Shapes: In this section, you can use the three-dimensional objects Blippar offers in your project.

Widgets: From this section, you can add wigs provided by Blippar (For example; audio, calendar, pdf).

Uploads: From this section, you can upload your own content to your workspace.

- Properties (Fig 44) is the section used to determine the properties of the design area such as layout, action and basic properties. Here you can adjust the dimensions of your design screen, change the actions of your objects and the name of your workspace.

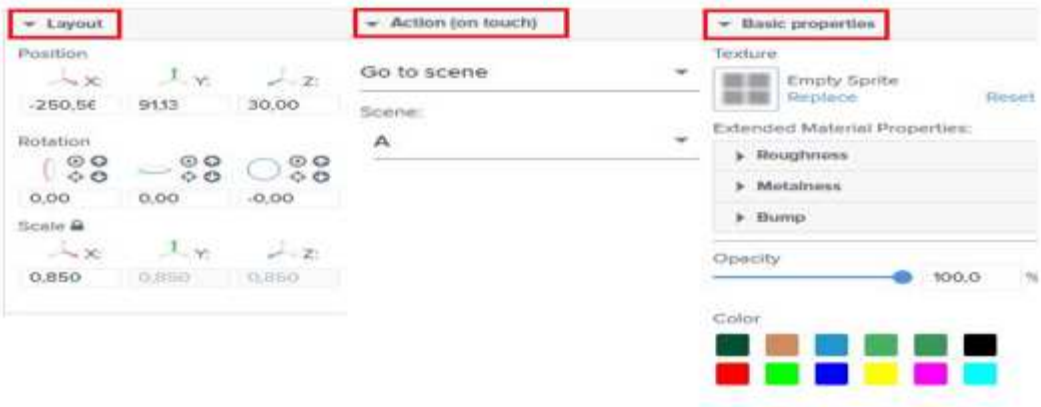


Figure 44. Properties Section

Position: In this section you can adjust the position of all objects on your design screen.

Action: In this section, you can specify how objects you add to your workspace should behave when touched.

Basic Properties: From this section, you can change the shape of your objects and make opacity adjustments.

It is the section where you can add the moving objects used in the animation design area and the effect properties you want to give to the objects from the motion effects section (Fig 45).

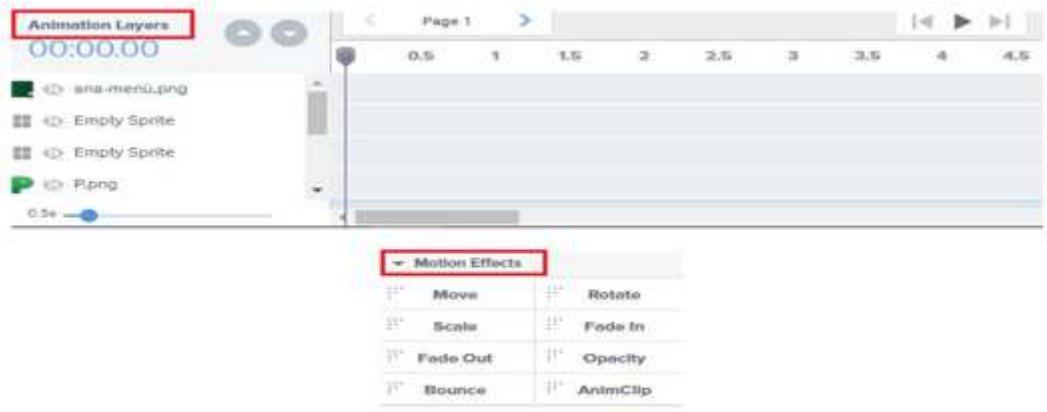


Figure 45. Animation Layers

Move: Change the position of an element over time.

Rotate: Change the orientation of an element over time.

Scale: Over time, blend an element from its normal opacity value down to completely transparent.

Fade Out: Over time, blend an element from its normal opacity value down to completely transparent.

Fade In: Over time, blend an element from completely transparent up to its normal opacity value.

Opacity: Change an elements transparancy over time (keyframeable)

AnimClip: Animation clip bundled within a model asset (available only for model formats like gift that can contain animation data.)

Bounce:Over time move an element from one position to another with a bounce- like motion.

7. To add a scene to your project, click on “Scene 1” at the bottom left of the page. You can create your scenes by naming them in this section.

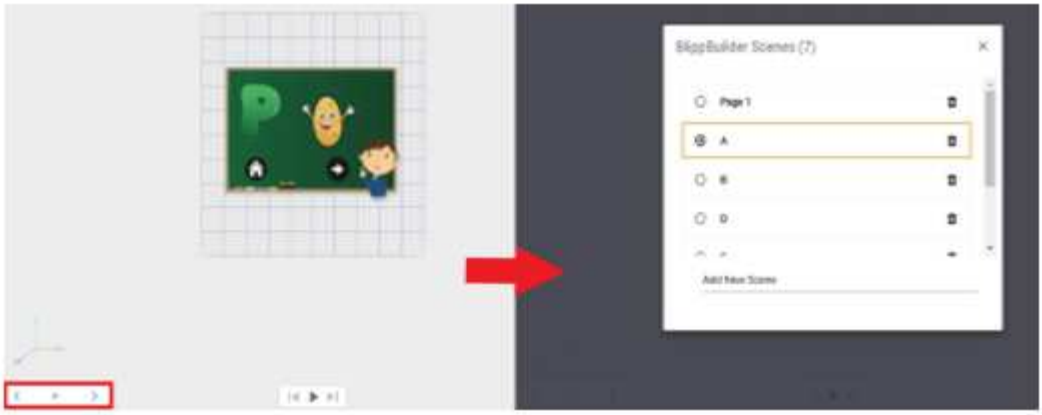


Figure 46. BlippBuilder Scenes

8. You can move and position the objects you have added to your project from the "3D" section on the right or the "Sprite" section on the right side.

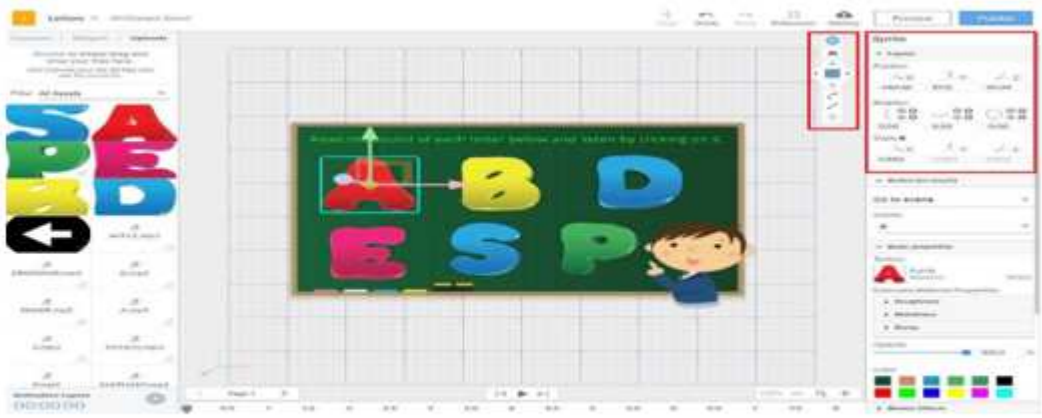


Figure 47. Position

9. After the content is prepared, you can publish your project in the world or in any location by pressing the "Publish" button on the upper right

If you want to use it without publishing, press the Preview button. Press the "Continue" button by taking note of the code given in the window that opens

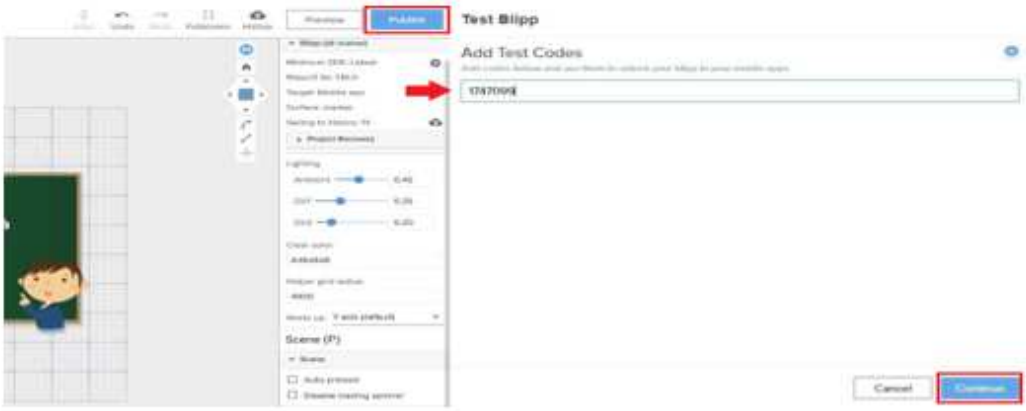


Figure 48. Test Blipp

10. Make the program ready to run by clicking the "Publish to Test" button in the window that opens.

Figure 49. Publish To Test

11. Download Blippar for mobile distribution from Google Play to run your project. After opening the application, confirm your test publishing code given by the program from the Settings section by entering it

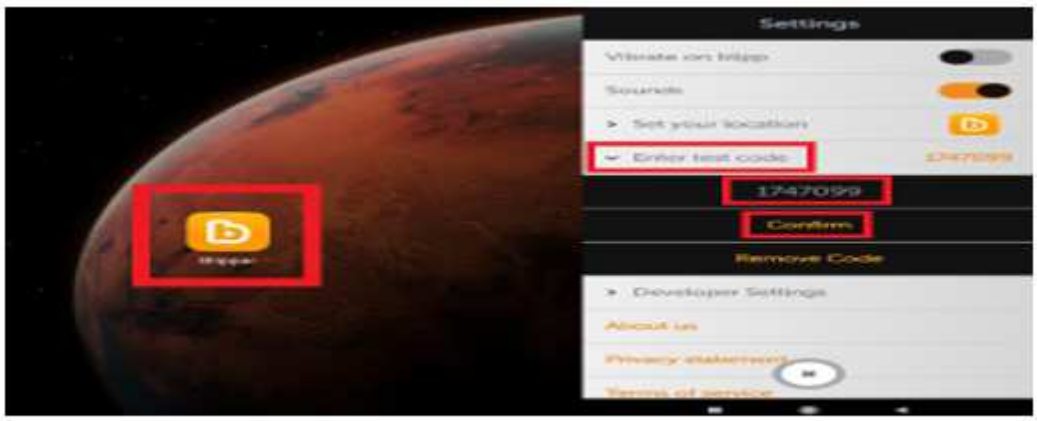


Figure 50. Application

12. After entering your code, hold your phone camera on your ground photo in the application and press the Tap to Scan button. Wait like this until the installation is finished

Figure 51. Application Camera

13. After the download is complete, your project will run. Some images of the sample work done for the application are given below.

Figure 52. Project Scene

3.1.3. Tips for using in learning environments

As a teaching tool, Blippar can help encourage creativity, facilitate studies and ensure visual and auditory retention. It contributes to creating effective, interesting and productive learning environments.

For example:

- Worksheets: By creating worksheets with Blippar scenes, you can enrich the content you present to students.
- Group Project: Some students enjoy the interactive nature of group projects and even learn better in groups, but more introverted or self-sufficient students may hesitate to learn this way. Canva meets the needs of both types of learner as collaboration can take place face-to-face, virtually, or a combination of both.

3.1.4. Example Practices

You can create the projects you want with Blippar, considering the results of the course and using your creativity. "Read and Listen Numbers" activity was prepared using the blippar tool. To do this activity, follow the steps in order.

Step 1. Open a new project and follow the steps Create App AR -> Start from scratch. Click the browse button from the tab that opens and add a new floor photo (For example; This floor can be any floor or board picture)

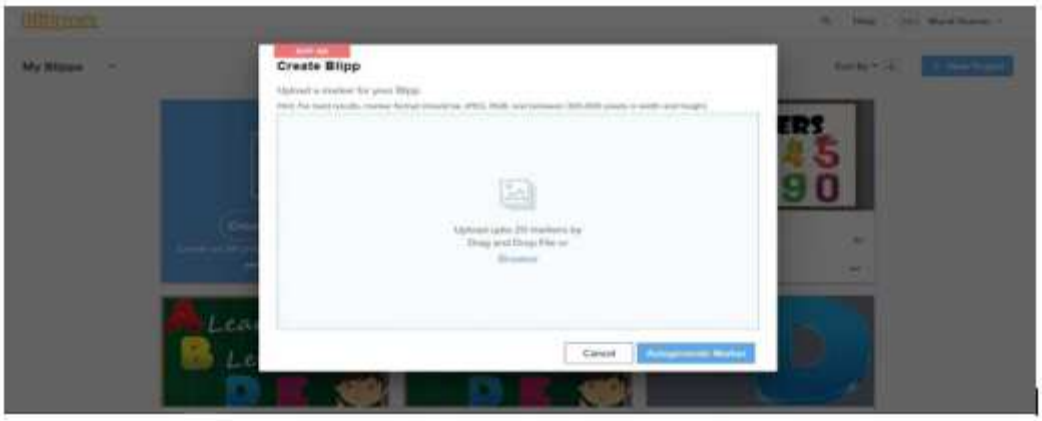


Figure 53. Create Blipp

Step 2. Upload the numbers, boards and sounds that you have prepared yourself or have taken from the Uploads section. And position your numbers by dragging and dropping them onto the board.

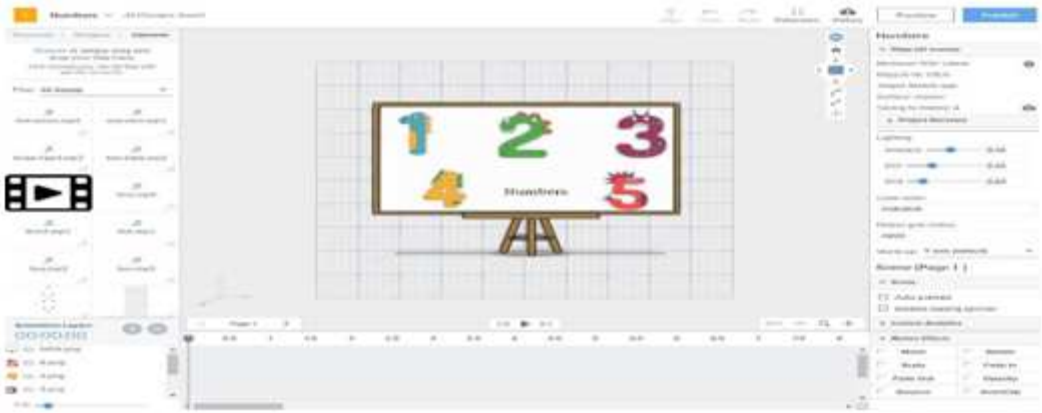


Figure 54. Uploads Section

Step 3. Direct the numbers you created on the first page to the scene you will open for each number from the Action section on the right. To do this, follow the steps Action -> Go to scene -> Scene 1 (2,3,4,5…). In this way, make your directions in the form of 3 scenes for 2 and 2 for 3. In this way, when you click on the numbers, you can switch to the relevant scene.

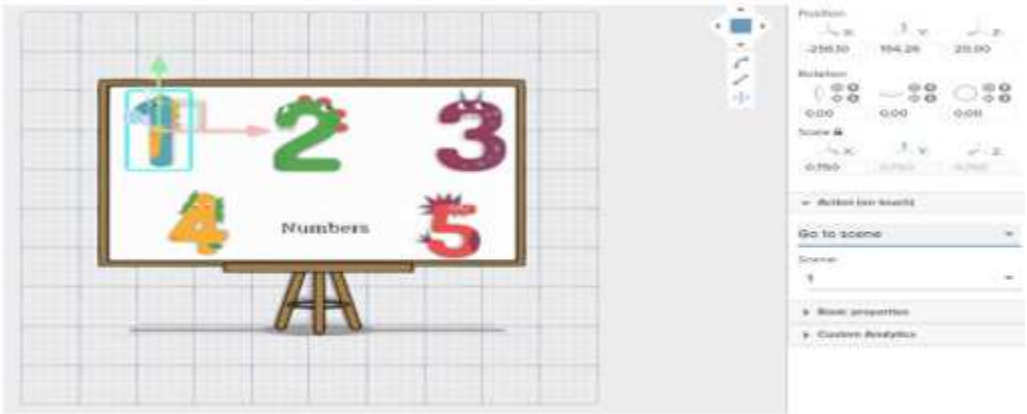


Figure 55. Action

- Use the Scene 1 button at the lower left to create the scene.

Figure 56. Create Scene

Step 4. In the figure scenes, create a button to return to the lower left section to the home page. For this, click on the relevant picture and select your home page from the Action section on the right

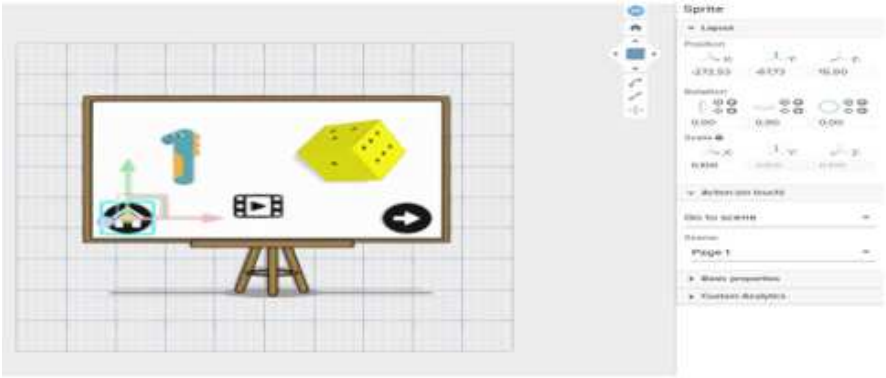


Figure 57. Home page key

Step 5. For each number, use the audio playback feature when you click the numbers to play the audio recording of that number. To do this, follow the steps Action-> Audio -> related audio file respectively.

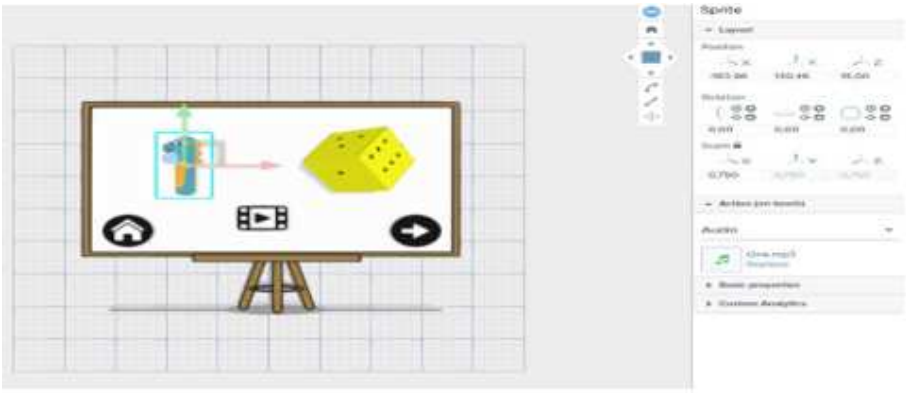


Figure 58. Audio for numbers

Step 6. In the

figure scenes, create a button to switch to the lower right section to the next scene. For this, click on the relevant picture and select the relevant scene name from the Action section on the right.

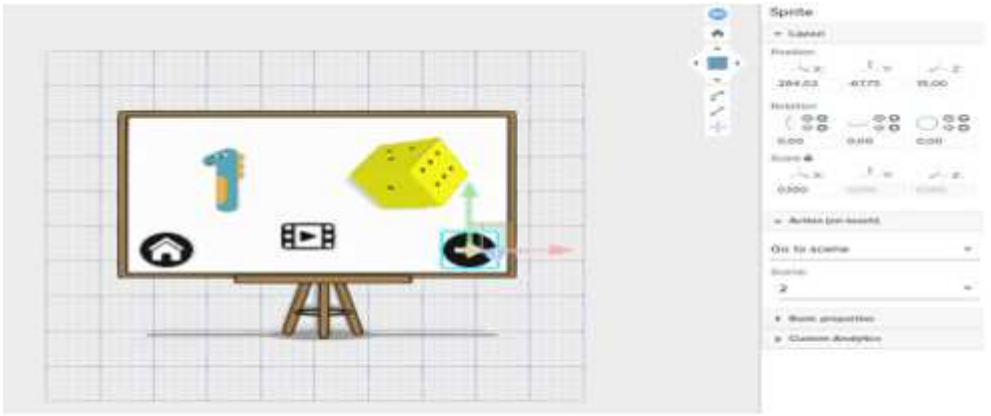


Figure 59. Direction key

Step 7. If you want to create an audio file when you click on the 3D objects that you will add as many as the corresponding number in the digit scenes, follow the steps of Action-> Audio -> related sound file again.

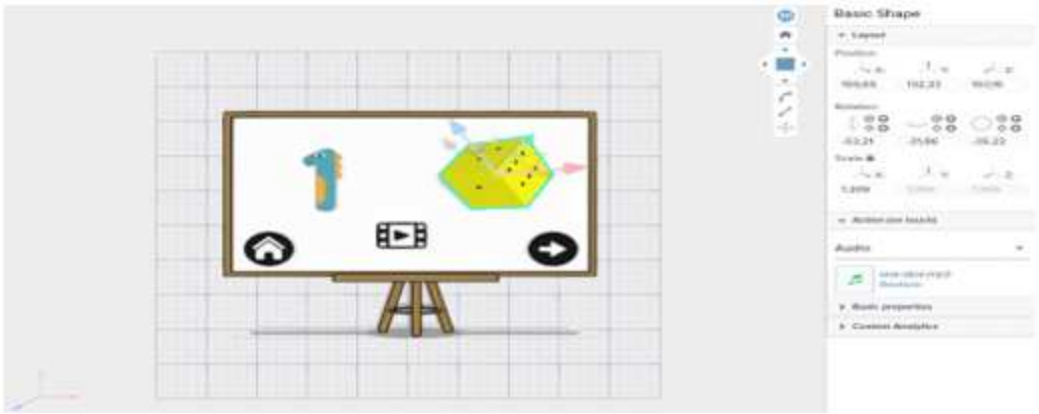


Figure 60. 3D object for numbers

Step 8. If you want to add a video button for the relevant number in the number scenes and play the video, you can click on the icon you have added and follow the steps Action-> Video-> upload the relevant video.

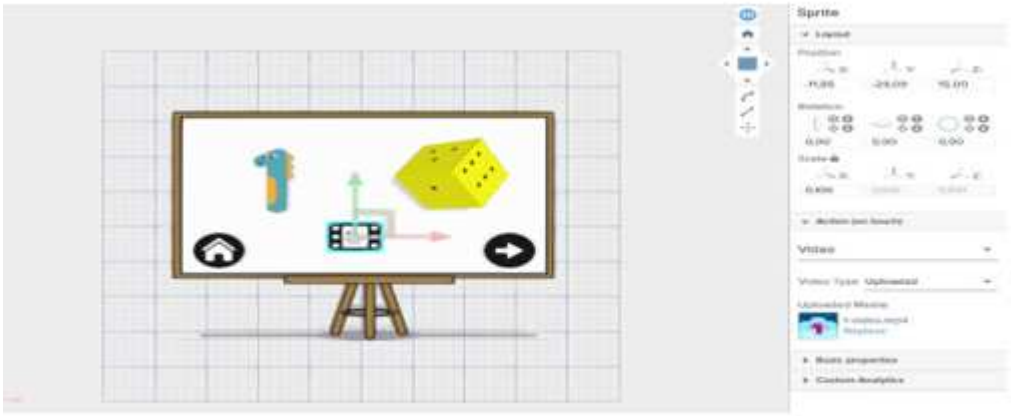


Figure 61. Upload Video

Step 9. Apply all the applications made in the first scene to your other scenes in the same way.

Scene 2

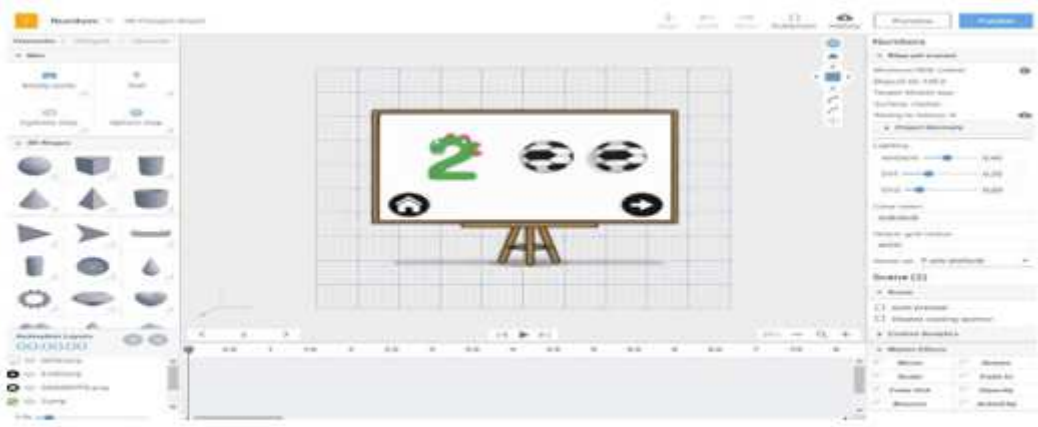


Figure 62. Scene 2

Scene 3

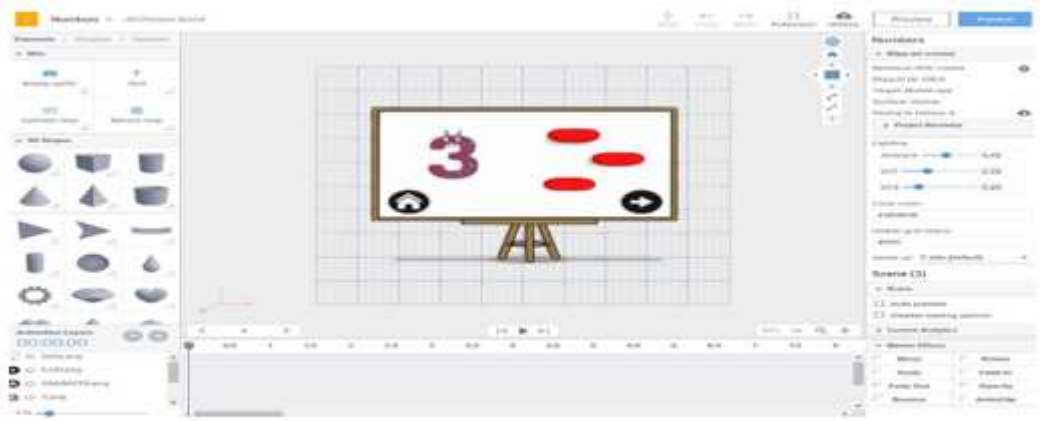


Figure 63. Scene 3

Scene 4

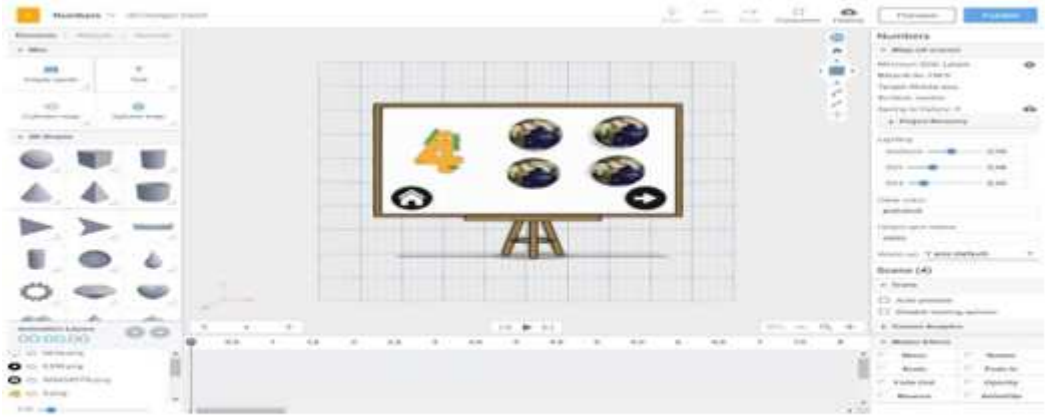


Figure 64. Scene 4

Scene 5

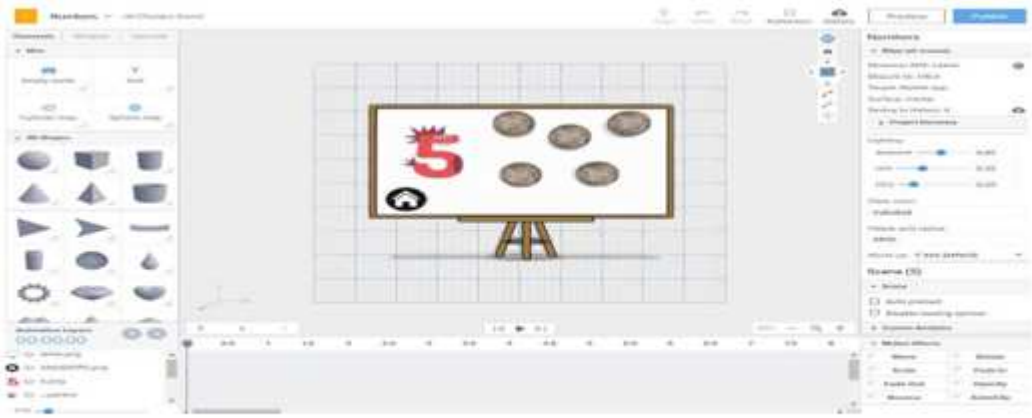


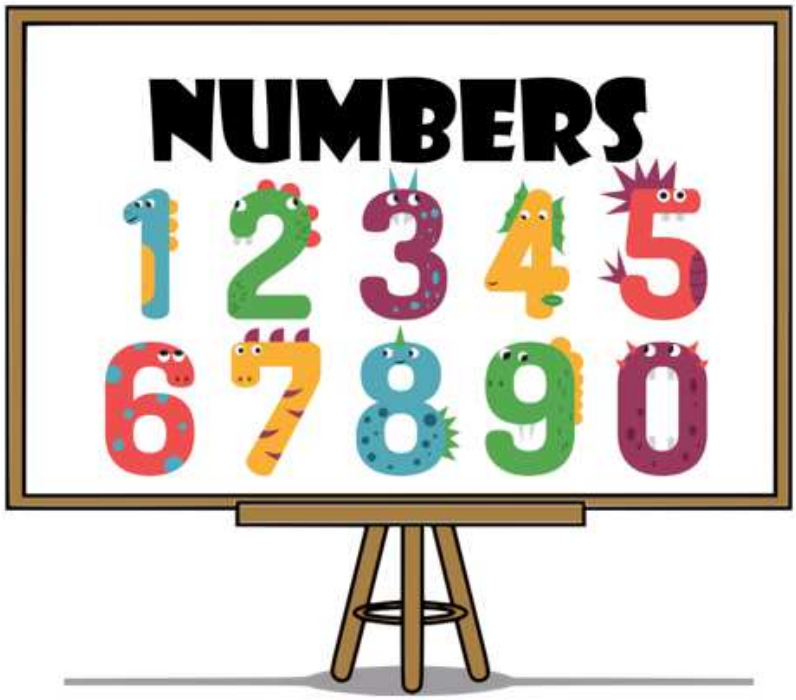
Figure 65. Scene 5

Step 10. After all the scenes are created, follow the steps of Preview-> Continue -> Publish To Test, and enter the code given by the program in the code section of your mobile application with the relevant floor photo. After entering the code, run your project by coming to the ground photo with the application camera.

Figure 66. Test Blipp

Congratulations!

You can now start your work by holding your camera at the picture.



3.2. Artsteps

3.2.1. Aim of the Tool

Artsteps is a Web 2 tool where you can create a virtual exhibition or museum by scanning your own pictures and pictures made by your students. ArtSteps offers a web-based environment that's used to create virtual art galleries in lifelike 3D spaces. Created as an application for artists, art organizations, and art enthusiasts to model actual or virtual exhibitions by designing realistic 3-dimensional room complexes, the use for art educators and students — especially when learning remotely — is endless. In Artsteps, you can even draw the hall yourself, add 3D objects, or visit this hall with VR glasses via the web page or the application. In Artsteps, you can use a pre-existing template, or you can build a hall the way you want by building the walls of the exhibition area yourself from the very beginning. Then you can start adding your works to the walls, respectively.

3.2.2. How to Use

You can subscribe at www.artsteps.com and use templates and features for free. You can share your works publicly or, if you wish, you can share them on your personal blogs or social media accounts such as Facebook and Twitter. You can design your own work immediately after signing in. In addition, Artsteps is a common platform that can be used by both teachers and students. Therefore, both students and teachers can open accounts and do individual work.

1. Click on Artsteps's home page (www.artsteps.com) and log in.

Figure 67. Artsteps's home page

2. It will be loaded after logging into Artsteps homepage. If you are using it for the first time (sign up: Fig 67, 2), you can register using a Google account, Facebook account or a valid e-mail address. (After registration, you can log into Artsteps from any computer or phone)

Figure 68. Figure 2. Get started

3. After logging in, click on the "create" button in the upper right section, and switch to the project design screen.

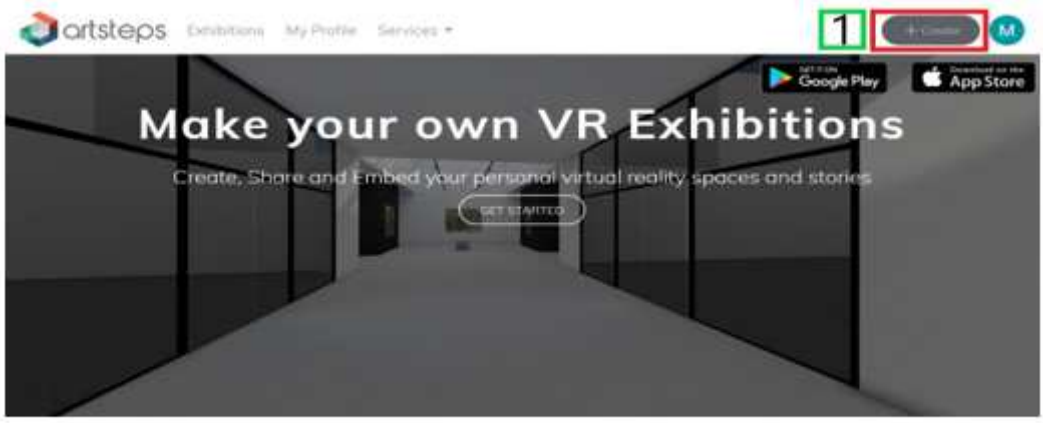


Figure 69. Create Project

4. There are three main sections in your Artsteps project design screen: the top panel (Fig 70.1), the designs section (Fig 70, 2), and the area where you will create the project (Fig 70, 3).

Figure 70. Artsteps's main sections

Define: You can either design the virtual world that you will design in this section yourself, or you can use the ready-made virtual worlds that are offered in limited numbers.

Design: If you are redesigning the content of your virtual world, you can change the colors and patterns of your virtual world here.

Add& place: In this section, you can add your own pictures, videos, three-dimensional objects and texts for your virtual world. You can also use the library provided by the artsteps tool.

Plan: In this section, after creating your virtual world, you can easily navigate the virtual world by putting guide cameras.

Publish: You can share your virtual world and contents that you have created in this section with the whole world. Do not forget to give a name to your work so that it can be accessed better after you publish it.

5. In the " Define" (Fig 71,1) section, there are tools to create your virtual world area on the right. Accordingly, you can create your virtual world by using walls and doors from the "Construction tools" (Fig 71,2) area. On the other hand, you can create your own default virtual world from "create your own" (Fig 71,3). You can use the ready-made virtual worlds provided by the artsteps tool from the area of “Exhibition templates” (Fig 71,4). To do all these steps, simply drag and drop the material you have selected from the left-hand area to your project area on the right.

Figure 71. Define Section

6. In the "Design" (Fig 72,1) section, there are painting and pattern tools for doors or walls that we use for the virtual world on the right. Accordingly, you can change the color of the doors or walls you add to the project area by selecting any color from the "Colors" (Fig 72, 2) field. You can change the pattern of walls or doors by selecting any pattern from the "Textures" (Fig 72, 3) area. To perform all these steps, you can click once on the colors or patterns you have selected on the left, then point to your object (door or wall) on the right and click once to make your changes.

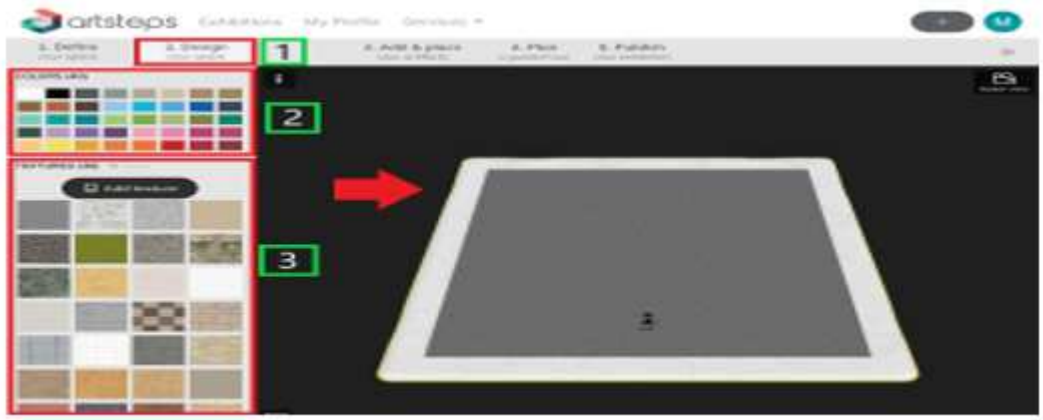


Figure 72. Design Section

7. In the "Add & place" (Fig 73, 1) section, you can add your pictures, videos, three-dimensional objects and writing materials for the virtual world created on the right. Accordingly, you can use the three-dimensional objects presented by the Artsteps tool from the "Display Cases"(Fig 73, 2) area. You can add pictures, videos, three-dimensional objects and texts you want to add from the "Artıfacts" (Fig 73, 3) area.

You can also use the Artsteps tool's own library in this section. In order to do all these operations, you can add your own library by clicking the add button in the sections where you will add the materials. On the other hand, you can add these materials by dragging and dropping them to your virtual world area on the right.

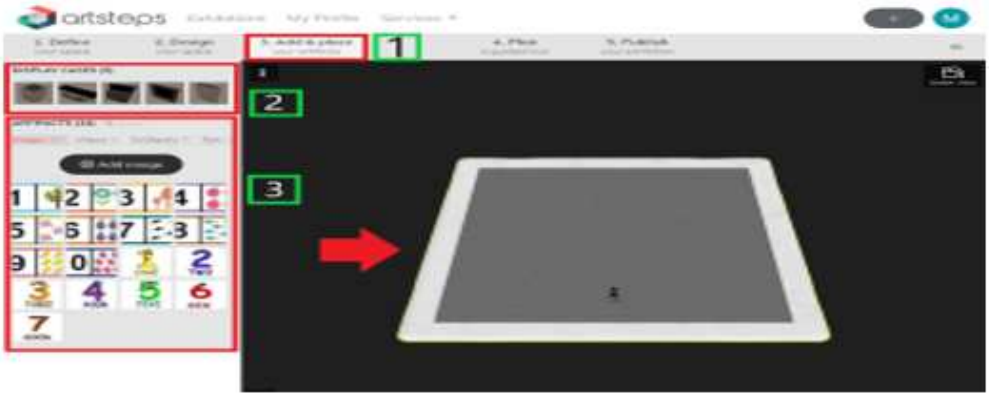


Figure 73. Add&Place Section

8. You can add guide cameras to your visitors (students) for the virtual world you have created in the "Plan"(Fig 74, 1) section. In this way, you will ensure that your students visiting your project can navigate regularly within the virtual world you have created. You can also add more than one guide camera to your virtual world space. All you need to do to do all these operations is to add your cameras from the "Add guide point"(Fig 74, 2) section on the left and drag and drop them into the virtual world on the right. After adding, you can position your camera wherever you want.

Figure 74. Plan Section

9. You can share the virtual world you created in the "Publish"(Fig 75, 1) section with the whole world. To do this, first take a picture of your project by clicking the

"Capture" button in the "Cover"(Fig 75, 2) area. Second, enter the information of the project you will publish in the "Public Information"(Fig 75, 3) field. Third, if you want to share your project on the Artsteps page, make the button (Fig 75, 4) selected. And finally, you can share your project with the world by clicking the "Publish" (Fig 75, 5) button on the top right. Therefore, your students can access the virtual world you have created at the same time.

Figure 75. Publish Section

3.2.3. Tips for using in learning environments

Artsteps has a wide range of uses in your learning processes and depends on your creativity. Some of these are listed below:

- You can use it to showcase the activities you have made for your students in your lesson.
- You can organize exhibitions to introduce letters, numbers, animals, plants, etc.
- By creating stories, you can let the student learn by discovering and having fun.

3.2.4. Example Practices

Considering the results of the course and using your creativity, you can design the virtual world you want with Artsteps and add content. In practice1, the "Numbers" activity was prepared using the virtual world. To do this activity, follow the steps in order.

1. Add the virtual World

Click on the "Define" section and add the selected virtual world from the "Exhibition Templates" section to your project screen. You can also drag and drop the "Start" icon on the bottom right where you want your camera to start.

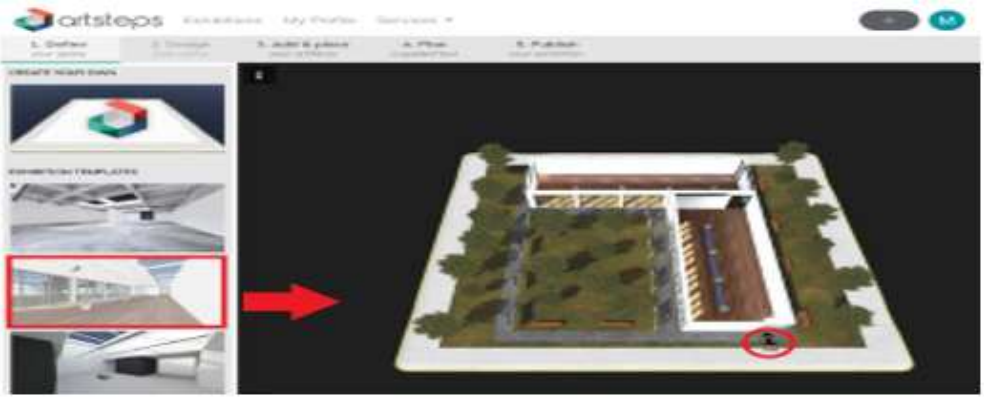


Figure 76. Define Section

2. Add your materials

Click on the "Add & place" section. In this section, add the pictures belonging to the numbers to your library one by one by clicking the "Add Image" button.

Figure 77. Add & Place Section

3. Add sound to pictures

Click the "Add image" button and enter information about the number you added (For example, you can write the number and the name of the objects representing it in the description section). Next, scroll down to the Audio file section and upload the audio to read the number (For example, reading number 5: five butterflies). Complete your upload by

clicking the "Save" button. In this way, add all the numbers you want to add and save them in the "Artıfacts" section.

Figure 78. Add sound

4. Add pictures to the virtual world

To add the pictures you have added to any part of your virtual world, drag them from the left section and drop them into the virtual world area on the right. You can edit the size and position of your picture from the positioning section located right at the top. You can also add a frame to your picture from the same section.

Figure 79. Add pictures to the virtual world

5. A
   dd other numbers

You can position all other numbers at any point in the virtual world (Example, Fig 80).

Figure 80. Add other numbers

6. Positioning the Start symbol

Put the "start" symbol at the point where you will start your trip inside the virtual world.

Figure 81. Positioning the Start symbol

7. Add camera to library

Click on the "Plan" section to add the cameras you will add to your virtual world. To do this, click on the "Add guide point" button. Then, add the name and description of your camera and click the "Save" button to complete your process.

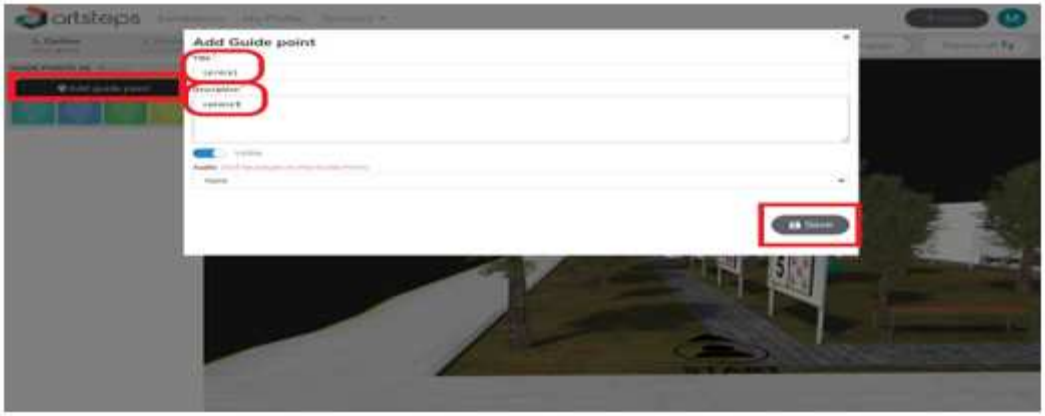


Figure 82. Add camera to library

8. Add camera to virtual world

Drag and drop cameras that you have added to the library to any point in the virtual world. You can change the view and position of your camera at the point you add (Remember, you can add multiple cameras and position them all at different points).

Figure 83. Add camera to virtual world

9. Add camera to virtual world

When your work is finished, in the window opened by clicking the "Publish" button; Write your study title and explanation part of the study. Then choose a category on the Artsteps page of your work to make the view more distinctive. You can share your work with everyone by clicking the "Save" button.

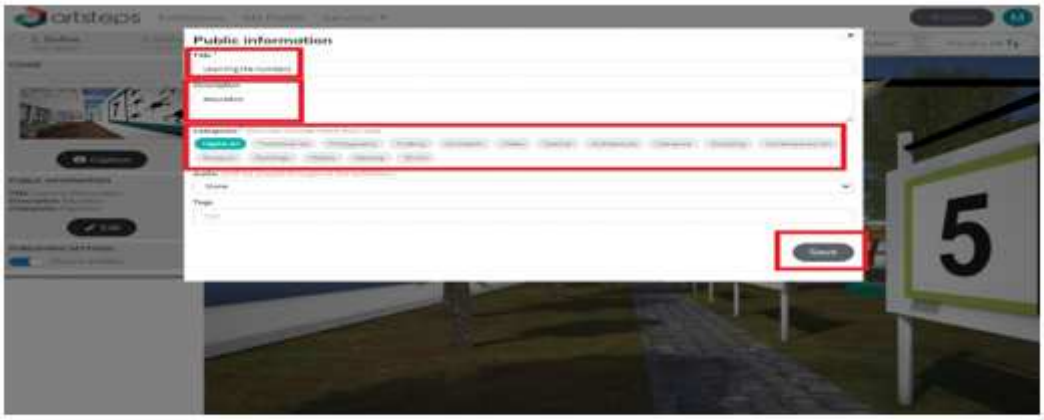


Figure 84. Add camera to virtual world

Congratulations!

Now you can share your virtual world with your students.

CHAPTER 4 - DIGITAL ASSESSMENT FOR LEARNING DISABILITIES

1. Google Forms

1.1. Aim of the Tool

Google Forms is a cloud computing service provided by Google. It basically offers an assessment service by which data are collected, stored, and reported online. It could be used to create online exams, quizzes, polls, and questionnaires. The options for the question type include short answer, paragraph, multiple choice, checkboxes, drop-down, file upload, linear scales, and grids. The created assessment instrument can be customized in terms of question type and visual design based on teacher preferences and goals. The created assessment instrument automatically saved on Google Drive. It could be distributed to the participants through e-mail, link, and embed HTML code. The collected participant responses are stored online and shown in the form of graphs. In addition, the responses can be downloaded as a CSV file and used for further analyses in another offline software such as Microsoft Excel or SPSS.

1.2. How to Use

1. Creating Forms

Google forms is used via a Google Account or Gmail address. It can be accessed via one of the following web addresses: (1) forms.google.com and (2) drive.google.com. On one of these web addresses, the teachers log in through their Gmail addresses and passwords. When logged in, the main pages of forms and drive are shown in Figure 85. and Figure 86., respectively. In Figure 85., a new form can be created by clicking on the “Blank” button. In Figure 86., a new form can be created by clicking on the “New” button, and then on “Google Forms”. The page in Figure 86. is also where the created form is automatically saved. A form entitled “My New Form” was shown as an example in the Figure.

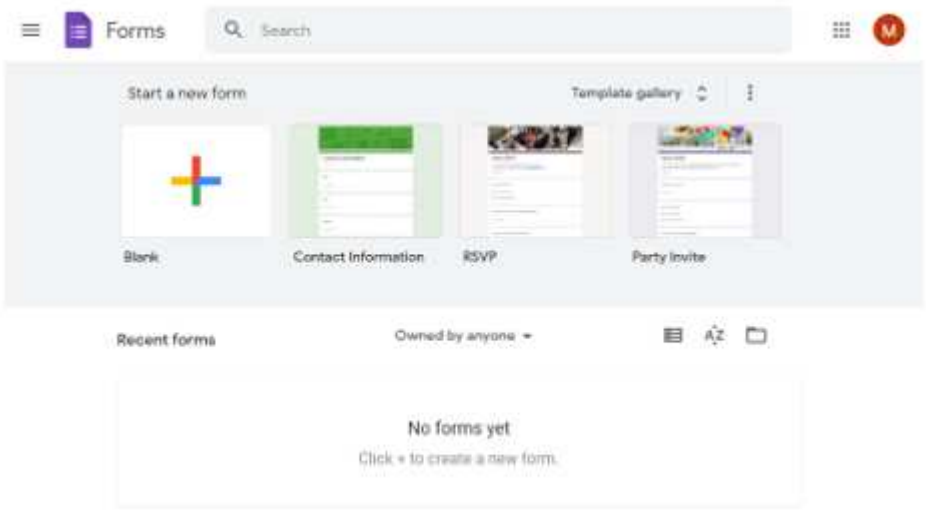


Figure 85. Main Page in Google Forms

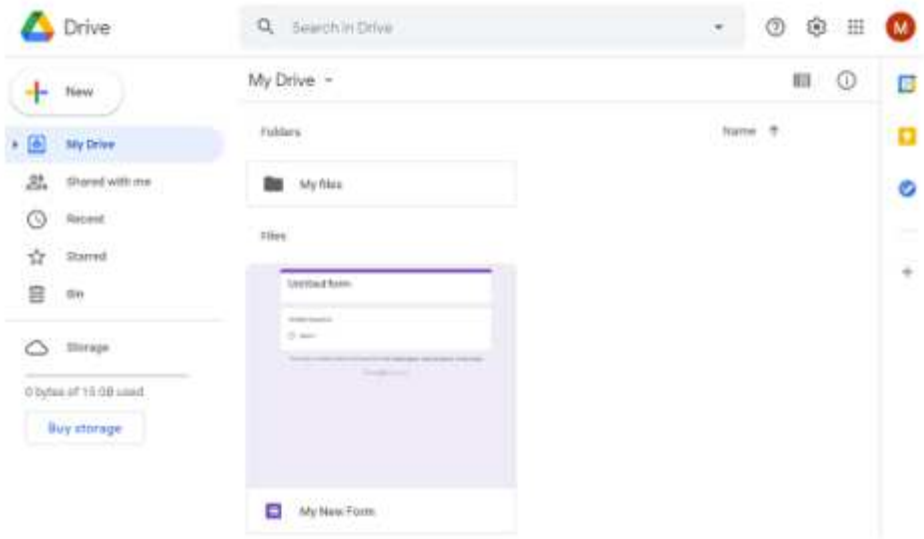


Figure 86. Main Page in Google Drive

Figure 87. indicates a default view of a form in Google Forms. By clicking on the "Untitled form" at the top left of the form, the name of the file on Google Drive can be changed. Through the folder icon beside the file name, the crated form can be moved to a specified folder on Google Drive. Note that the notification, "All changes saved in Drive", are shown at the top of the page after any action by the user. The notification means that all changes in the form are automatically saved in Google Drive without any further user action.

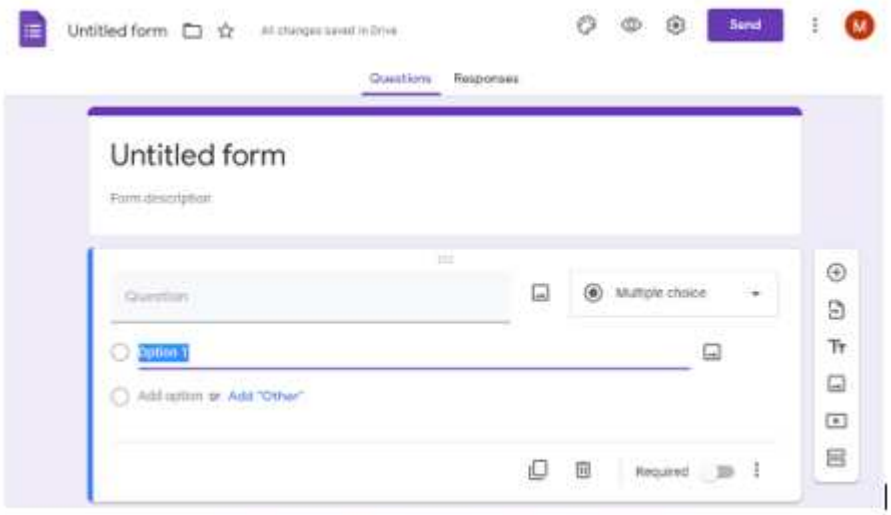


Figure 87. Default view of a new form on Google Forms

The first section in the Page on Figure 87. is where the assessment form is named and the necessary descriptions are provided. The following section shows a question in multiple-choice type. The type of the question can be changed by clicking on “Multiple choice” at the right part of the question panel. The question types available in Google Forms are displayed in Figure 88. below. Teachers can use any of these question types based on their assessment aims. For example, “Short answer” can be used to ask students’ age while “Multiple choice” can be used to ask their gender. On the other hand, the “Linear scale” can be used to distribute the items of a valid and reliable scale when data are collected within a scientific research study. Images can also be added to either question or the choices through the image icons beside them on Figure 87.

Figure 88. The question types available on Google Forms

The options at the bottom of each question item, shown in Figure 89, can be used to edit the questions. The question is duplicated via the duplicate button, is deleted via the delete button, and is set as required. Additional options are available through the menu besides the "required" checkbox. This menu offers options to add a description to a question, direct respondents to a specific section based on their responses, and shuffle option order.

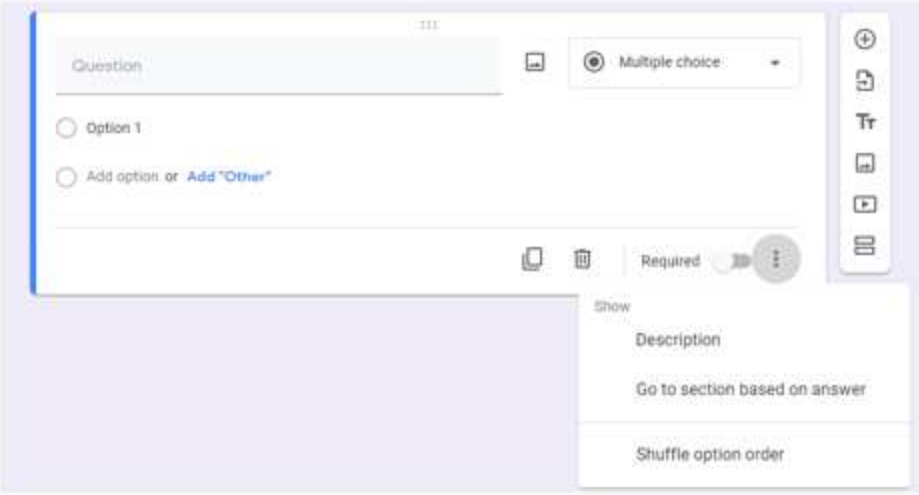


Figure 89. Options to edit a Question

The toolbox at the right of the default page, as also indicated in Figure 90, contains options that can be added to the form. The toolbox can be used to "add question", "import questions", "add title and descriptions", "add image", "add video", and "add section". The first option in the figure below is used to add a new question. The second option is used to add a question from another form. The third option is used to add a new title and description, just like at the top of the default page. The fourth option is used to add an image from the computer, via a camera, URL, or other Google services. The fifth option is used to add a video from YouTube. The final option is used to add sections so as to create multiple sections in the form.

Figure 90. Options to add to a form

2. Customizing and Distributing Forms

The created form is customized through the theme options shown in Figure 91. Theme options are accessed by clicking on the “customize theme” button at the right top of the page. Theme options enable users to customize their forms by adding a header image and selecting colors and font styles. The “preview” button beside the “customize theme” button enables users to view their forms through the eyes of the respondents. The “settings” button beside the “preview” button contains form settings such as “limiting to one response”, “showing progress bar”, “shuffling question order”, and “confirmation message”.

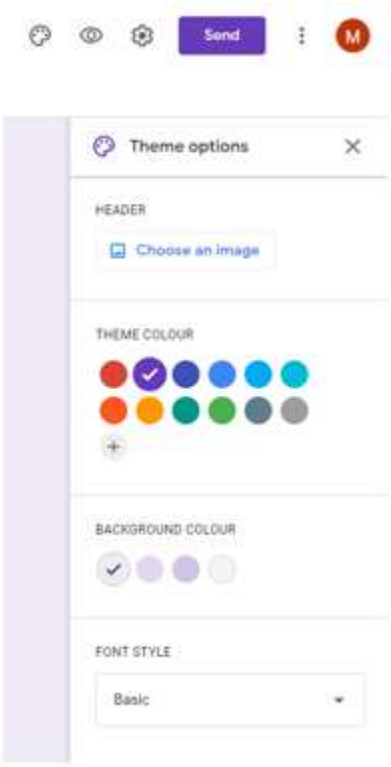


Figure 91. Theme options in Google Forms

The “Send” button beside the “settings” button is used to view the distribution options. Figure 92. shows the distribution options available in the “Send form” window. The created form can be sent to the participants through e-mail, link, and HTML embed code. The form can also be shared through Facebook and Twitter. Through the e-mail option, the form is sent to the specified e-mail addresses. In this section, the collaborators who can edit the form can also be specified and invited. The form can be viewed by anyone with the “link” option. Through the HTML embed code option, the form can be embedded in a website and displayed through the HTML code produced in this option.

Figure 92. Form distribution options

3. Viewing Form Responses

The responses to the form questions are viewed through the "responses" tab as shown in Figure 93 below. As shown, the responses can be viewed in the forms of "summary", "question", and "individual". The summary section presents the total responses in the form of tables, graphs, and text. The question section presents the responses given to each question. The individual section separately presents the responses of each participant. The form might be deactivated or activated again through the "accepting responses" option. The responses can be transformed into spreadsheets through the "create spreadsheet" button at the right top of the page below. The responses can be downloaded as a spreadsheet in CSV format through the pop-up menu beside the "create spreadsheet" button. The responses can also be printed or deleted through the options in this menu.

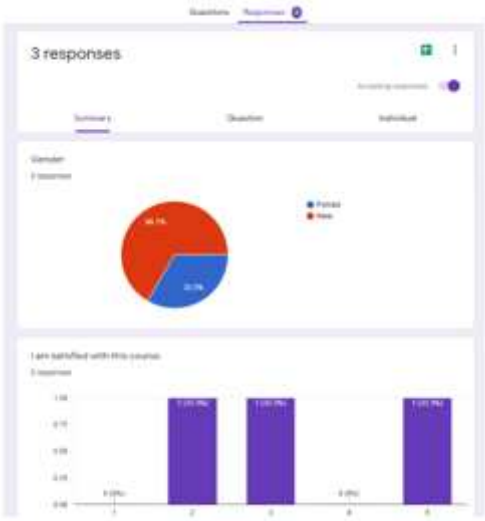


Figure 93. Responses view in Google Forms

1.3. Tips for Using in Learning Environments

Google forms can be used in learning environments in terms of various assessment goals such as needs analysis, instructional evaluation, polling, and scientific inquiry. The tips for using it in learning environments are presented as follows:

- Teachers may use Google forms to collect data from students or other stakeholders for needs analysis. The data from needs analysis are used to inform teachers about decisions on learning design. Through the needs analysis, students' demographics, prior knowledge on the subject, attitudes toward the course, or learning needs can be diagnosed and the collected data can be used in instructional design.

- Google forms can be used to evaluate both learners' academic achievement and their evaluation of the educational experience they engaged in. Firstly, teachers may create online quizzes or exams based on the pre-defined objectives and evaluate how students achieved these objectives. Secondly, teachers may use Google Forms to evaluate their satisfaction with the instructional methods, materials, teachers' attitudes, and so forth.

- Google forms can be used as a polling tool to get information about students' views on a specific issue. This approach would enable students to attend to the decision-making process and may develop a sense of democracy in classrooms.

- Finally, Google forms can be used by teachers to conduct research studies. They can use valid and reliable instruments developed to measure specific constructs and collect data from their students using these online instruments. The collected data can be analyzed and presented as a scientific research paper.

1.4. Example Practice

As explained in the "Tips for Using in Learning Environments" part, Google Forms can be used to obtain data about students' satisfaction with a course. The data can be used to diagnose weaknesses and good practices in a specific course through the eyes of the students and the course design might be improved, accordingly. Based on this aim, an online form can be created and distributed to learners.

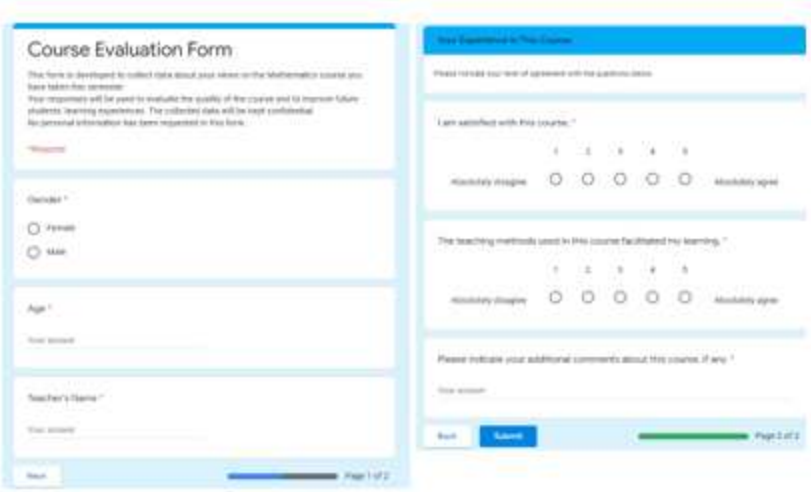


Figure 94. Example form developed for online course evaluation

As an example, a course evaluation form for a mathematics course can be created and distributed to the students who have taken this course. The example course evaluation form is shown in Figure 94. This form enables students to anonymously indicate their views on the course they have taken. The title is specified as “Course Evaluation Form”. The description section below the title presents an explanation about the aim of the form and how the collected data will be used.

The example form consists of two sections. The first section includes questions about the demographics of students without requesting any personal information. The second section includes questions about the students’ satisfaction with the course. The last question at the end of this section also includes an open-ended question, which enables students to state their additional comments about the course. All questions, except this optional open-ended question, are presented as required to avoid missing data as students cannot submit the form without responding to all required questions. The theme of the form customized in terms of color. A progress bar was added at bottom of the form so that students can follow their progress.

Teachers may evaluate the total responses through the “summary” option, the responses to each question through the “question” option, or each response through the “individual” option. Thus, teachers can determine both the problematic and satisfactory aspects of his/her course and make decisions in his/her future instructional design.

2. Kahoot

2.1. Aim of the Tool

Kahoot is an online assessment tool used to create game-based quizzes. Its distinguishing characteristic is that it aims to create a game-like assessment environment for teachers, students, or home and business purposes. It offers quizzes in the form of multiple-choice, true/false, and type answer, and puzzle questions.

In addition, it can be also used to create a poll, word cloud, open-ended questions, and brainstorming activities. These assessment types are called Kahoots. While multiple-choice and true/false types of quizzes are free, the use of other types of assessment activities is Kahoot's premium feature. In this chapter, Kahoot's free features have been introduced. In Kahoot quizzes, teachers may create quizzes, set a time limit and points for each question. Then, they can view and download the quiz results in both the web environment and Excel file.

2.2. How to Use

1. Creating Kahoots

Kahoot is used by registration through a registration form or the Google, Microsoft, or Apple accounts on the kahoot.com web address. During the registration, teachers should select "Teacher" as the account type as shown in Figure 95 below.

Figure 95. Selection of the account type during the registration

In the next step, teachers are asked to select their workplace. Figure 96 indicates the "describe your workplace" page. Teachers working at the K12 level should select the "School" option. After this page, teachers may sign in by filling in the registration form or their Google, Microsoft, or Apple accounts

Figure 96. Selection of the workplace during the registration

When logged in, the main page of Kahoot is viewed as shown in 95. The menu at the top of the page can be used to navigate in Kahoot. The “Home” button is used to return to the main page. The “Discover” button is used to find Kahoots created and shared by other users.

Teachers view their Kahoot collection by clicking on the “Library” button. The “Reports” button is used to view the report about the results of the created quizzes. The “Groups” button is used to collaborate with other teachers.

The “Share” button is used to share the created Kahoots with others. Teachers may begin to create their own quizzes by clicking on the blue “Create” button at the top left of the page. They can view their previously created quizzes in the “My Kahoots” section just below the “Create” button.

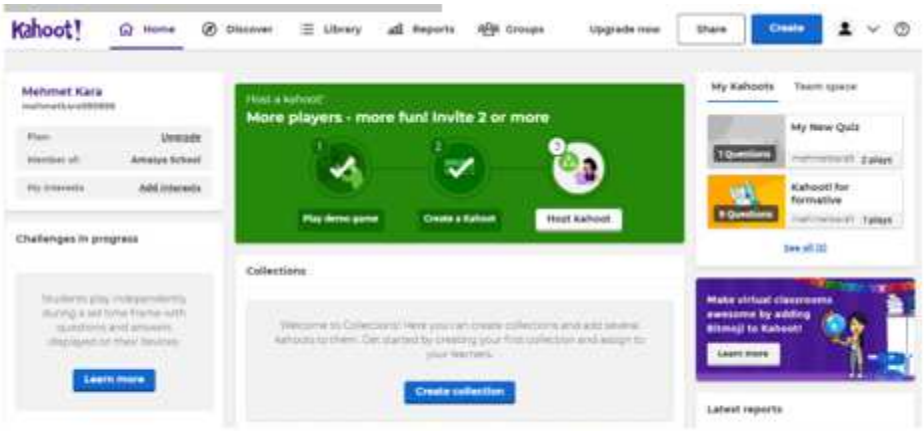


Figure 97. The main page of Kahoot

By clicking on the “Create” button, a pop-up window is displayed as shown in Figure 98 for teachers to select a Kahoot template depending on their usage goal. They can select the “New Kahoot” option to customize their own Kahoot. In this chapter, the “New Kahoot” option was selected by clicking on the green “Create” button.

Figure 98. Pop-up window for the options of Kahoot templates

Figure 99. displays the page where a Kahoot can be created. At the left top of the page, the name of the Kahoot is entered into the "*Enter Kahoot title…*" text box. The title is customized through the "Settings" button in terms of description, location, language, and so on.

Questions are added and listed through the frame at the left of the page. "Question type", "time limit", "points", and "answer options" are determined through the frame at the right of the page. The default options for them are shown in Figure 99.

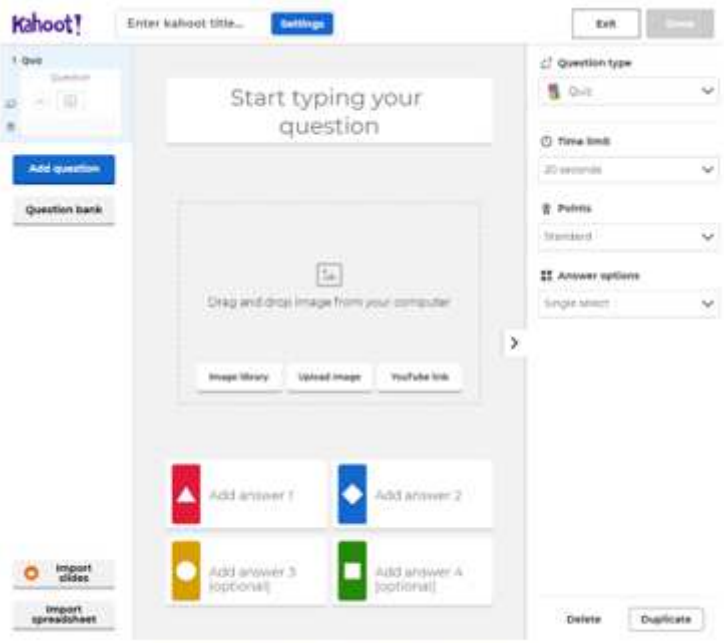


Figure 99. The page where Kahoots are created

The question is asked through the text box in the body, in which "Start typing your question" is written in Figure 99. Image and video can be added to the question through the

options below the questions: “Image Library”, “Upload image”, and “YouTube link”. Then, the options are indicated in the red, blue, orange, and green boxes. The correct answer is identified by clicking on the circle at the right side of a button as shown in Figure 100. below. The answers can be either written as text or shown as an image through the image button beside the circle used for the correct answer. As shown in the Figure below, the “add image as answer instead of text” message is viewed when the cursor is over the image option. For example, in the following example, the pictures of the cities might be used as options instead of their names in the form of text. All user actions in Kahoot are automatically saved as shown below at the top of the page.

The next questions are added through the “add question” button on the frame at the left of the page. Previously created questions may also be added through the “question bank” button. The created question can be duplicated or deleted through the “duplicate” and “delete” icons at the left of each question.

The questions can also be duplicated or deleted through the “Duplicate” or “Delete” buttons at the end of the right frame. The questions can be imported from existing slides and spreadsheet files through the “Import slides” and “ımport spreadsheet” buttons. Note that the “Import slides” option is for premium users.

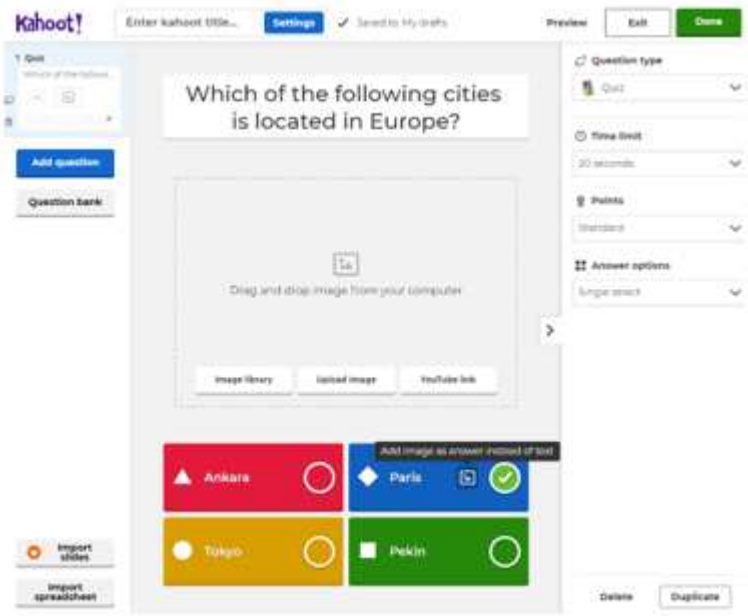


Figure 100. Creating example question in Kahoot

When clicked on the “Add question” button, Kahoot asks the user to select the type of question they would like to add as shown in Figure 101. The question type may also be

selected through the “Question type” option on the right frame. Note that only “quiz” and “True or false” options are free and the others are for premium users.

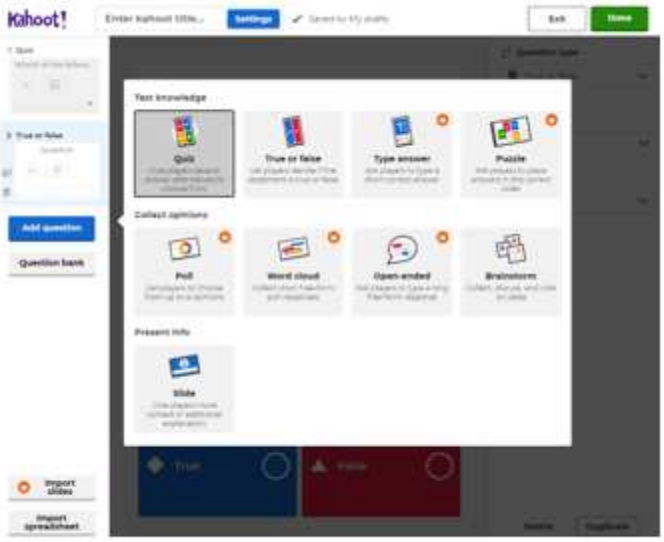


Figure 101. Question options in Kahoot

2. Sharing Kahoots

When the Kahoot is created as desired, how it will be viewed by the students might be viewed through the “Preview” button at the right top of the main page. An example preview is displayed in Figure 102 below.

Figure 102. Preview of a Quiz in Kahoot

If the Kahoot is created as desired, the process is completed by clicking on the “Done” button at the right top of the page as shown in Figure 100. When clicked on the “Done” button, the teacher will view the Library page, where the Kahoot collection is listed as shown in Figure 103 below.

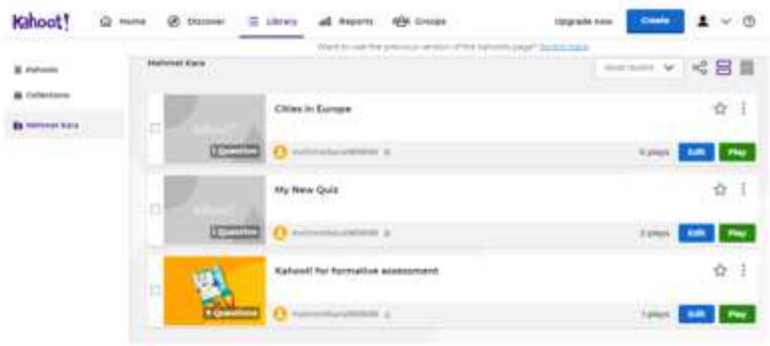


Figure 103. Library view in Kahoot

On the Library page, the created Kahoot can be edited by clicking on the “Edit” button. The “Play” button is used to share the created Kahoot with students. When clicked on the “Play” button, a pop-up window is displayed as indicated in Figure 104. The window asks teachers to select from the options “Teach” (“for virtual classrooms”) and “Assign” (“for self-paced learning”). As shown below, the first option allows teachers to “play a live game together with learners over video or in class”. The second option allows them to “assign a challenge game to learners who play it at their own pace”. For this chapter, the “Teach” option was selected.

Figure 104. Sharing options in Kahoot

After selecting the “Teach” option, Kahoot asks teachers to select from the “Classic” and “Team mode” options as well as other game options such as nickname and music as indicated in Figure 105 below. These options offer an opportunity for learners to play either as single players or team players. For this chapter, the “Classic” option was selected.

Figure 105. Playing options in Kahoot

After the “Classic” option is selected, the following page in Figure 106 is displayed. This page provides teachers with a game PIN, which is used by students to join the game through kahoot.it web address or mobile Kahoot application. As shown below, the game PIN for the example Kahoot is 1713864. The students who joined the game are displayed with their nicknames as shown in the Figure below (Player 1 and Player 2). The teacher starts the game by clicking on the “Start” button on the right side of the page.

Figure 106. Game environment in Kahoot

Students will play the game by using this game PIN together with their nicknames. Figure 107 shows the pages requesting “Game PIN” and then “Nickname” from the students.

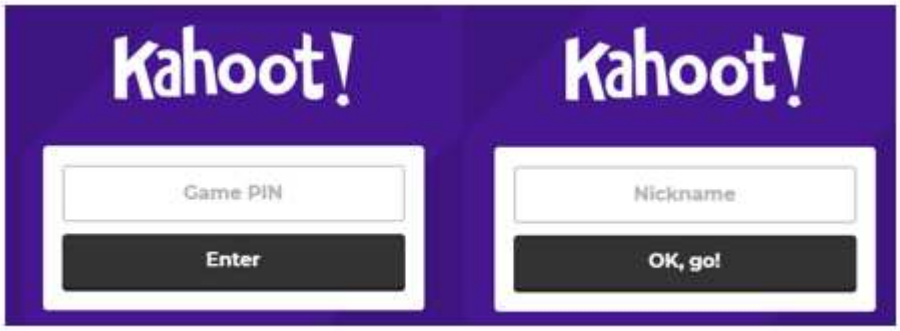


Figure 107. Learner Entrance to a Game in Kahoot

After students answered the question, they are informed about whether they answered correctly or incorrectly. As displayed in Figure 108, teachers also view the number of students selecting each option.

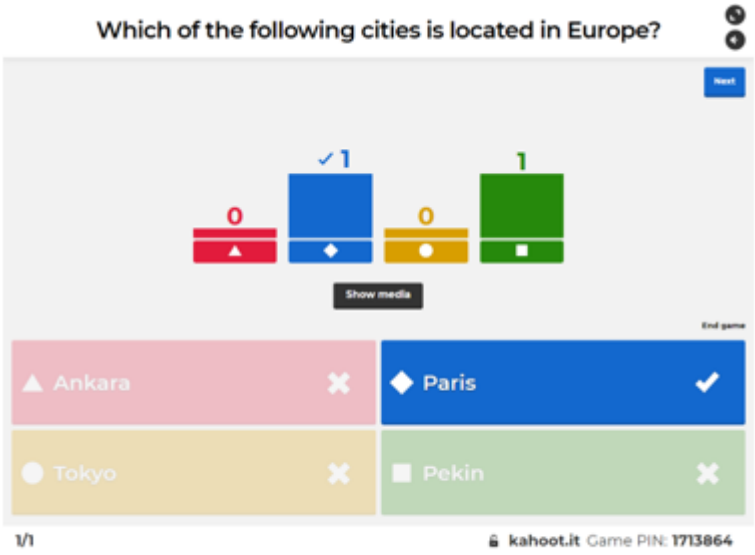


Figure 108. Teacher view for the results after student responses

3. *Viewing Results*

eachers can view the results of the Kahoots by clicking on the “Reports” at the top of the main page. In the “Reports” page, all created Kahoots by a teacher are listed as shown in Figure 109. Teachers can view the report for each Kahoot by clicking on the name of the Kahoot or on the “Open” button.

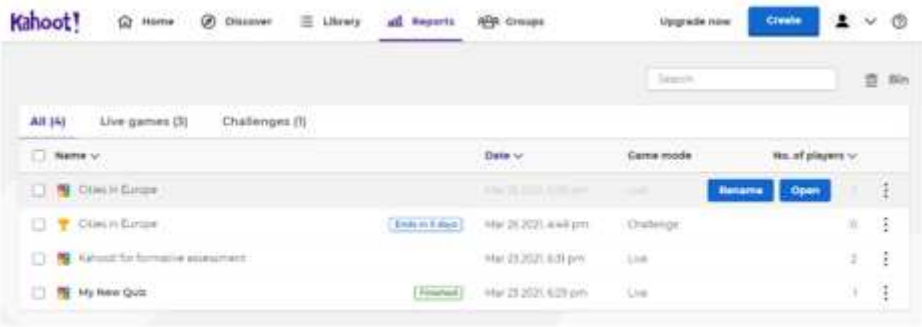


Figure 109. List of the Reports for the Created Kahoots

In Figure 110, an example report is displayed for a Kahoot. Teachers view the report as "Summary". They may also view the reports in terms of "Players" and "Questions". In the feedback tab, teachers can view the feedback from the students who played the game if they select the "Get feedback" option during the creation. By using the "Report options" menu at the right top of this page, teachers can download the report as a spreadsheet in xlsx file format or save it to Google drive via their Google account. By using the "Report options" menu, teachers can print the results, view other reports, view the Kahoot for which the report is generated, or delete the current Kahoot.

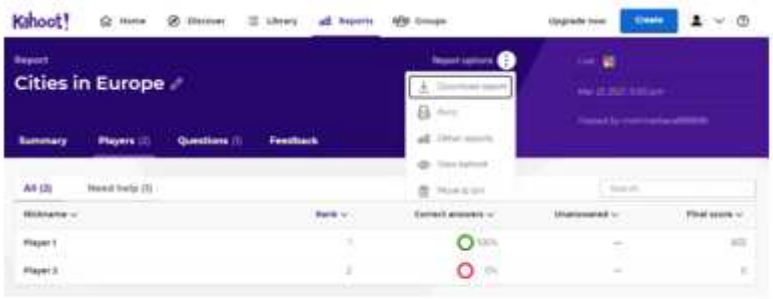


Figure 110. Report view in Kahoot

2.3. Tips for Using in Learning Environments

As Kahoot is a game-based learning tool, it can be used in learning environments to facilitate learning and to improve learner motivation and engagement in addition to using it for assessment purposes. The tips for using it learning environments are presented as follows:

- As Kahoot allows students to engage in a competitive activity in a game-based learning environment, it can be used to improve learner motivation and engagement. The time limits, points, and competition with peers provide teachers and learners a motivating environment.

- Kahoot enables teachers to add images and videos to the questions in the created Kahoots. Besides, they can also add images to the options of each question. These features allow teachers to enrich learning opportunities through multimedia. These features would be used to make abstract concepts more concrete, particularly for the students with learning disabilities.

- Kahoot can be used by the teachers for formative assessment as it provides them with synchronous assessment results for each question. In this way, teachers may evaluate each learning objective through single or multiple questions and provide feedback, accordingly.

- Learners might be asked to participate in Kahoot activities as teams. This approach has the potential for learners to develop their teamwork skills and to interact with their peers and learn from them.

2.4. Example Practice

As explained in the "Tips for Using in Learning Environments" part, Kahoot can be used to enrich a question item via multimedia elements of video and image. This approach facilitates learners' understanding of the concepts by making them more concrete. In addition, students' understanding of the concepts might be facilitated by providing tips or hints in the form of video or image in the question. The options might also be used to facilitate learners' understanding by providing them images instead of only text. Therefore, an example practice is presented to facilitate learners' understanding of vertebrate and invertebrate animals as well as evaluating their conceptions in this subject. Figure 111 below shows an example multiple-choice question in Kahoot prepared for this aim.

The selected question type in this example is a quiz, including a multiple-choice question. As shown, the Kahoot is entitled as Classification of Animals. The question is "Which of the following is an invertebrate animal?". The textbox for the question statement allows teachers to highlight a specific part of the question by making it bold. In this example, "invertebrate animal" is presented as bold. Just below the question statement, a YouTube video about "Vertebrate animals" is added to provide learners with an explanation (tips) about the

vertebrate animals. The teacher may also state the question and options in this video so that students' understanding of the concept can be facilitated.

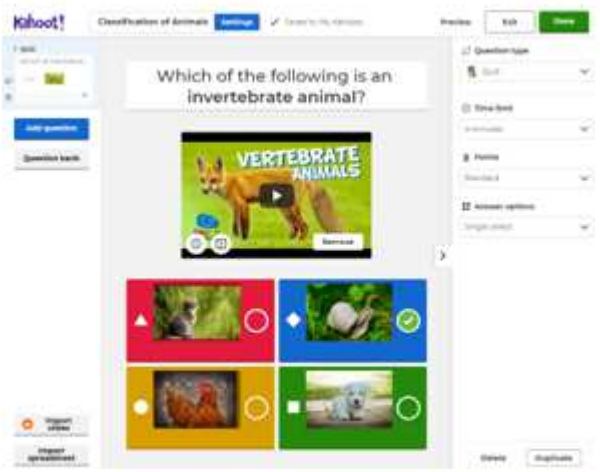


Figure 111. An example question enriched with multimedia elements in Kahoot

The options include the images of the animals instead of just texts to make the animal names, which might be abstract concepts for some learners, more concrete. In this way, learners have a chance to examine the anatomy of the animals presented in the options based on the explanation in the video. Thus, the images of a cat, snail, chicken, and dog are used instead of their names. The images can be added from the image library in Kahoot. However, this library is available for only premium users. For this reason, free images from open sources like pixabay.com can be used as needed. The correct answer, the nail image in this question, is indicated by clicking on the circle on the right side of the option.

An added question can be customized through the frame on the right side of the page. As a default option, "Question type" is selected as "Quiz". The "Time limit" is set as 4 minutes as students will be asked to watch a video. The preview of the prepared Kahoot is shown in Figure 112 below:

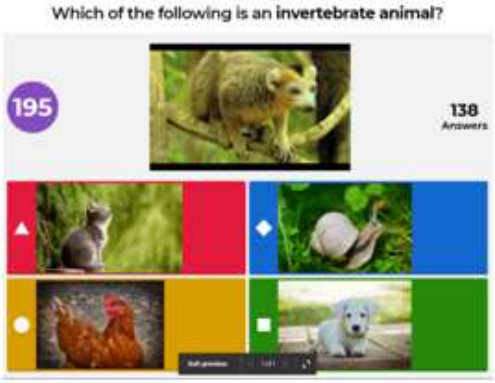


Figure 112. Preview of the Example Kahoot

CHAPTER 5 - VISUAL DESIGN TOOLS FOR LEARNING DISABILITIES

1. TinkerCad

1.1. Aim of the Tool

Tinkercad is an online 3-Dimensional (3D) design tool, offered by Autodesk. Users can use the design elements available in the library, customize them based on their goals, or create their own designs. Tinkercad can be used with free registration and enables users to collaborate on and share their designs with a community. It has a rich library including the designs created and shared by the community for other users to access and use. Users can get the various digital outputs of the 3D designs created by themselves or other community members and benefit from 3D printing services if they need them. Tinkercad can be used with a typical computer and a current web browser, without any need for additional software or hardware.

1.2. How to Use

1. Interface

After the free registration to Tinkercad, the dashboard in Figure 1 is viewed. The dashboard views the created designs. A new workplace is created by clicking on the “Create new design”. Tinkercad can be not only used for 3D design but also used for electric circuit design and code blocks. This part covers the use of a 3D design module.

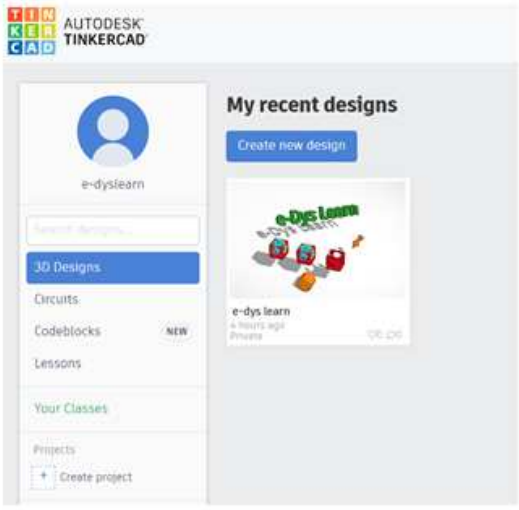


Figure 113. Dashboard in Tinkercad

The default design launch page is indicated in Figure 113. The launch page is viewed as empty for the initial design. This page mainly includes copy, duplication, and classification of objects, workplane, workplane orientation tool, and the list of the pre-defined shapes. The pre-defined shapes can be added to the workplane through the drag-and-drop technique.

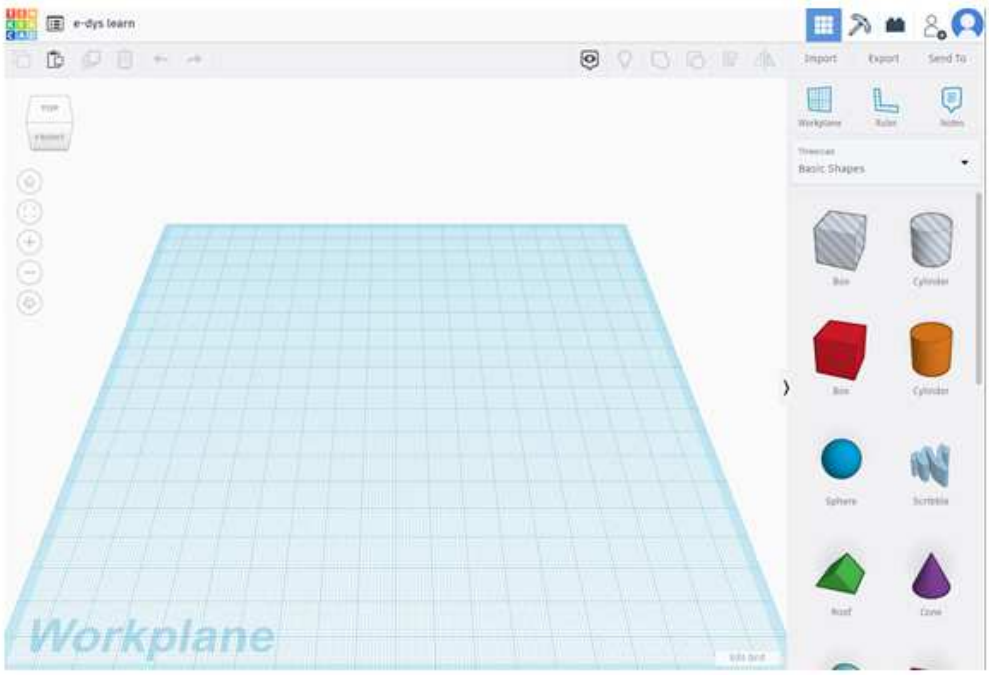


Figure 114. Default design launch page

2. Orientation and zooming

The cube at the left top of the page, as shown in Figure 115, can be moved by using the mouse to view the 3D design in the workplane from different perspectives. The viewing options are as follows:

- "Home" icon is used to return to the default view.
- The mouse cursor is moved by clicking on the right button of the Mouse to move within the view.
- + and – buttons are used to zoom the view.
- Users can move from "Perspective" to "orthograpic" views. This enables users to select the desired 2D and 3D views.

As shown at the left top of the page, the cube on which the directions are indicated can be moved by the right-click and the workplane can be viewed from different perspectives. In case of confusion, users can return to the default view via the “home view” button at the top of the “navigation” part.

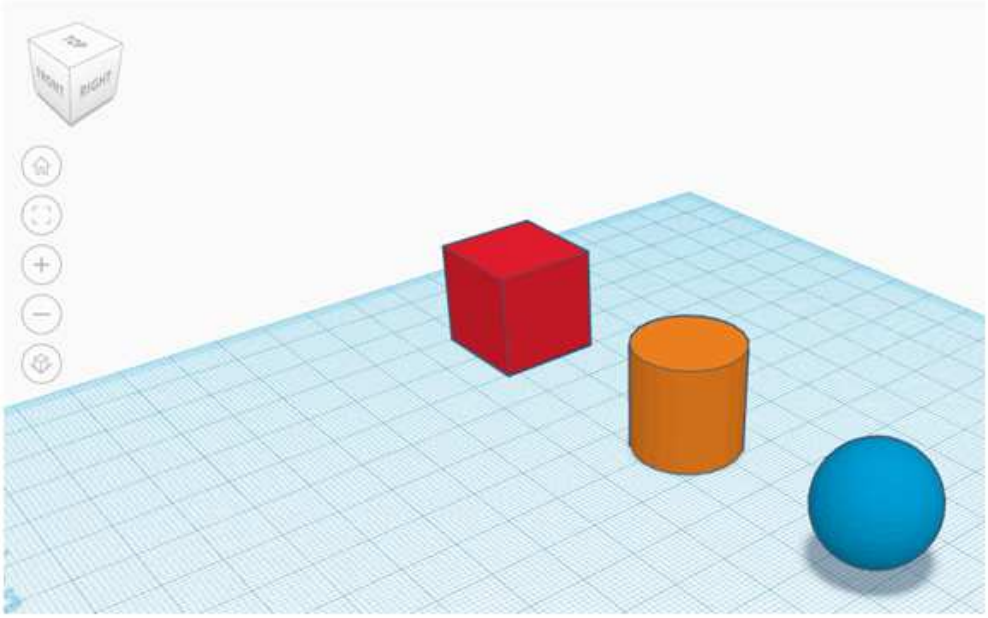


Figure 115. Workplane orientation and zooming

3. Moving and modifying objects

A “box” can be modified through the “ruler” tool as shown in Figure 116. The location and dimension can be modified in terms of the X, Y, and Z-axis. This can be done in two ways:

- The re-sizing can be conducted by moving the white boxes that appeared on the shapes after the selection by the left click of the Mouse.
- The numbers in the boxes appearing beside the shapes can be changed by entering new values from the keyboard.
- The angles in three axes can be customized via the arc over the shapes.
- The diverse parameters in the “Shape” view opened when clicked on an object can be changed.

- A location of an object can be changed in X-Y axes by moving via the Mouse. However, location change in Z-axis can be done by moving the cone over each object.

Figure 117 demonstrates the modified basic shapes in terms of shape, angle, and location using diverse parameters.

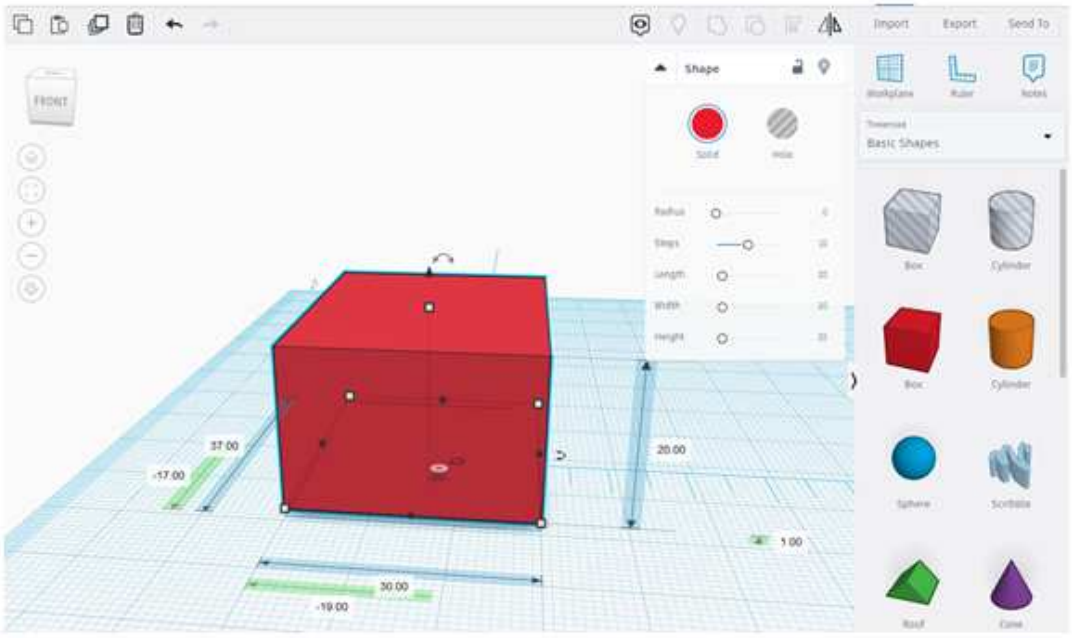


Figure 116. Ruler and changing dimensions of an object

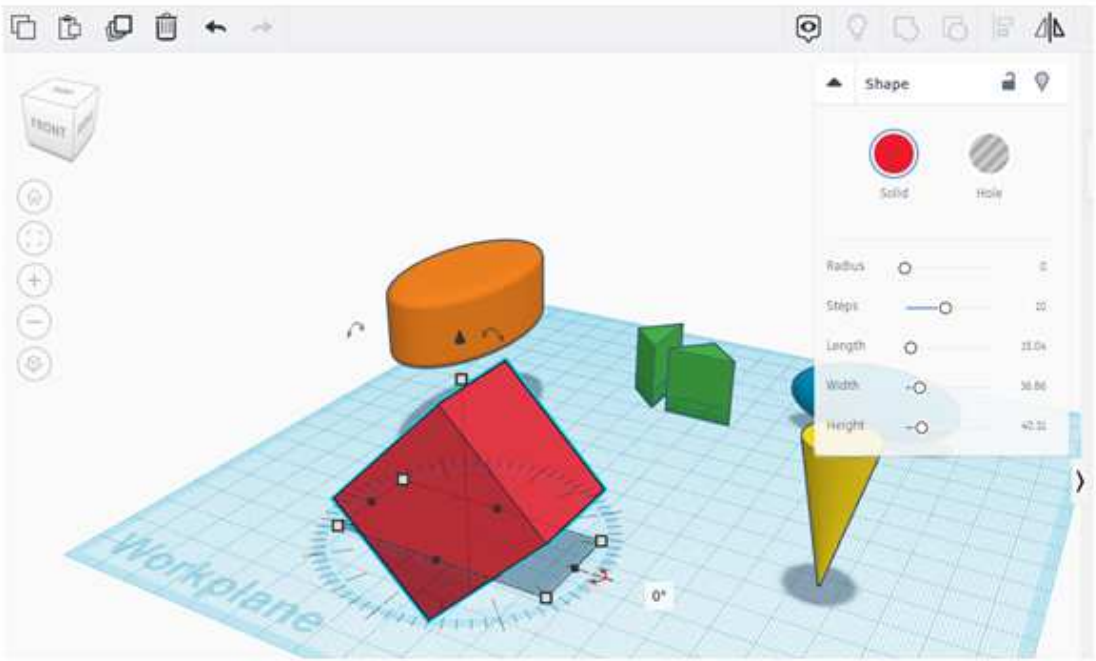


Figure 117. Different objects from the library

4. Duplicating and aligning objects

Tinkercad, enables to duplicate of the created objects. In Figure 118, the yellow box is duplicated from the red box. This can be done by using “copy” or “duplicate” buttons at the left top of the page after the selection of the object.

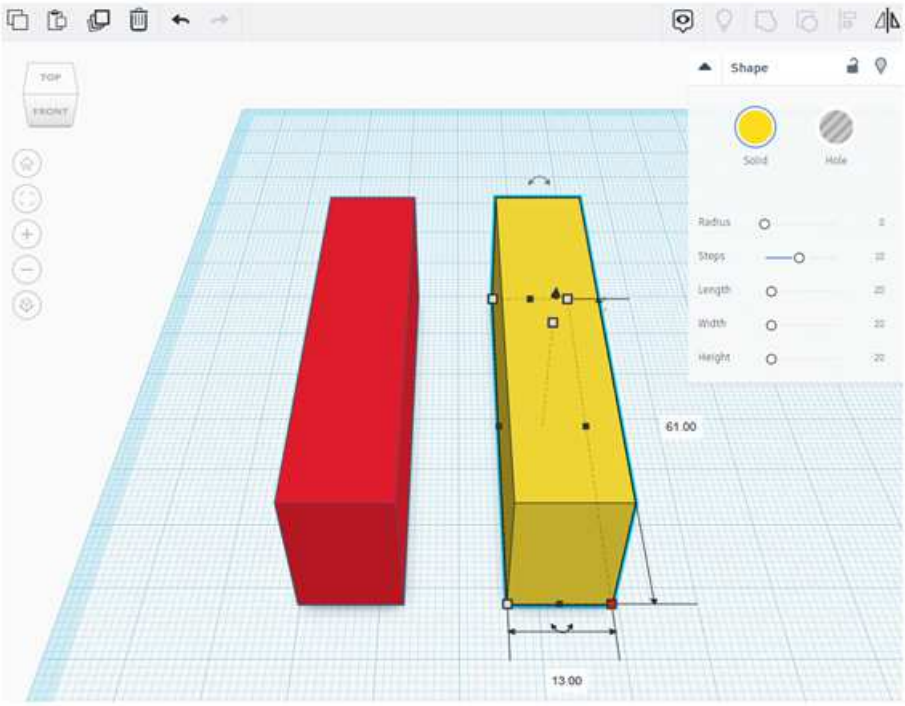


Figure 118. Duplication of objects

While working on multiple objects, users may need some alignments in the workplane. All objects are selected by keeping clicked on the left Mouse button and then align button is clicked to align the objects. Figure 119 shows seven objects that are to be aligned. The desired alignment can be done by clicking on the black dots on the shape.

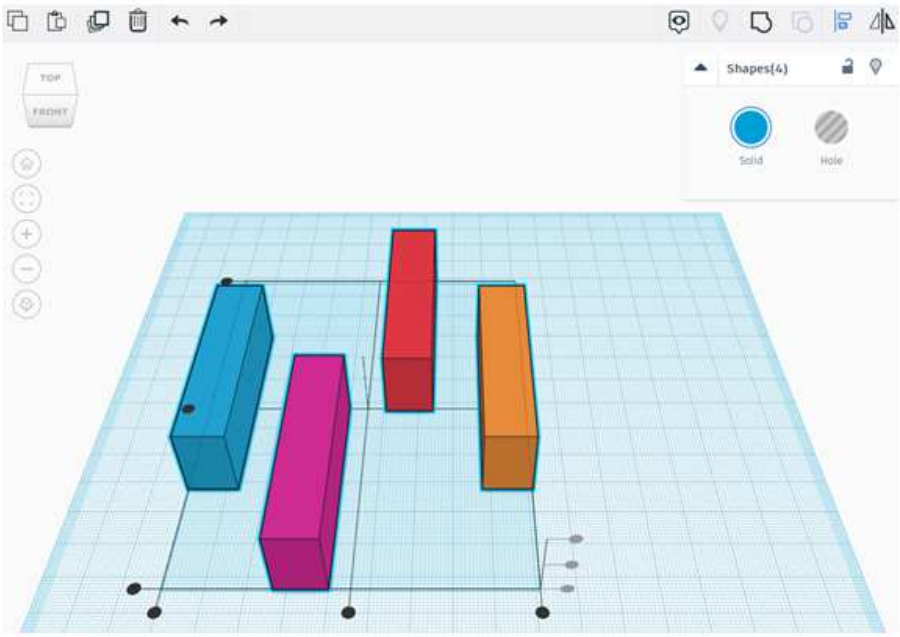


Figure 119. Alignment of the objects

5. Grouping objects and creating holes

Tinkercad allows using the objects in two forms as “Solid” and “hole”. The new objects with holes can be created by using solid and hole types of objects together. The steps needed to take to get the view in Figure 120 are as follows:

- The objects are overlapped as desired to combine the objects.
- The object to be deleted is selected as “hole”, instead of “solid”, in the “shape” menu.
- Both objects are selected by pressing the “shift” key.
- The objects selected as solid and hole are grouped vie “group” command.

3D workplane allows working in X-Y axis as default. As shown in Figure 121, the default work axis can be changed as X-Z or Y-Z by using the “workplane” button. These axis-changing options are especially needed in designs with multiple objects.

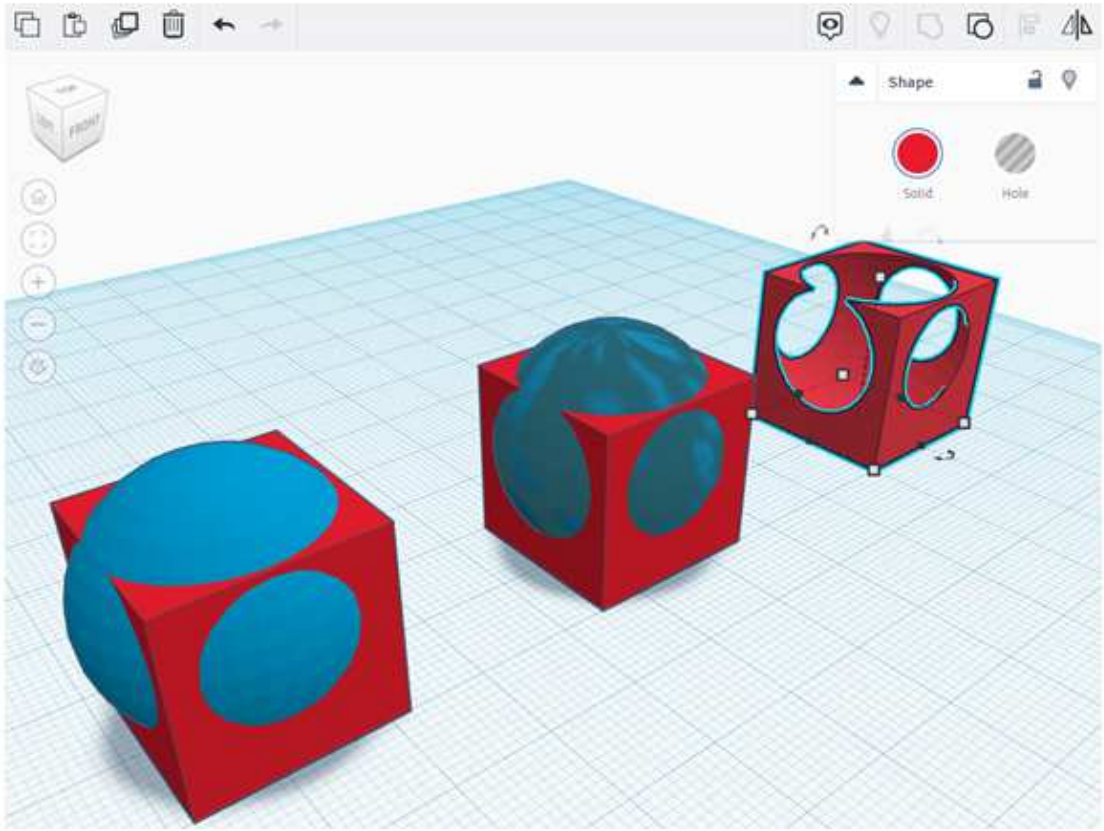


Figure 120. Combining objects and creating holes

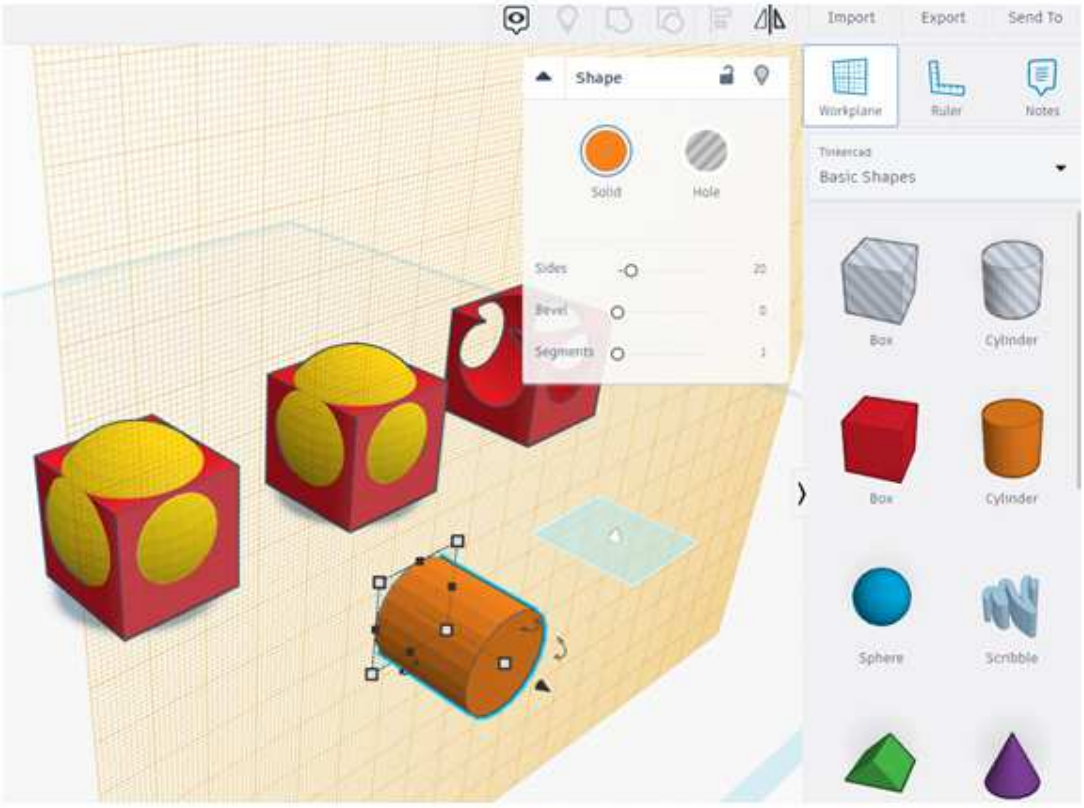


Figure 121. Workplane

6. Adding text to workplane

Tinkercad enables to addition of texts into the designs in 2D or 3D forms. The text, added into the workplane by drag-and-drop as done for other objects, can be considered as a special object and its content can be determined as desired. The object attributes such as color, font type, and so forth can be customized as done for other objects. In addition, the text can be viewed from different perspectives in three axes as shown in Figure 122. The height of the text in the X-Y axis can be determined by moving the cone over it.

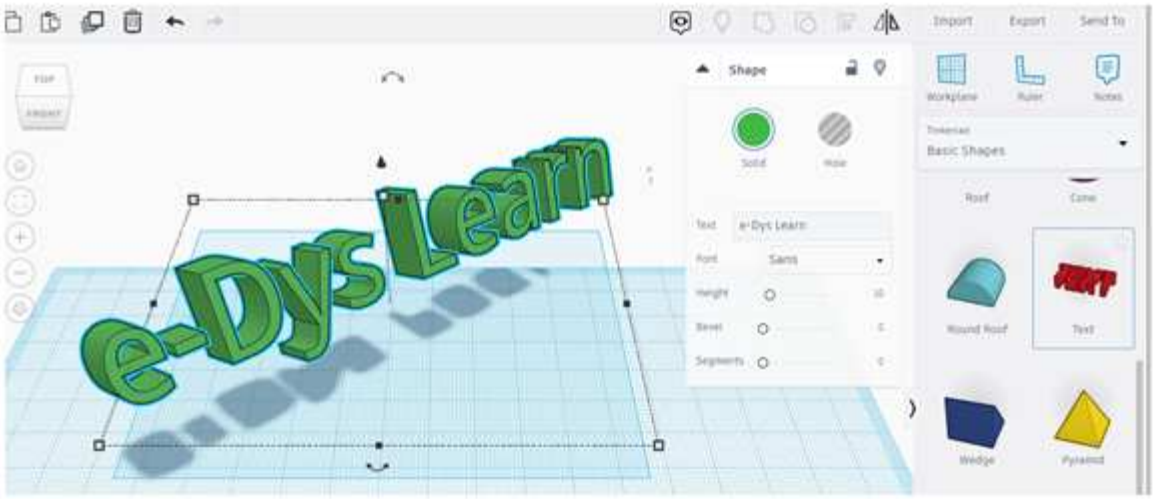


Figure 122. Adding text to the workplane

2.3. Tips for Using in Learning Environments

Tinkercad has several characteristics that can be used in learning environments. The users in the role of teacher can create their own virtual space and invite students to the virtual classroom.

Students collaboratively create designs or modify the previously created designs in virtual classrooms. As it is browser-based software and does not need any further software or hardware, it can be used for learning activities both in and out of classrooms. Students have opportunities to improve their three-dimensional thinking skills and creativity by creating and customizing three-dimensional designs from basic to more complicated shapes. In addition, they can participate in the design activities in collaboration with their peers with the supervision of their teachers as independent of time and place.

A wide variety of design tools are offered to students from "basic shapes" to the more complicated ones, as shown in Figure 123, depending on the students' usage skills. For this reason, Tinkercad would facilitate students' comprehension of the basic shapes and their attributes as well as their differentiation based on their similarities and differences. It allows students to design at their own pace and helps improve their thinking skills.

Tinkercad has advantages as it is online and browser-based. The projects are saved immediately after the user actions and this enables students to keep working on their projects out of the classrooms whenever they need. The completed projects can be shared with both teachers and classmates for their feedback.

Tinkercad is a free, online easy-to-use 3D design tool for all students from various grade levels and allows them to create their own 3D material. Therefore, it can be used to enrich learning opportunities that facilitate students' collaboration and creativity.

2.4. Example Practice

Figure 123 shows a project shared by a user for other Tinkercad users. A model of "Mars Land Rover" has been created and shared public by a user. Other users would provide contribute to this Project by their feedback. Besides, other users can modify the shared projects based on their needs and objectives.

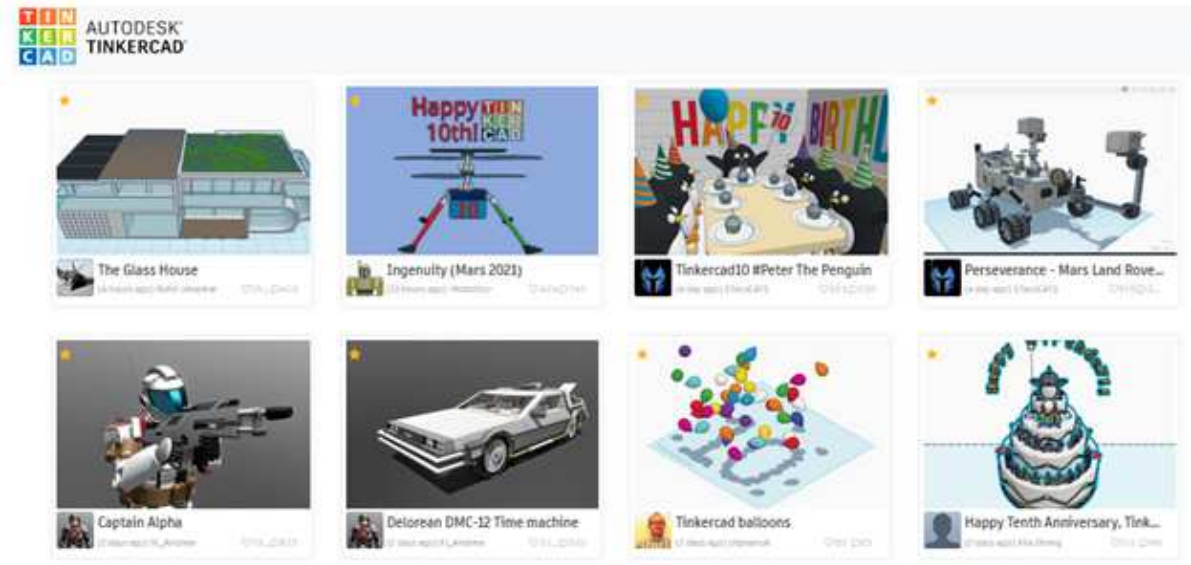


Figure 123. Project gallery from the community

Students can share their designs with the community in the library within Tinkercad. Figure 124 indicates an example design Project shared by a community with the other users. Students can exhibit their design portfolio, like an exhibition hall, and teachers can follow the progress of their students. The projects can be stored as public or private depending on the preferences of the users. When shared with a community, students would get feedback and improve their design in collaboration with them. In this way, students have an opportunity to improve their communication and collaboration skills.

3. Diagrams

3.1. Aim of the Tool

Diagrams, formerly known as draw.io, is an open source, browser-based and free two-dimensional (2D) drawing service. Users can draw basic shapes themselves, as well as use ready-to-use templates by changing them according to their needs and make their own designs. Since Diagrams is browser-based, it can be used on almost all current desktop

browsers without the need for additional software installation. Thanks to the possibility of integration with popular cloud services such as Google Drive, Dropbox, OneDrive, Github, it is very easy to store designs and access the prepared designs from different places. It is possible to save the two-dimensional designs to your personal computer or to use cloud services. That is, you can print your drawing, download the digital version to your personal computer or store it on cloud services. The possibility of data loss in your interrupted works is minimized due to the automatic recording feature. Desktop software of Diagrams can be downloaded optionally, and designs can be made on the local computer without the need of internet connection.

Features such as ease of use, support for cloud services and editing options, Diagrams is a favorable service for the need of educators to create educational materials.

3.2. How to use Diagrams?

The diagrams service we will use for two-dimensional drawings is available at Diagrams.net. website. You can sign up for free or log into the system with your existing cloud accounts, if any. Figure 125 shows the login screen. With the "Start" button, the service is launched for the first drawing. The "download" link can be used for the desktop version. Browser-based version is used in this section.

Figure 125. Home page of Diagrams

Introduction

Integration with the desired cloud service is provided to benefit from cloud services. If you do not want to use the cloud service, you can switch to the drawing interface by clicking the "Decide later" link. Figure 126 shows options on how to save the first design. Naming the project and file type can be selected at this stage.

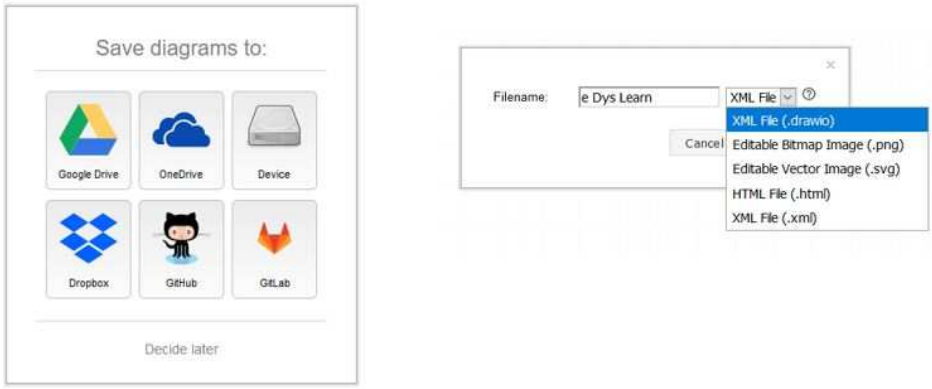


Figure 1. Options for saving a Project

1. Interface

After deciding where to save the project, a standard interface as shown in Figure 127 welcomes the user. As in a standard software, there are main menus in the upper column, tools on the left and the "properties" section on the right.

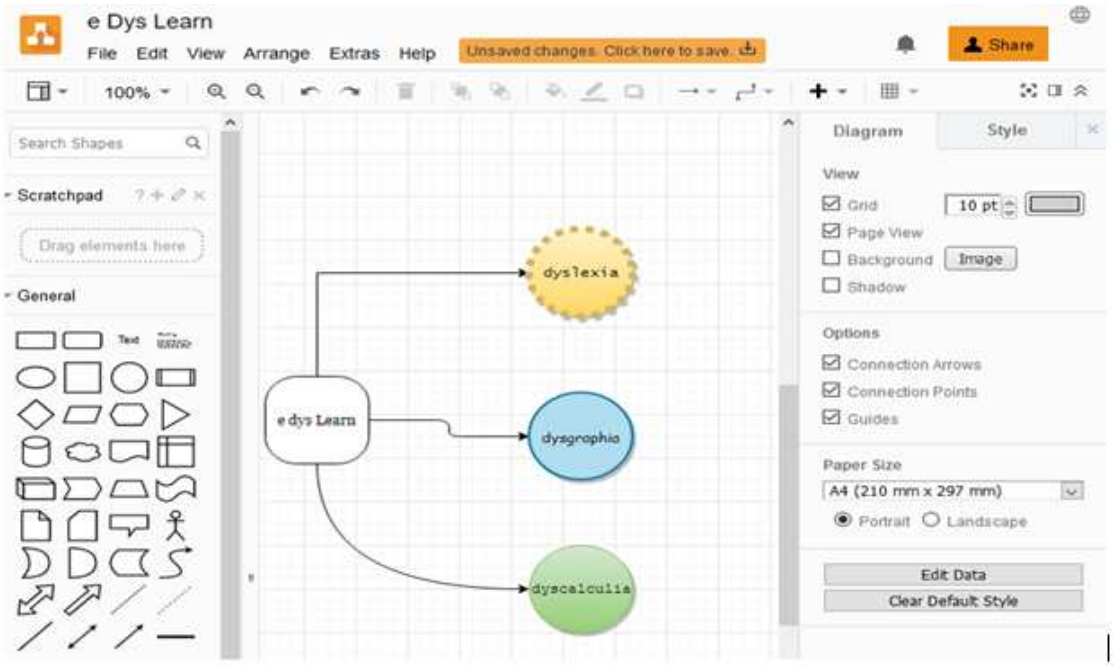


Figure 127. Diagrams interface

2. Adding and Editing Shapes

The interface includes basic items such as menus, ready-to-use shapes, arrows, and lines. In order to add a new shape, shapes in the "general" tab on the left side can be added to the page by 'drag-and-drop' or '+' button on the top line. Options for adding shapes are given in Figure 128.

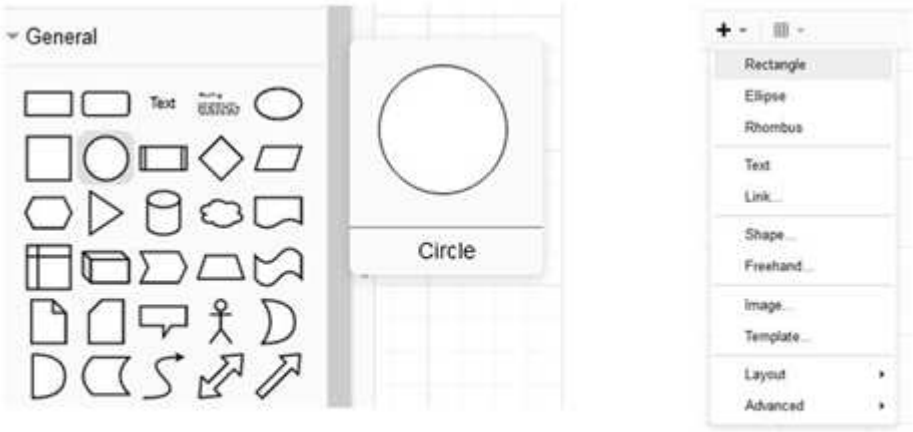


Figure 128. Options for adding shape

Figure 129 shows a simple rectangle drawing. Two kinds of operations can be done on a shape in Diagrams. The first one is to choose the shape to change its properties. The size of the shape can be changed from the small dots that appear when clicked on it. A copy of the shape in that direction can be obtained by clicking the small arrows with the mouse. In addition, the small x marks that appear when the mouse is hovered over the shape represent the connection points with other shapes. In addition, the small x marks that appear when the mouse is over the shape represent the connection points with other shapes. By clicking the small arrows with the mouse, a copy of the shape in that direction can be obtained and the connection line between the two shapes is drawn automatically.

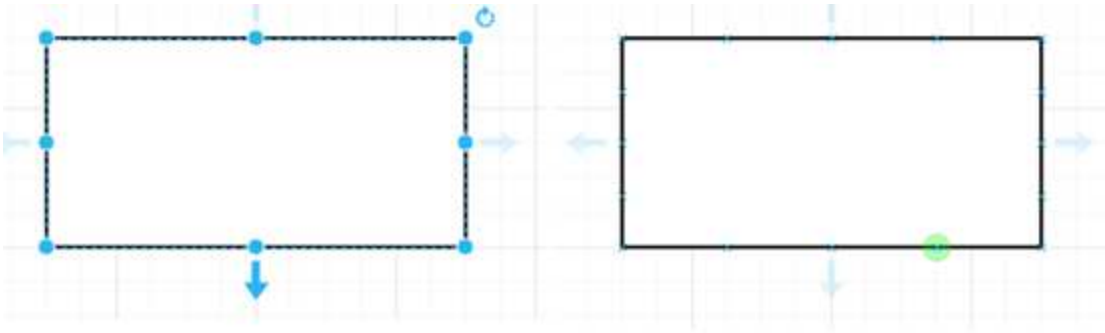


Figure 129. An example of drawing a simple rectangle

By clicking on the added shapes, customization can be done in three main headings. The first of these is the "style" for the figural properties of the shape. Basically, there are parameters such as fill and line colors, line style and thickness. In the "Text" tab, you can edit the added text by clicking on any shape or line. Font, font size, post alignment are some of the options in this section. In the "Arrange" tab, the dimensions of the shapes can be edited. In Figure 130, customization options are given for shapes and lines. Also, when more than one shape is selected, the option to align the shapes is also activated.

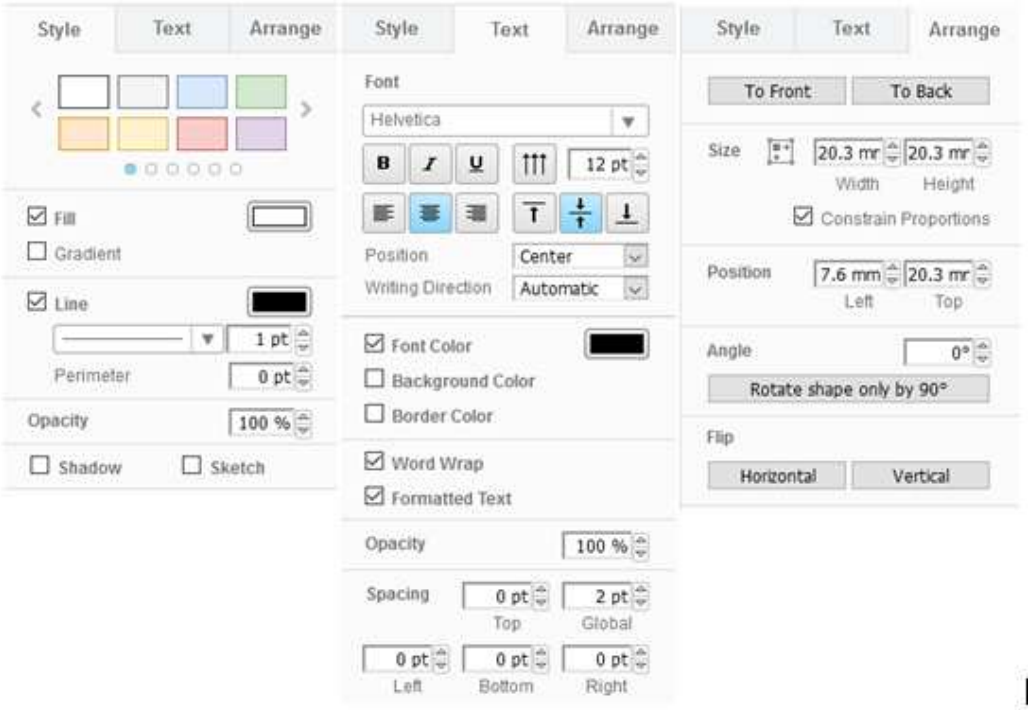


Figure 130. Options for shape editing

3. Lines

One of the greatest strengths of Diagrams is the ease of creating connecting lines between shapes. There are different types of lines as can be seen in Figure 131. Line types such as “straight line”, “curved line” and adjustable “simple line” can be used. Lines can be reshaped by drag-and-drop. In addition, the arrow shapes at the end of the line can be changed according to need.

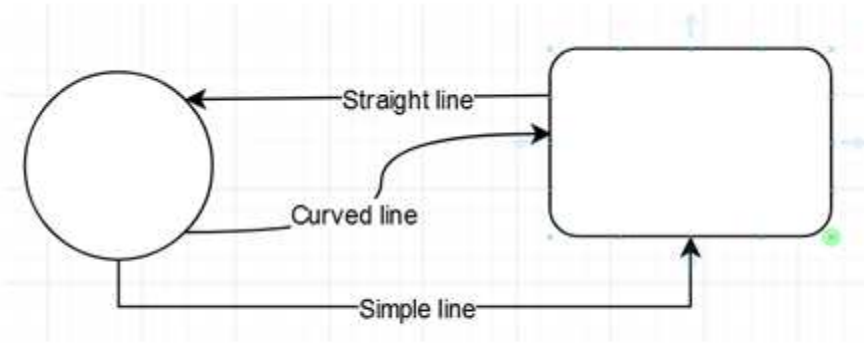


Figure 131. Types of line

4. Library

Diagrams offers a rich library. With options such as "general", "misc", "basic" on the left panel, the necessary objects can be selected from the category that best suits your needs. The libraries to be displayed on the screen can be selected with the “more shapes…” button at the bottom. Also, users can create their own object library by dragging their favorite shapes to the "scratchpad" section. The personal library is a highly functional feature. Figure 132 shows some examples of the shape library.

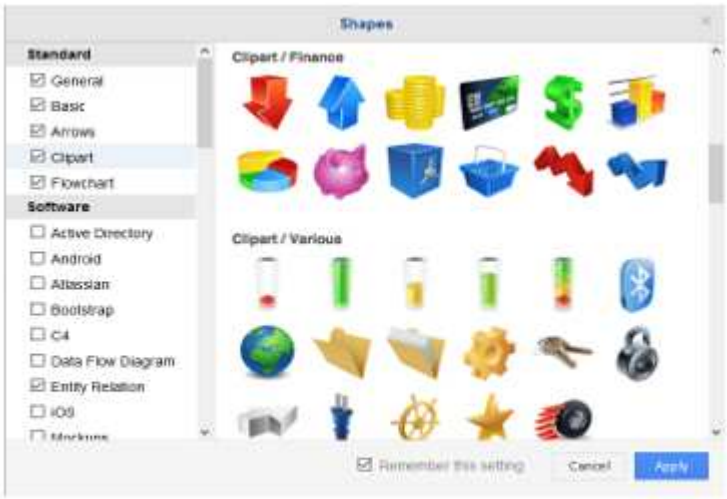


Figure 132. Shape library

Optionally, Diagrams offers its users not only individual objects but also ready-to-use diagrams. In addition to the basic organization chart, many ready-to-use designs such as venn diagram and flow chart can be added to the workspace. For this, you can follow the "Arrange> Insert> Template" steps from the main menu. An example of templates can be seen in Figure 133.

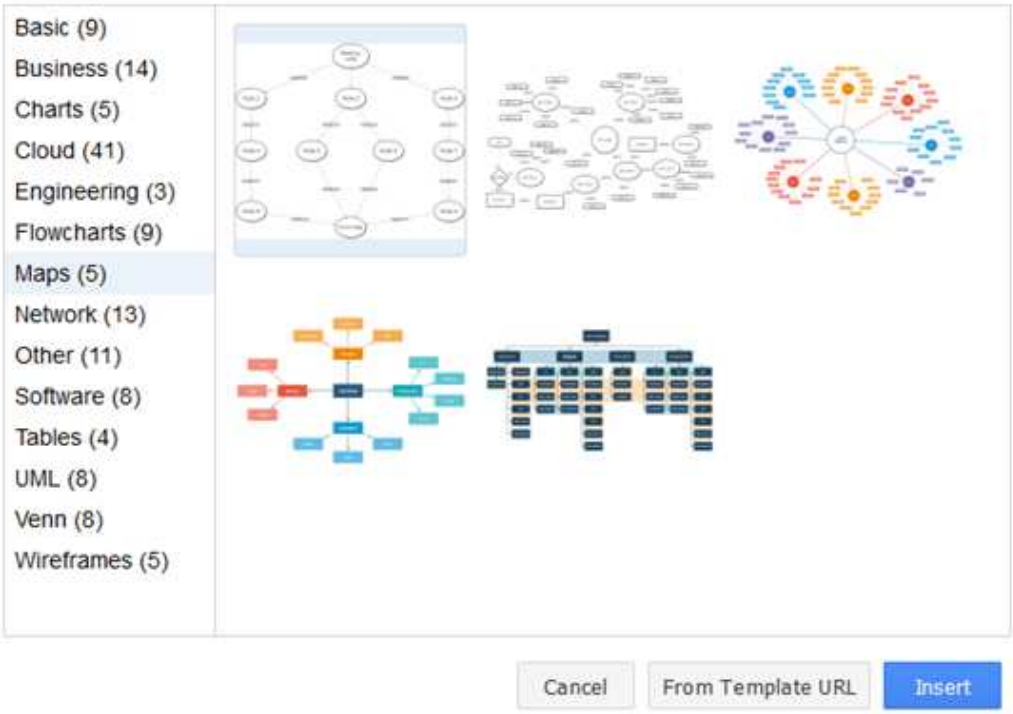


Figure 133. Templates

5. Saving the Project

There are multiple ways to save a project you made. From the "File" menu, with the "save" command, the options of where and in which file type the project will be saved can be accessed. As seen in Figure 133, the project can be saved in different file types, and downloaded to cloud services or local computer.

Figure 134. Saving the Project

3.3. Tips for Using in Learning Environments

Diagrams is not only a 2D drawing tool, but also an application (web application) with collaboration tools and other cloud services features. It offers its users facilities for drawing basic shapes. Thanks to its ease of use, it is a convenient platform for instructors and students, both with simple shapes and with rich library possibilities. It can be used not only as a drawing board, but also as a powerful mind mapping software. In this way, both instructors and students can have a rich learning experience. Mind maps are very powerful tools for conceptualizing complex information. It offers functional tools and a customizable library to reveal users' creativity. By means of these tools, instructors and students will be able to use their energy to solve their problems, rather than spending their time on technical details. The main usage areas of Diagrams can be listed as follows:

- Quick shapes
- Lines to show relationships between shapes
- Rich customization options for shapes and lines
- To create a personalized shape library
- Rich template options
- Cloud technology advantages, a wide range of saving locations and file types options

3.4. Example Practice

Below are some simple designs. In Figure 135, on the left, the visualization of the main focus of interest of the project named “e-Dys-Learn”, which is conducted on learning disabilities. This figure is an example of the use of properties such as line types, shapes, and colour of shapes. On the right, an exemplary relationship with the arrow directions is given.

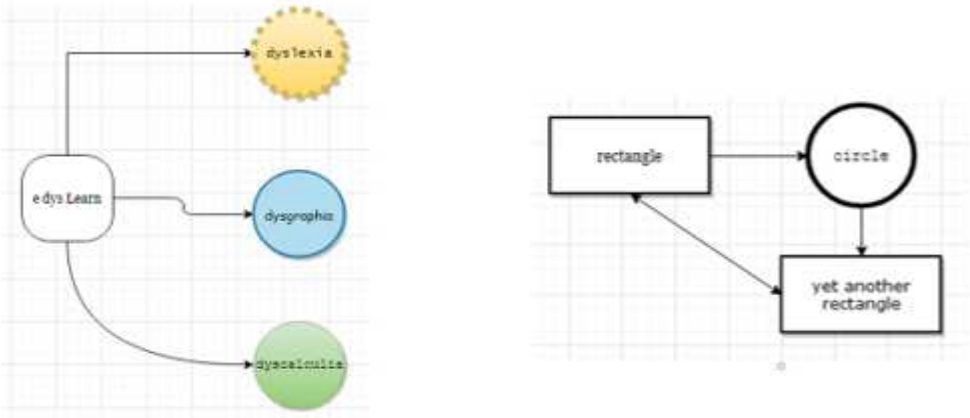


Figure 135. Simple diagrams

There is a simple organization chart in Figure 136. This shape has been added from the library, and the text, shape color and line styles in it have been changed. In Figure 137, the Venn diagram template in the library is used. Figure 138 shows a network diagram prepared for IT from the library. For this diagram, ready-to-use in the library are used with lines.

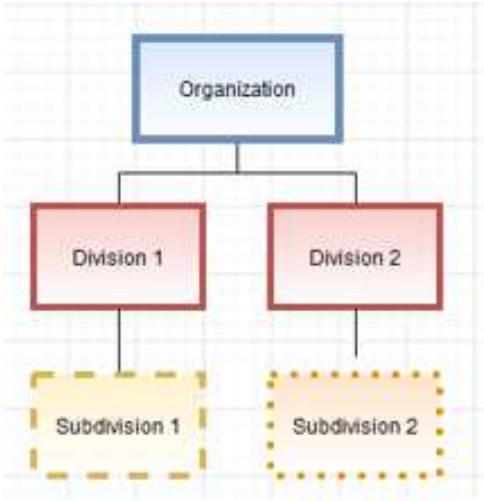


Figure 136. A simple organization scheme

Figure 137. A Venn Diagram

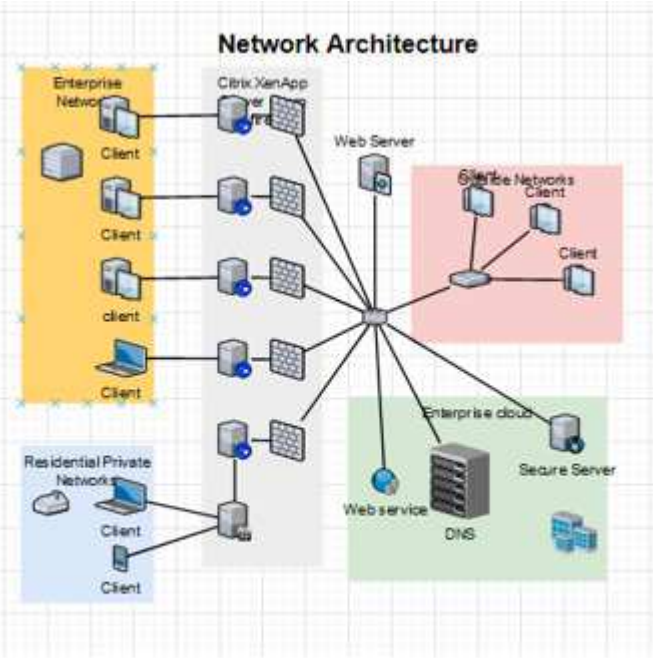


Figure 138. A computer network diagram

CHAPTER 6 – DIGITAL PLATFORMS FOR COLLABORATION

Web 2.0 has enabled users to collaborate, interact and share over the internet. New web technologies have been emerging intensively. Although the determinant factor of the emerging applications was not for educational purposes, they accommodate a virtual environment for teaching and learning activities. Technology integration in educational settings has been taking place for decades. However, creating an "authentic task-based collaborative learning environment" is not always achieved (Reeves, Herrington, & Oliver, 2004). Choosing the right tools and applying situated pedagogical methods are crucial to take advantage of web applications. These platforms can provide an opportunity for diversified learning needs.

As Elias (2004) states, students who have learning disabilities experience social relation difficulties. A collaborative virtual environment can provide a situated setting for student-student and student-teacher interaction. Teachers need to undertake emergent roles to constitute an authentic atmosphere such as "active facilitation, coordination, management, and tutoring" (Bjekić, Obradović, Vučetić, & Bojović, 2014). Proving the content would not be adequate for a rich learning environment. Especially, text-based content will increase concern and barriers with students' learning difficulties (Woodfine, Nunes, & Wright, 2008). When text-based activities are part of teaching, assistive technologies can be used for reading, writing, and spelling.

1. CLOUD COMPUTING

1.1. Padlet

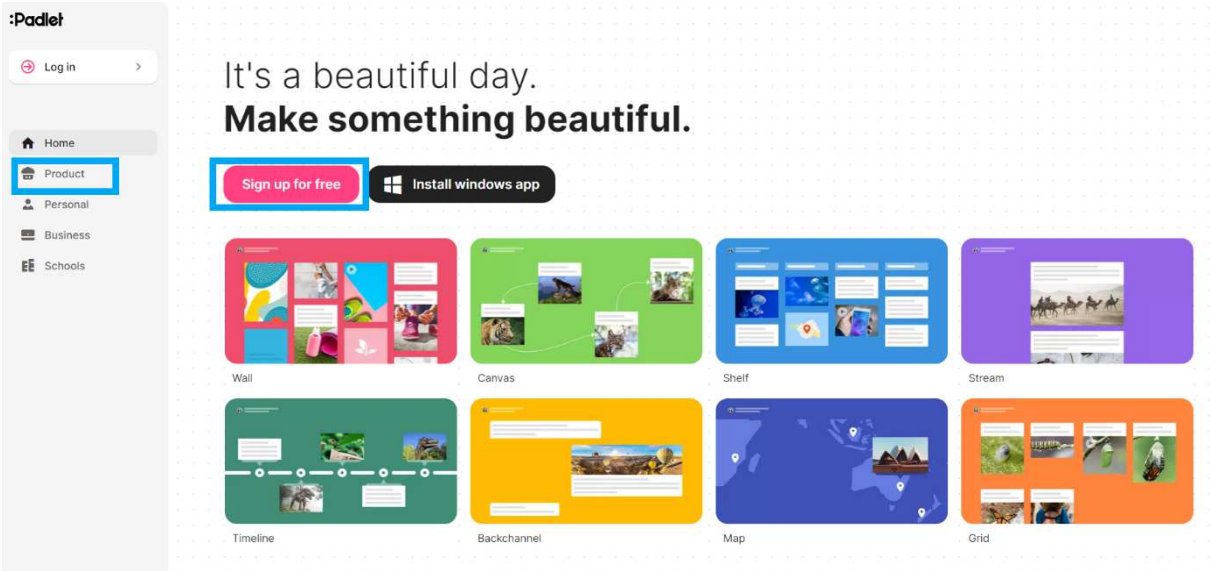
1.1.1. Aim of the Tool

Padlet is an online application that allows users to collect notes, links, images, and videos on a virtual board to gather an idea about any topic. It enables you to modify and share the created work online. Padlet offers several board options such as timeline, grid, map, etc. These all types of board and wall are called "Padlet". Users can create 3 Padlet freely. There are different plans for a paid membership.

As Padlet has interaction and collaboration features on walls, teachers and students can use it for teaching and learning activities. Students can interact on a Padlet to work together on an applied topic by their teachers. Online collaboration takes place without time and space limits.

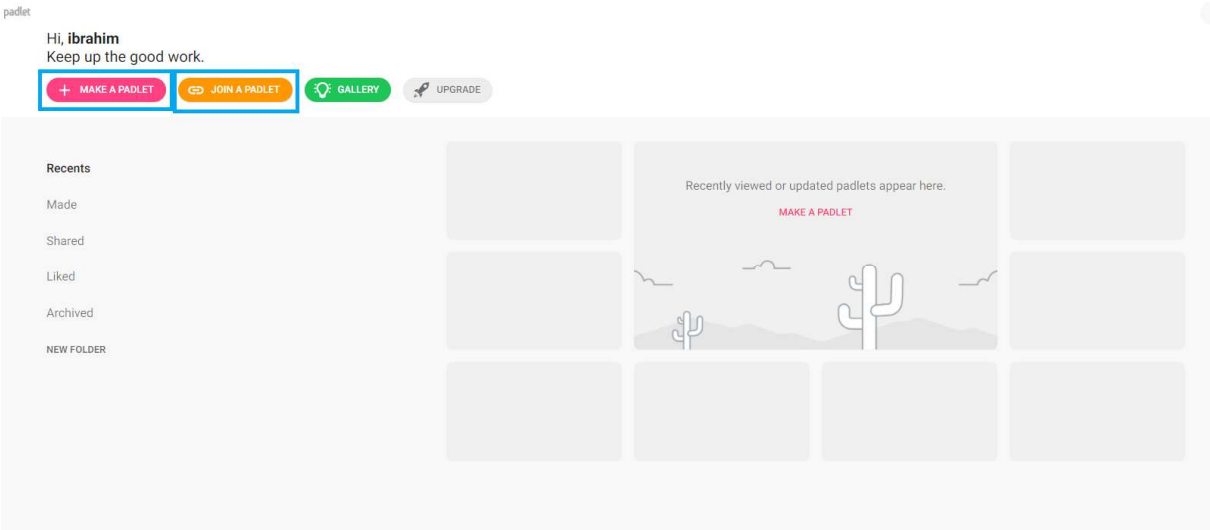
1.1.2. How to Use

Padlet's homepage is displayed after typing "www.padlet.com". It shows up eight types of Padlet tasks. The "Product" tab has an overview of the application. You can sign up by clicking the "Sign up for free" button. Google, Microsoft of Apple accounts are accepted to sign up. Or you can use your email address to create your Padlet account.

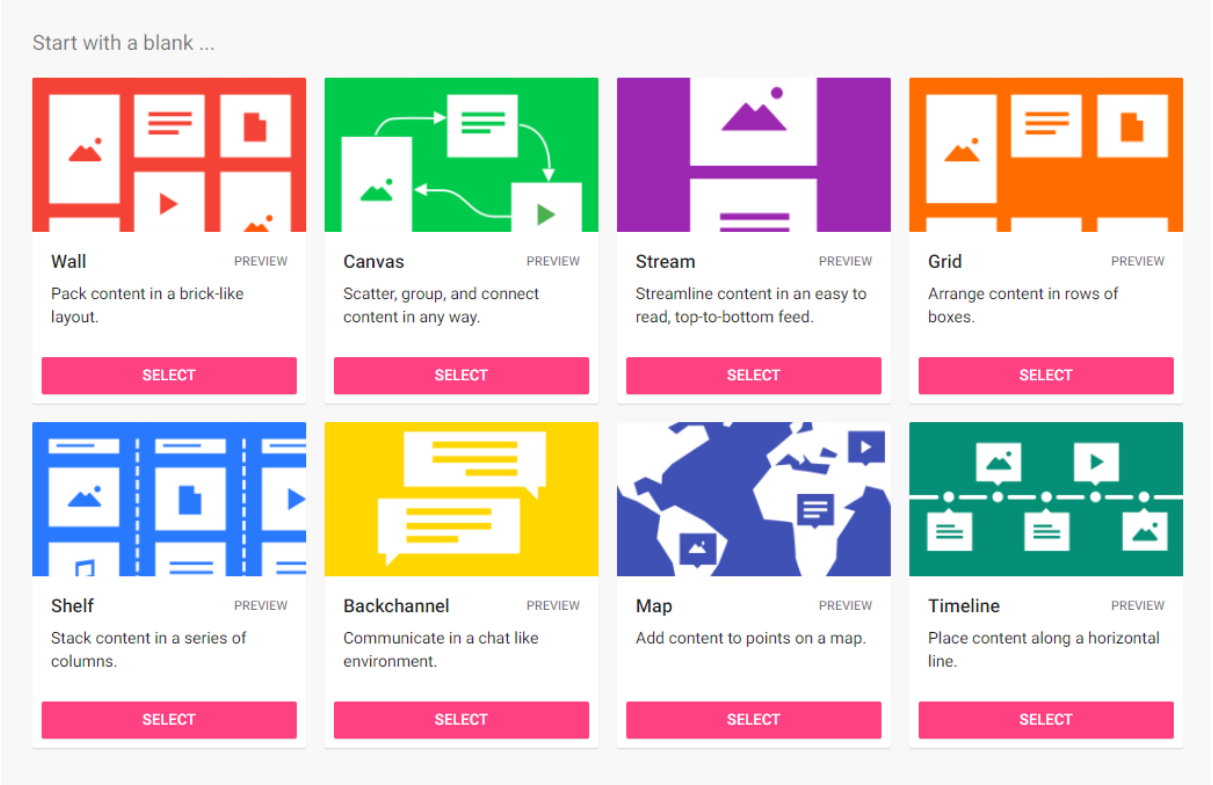


The free version permits creation of 3 Padlet. However, there are 3 premium membership versions such as personal (Padlet Pro), business (Padlet Briefcase), and schools (Padlet Backpack). You can use these premium memberships for 30 days trial freely. To familiarize the tool, the free version overview will be pursued.

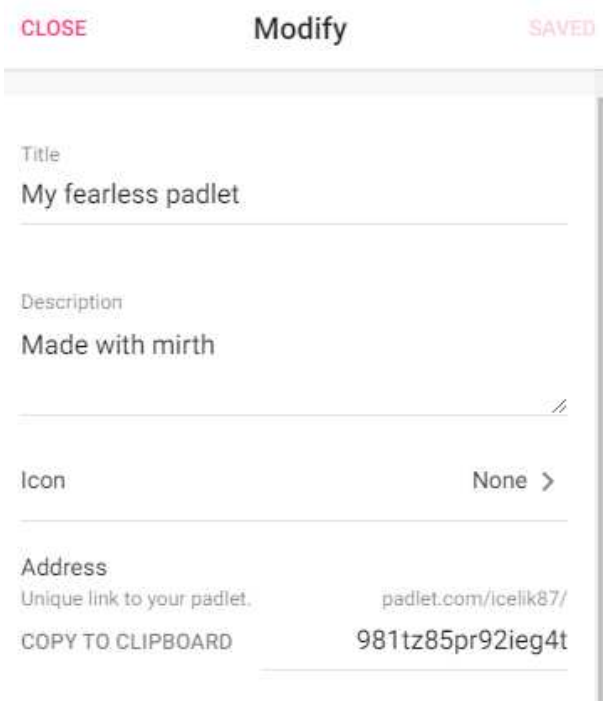
After signing up you can start by clicking "make a Padlet". Or you can join a Padlet that is already created by others. You need to have Padlet's URL address.



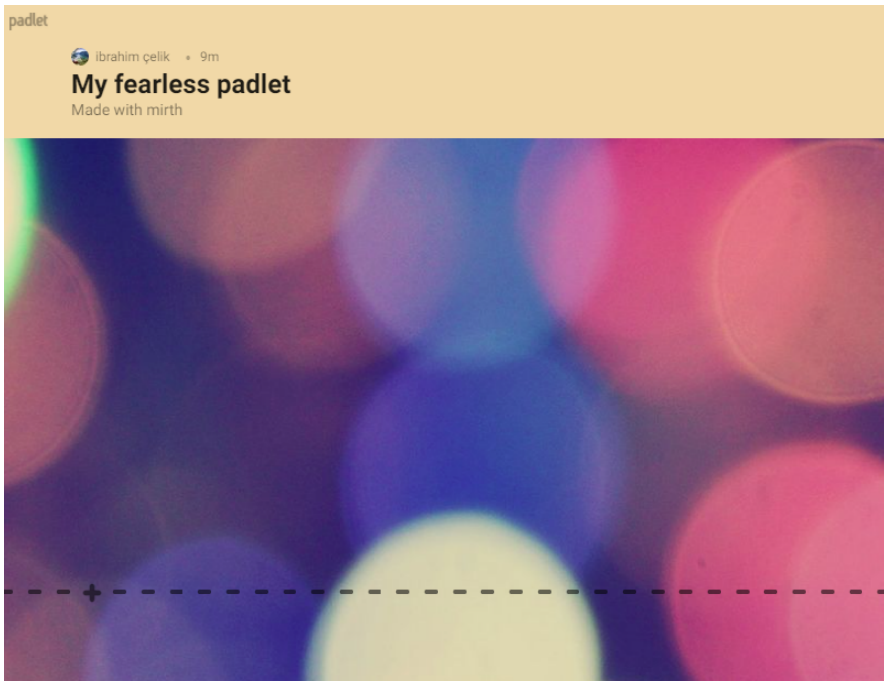
When you want to create your Padlet, you click “make a Padlet”. As it is stated early, there are 8 types of Padlet. You select the option that fits your needs. Small pictures and short explanations give you a general idea about these types.

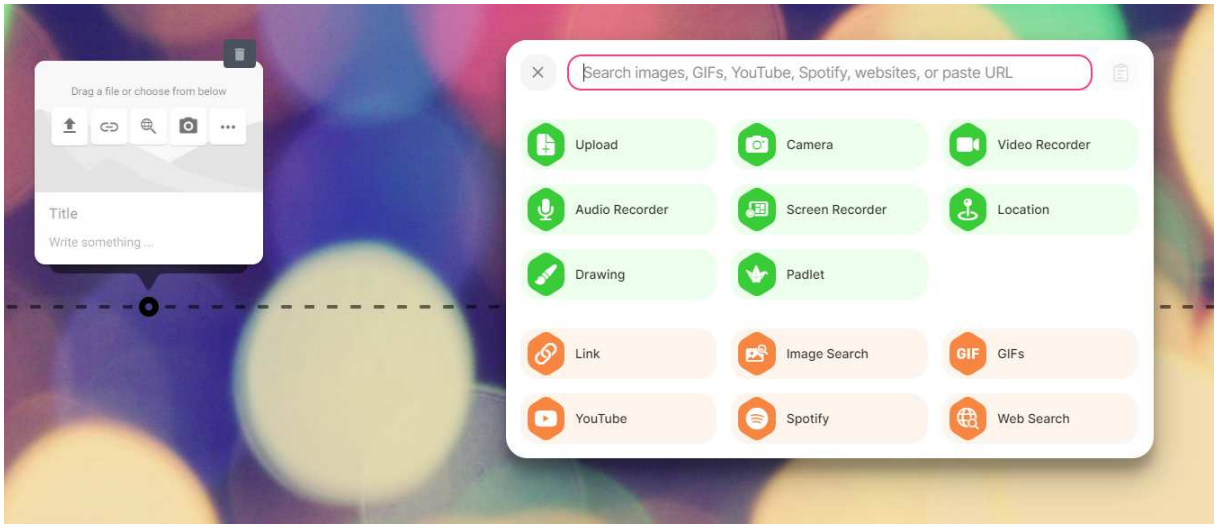


As an example of Padlet's tasks, "timeline" is selected. After it is created settings tab will pop up. You can change the title and description for your Padlet. To ask others to join the same Padlet, you copy and share Padlet's URL by clicking "copy to clipboard".



You start building your Padlet by clicking the "+" symbol. Padlet offers many options to enrich your post such as image, video, audio, link, web search, etc.





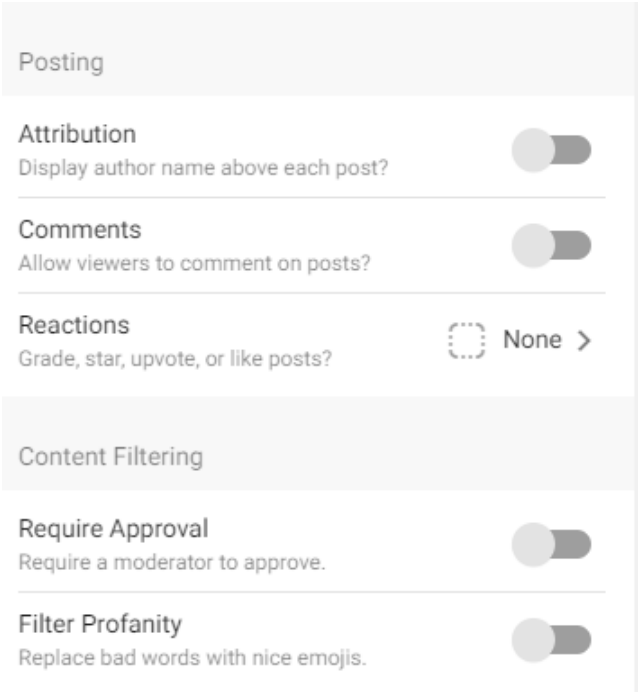
1.1.3. Tips for using in **learning environments**

1. Provide assistive technology tools for reading, writing, and spelling

If the learning activities involve reading or writing you can recommend proper tools for students that have learning disabilities. There are many online applications that would be assistive when they have difficulty with reading, writing, or spelling.

2. Facilitate and have control over the learning process

Padlet allows users to have control over content filtering. You may activate the “Require approval” function. Or you may check the content frequently. As teachers have the role of facilitator in online learning, students need to be monitored and guided while the learning process continues. Additionally, you can turn “posting features” on to observe each student's contribution.



2. LEARNING MANAGEMENT SYSTEMS

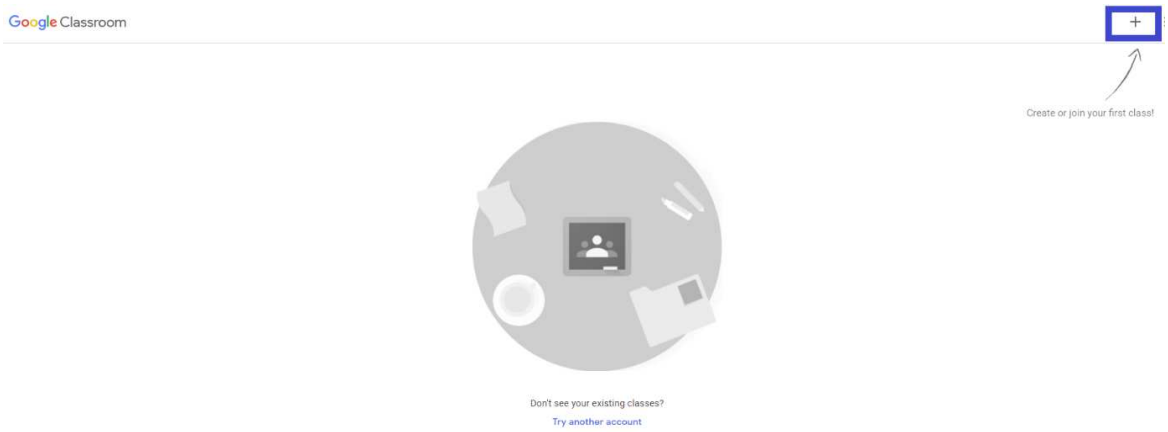
2.1. Google Classroom

2.1.1. Aim of the Tool

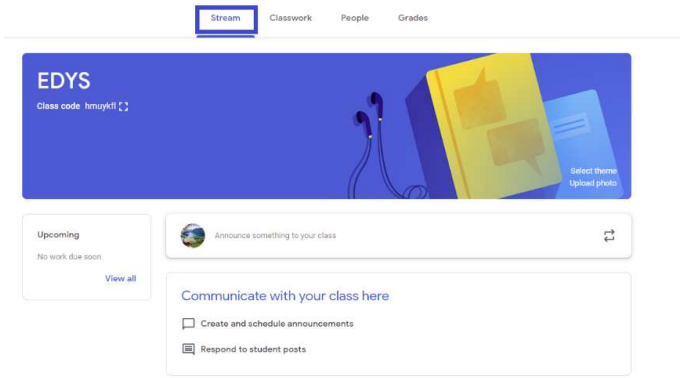
It is a free learning management system (LMS) that helps to organize teaching and learning activities in a virtual environment. After you create a class in Google Classroom you can form modules as a section to follow tasks in a weekly manner. It allows you to assign homework and ask a question that students can discuss and share ideas. Additionally, course materials are shared via the virtual classroom.

2.1.2. How to Use

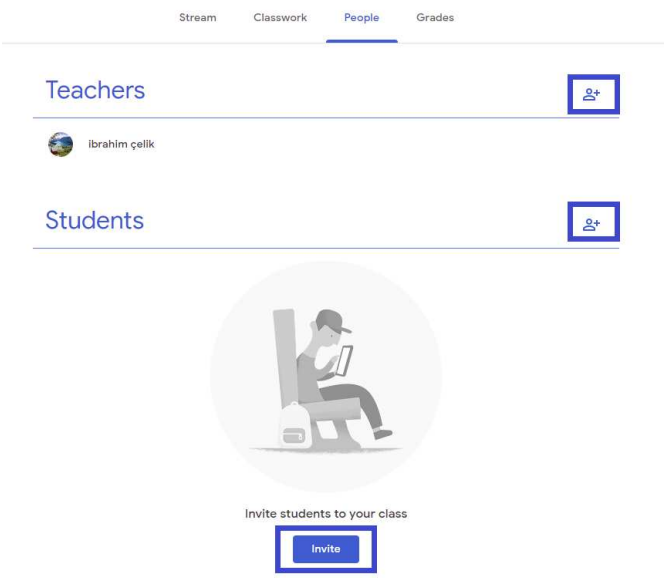
Google Classroom is a free LMS. You only need to have a Gmail account. You choose Google Classroom from Google applications after logging in to your account. You click the "+" symbol to create a class.



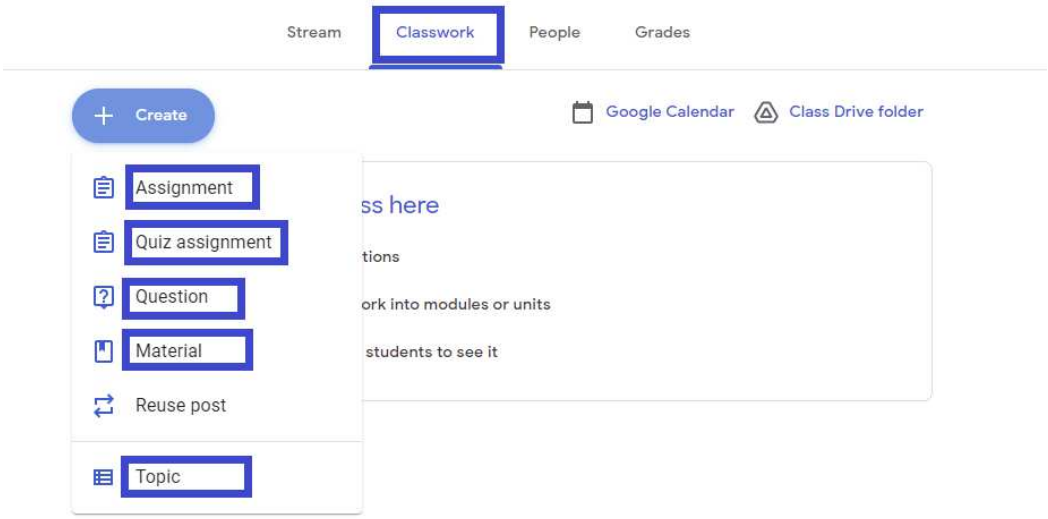
The homepage of the class will be loaded after you type a class title. You can organize class announcements and students' postings on the homepage.

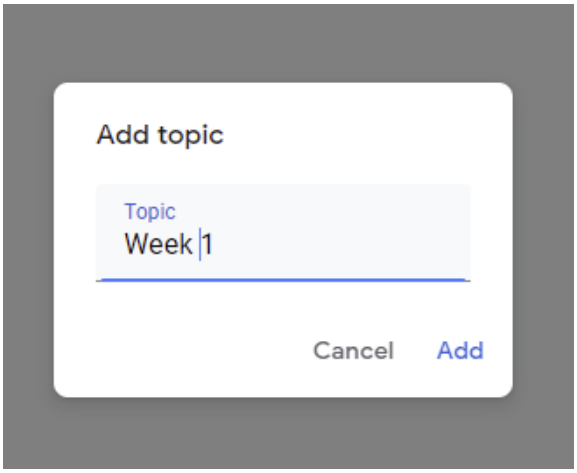


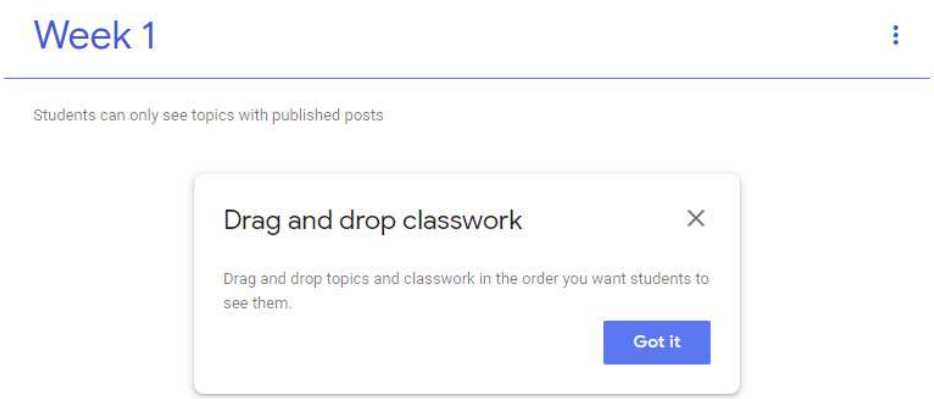
You may invite your students to the classroom by adding their email addresses. Or you can share the invitation link. If you would like to instruct the class with a colleague you can add teachers to the classroom.



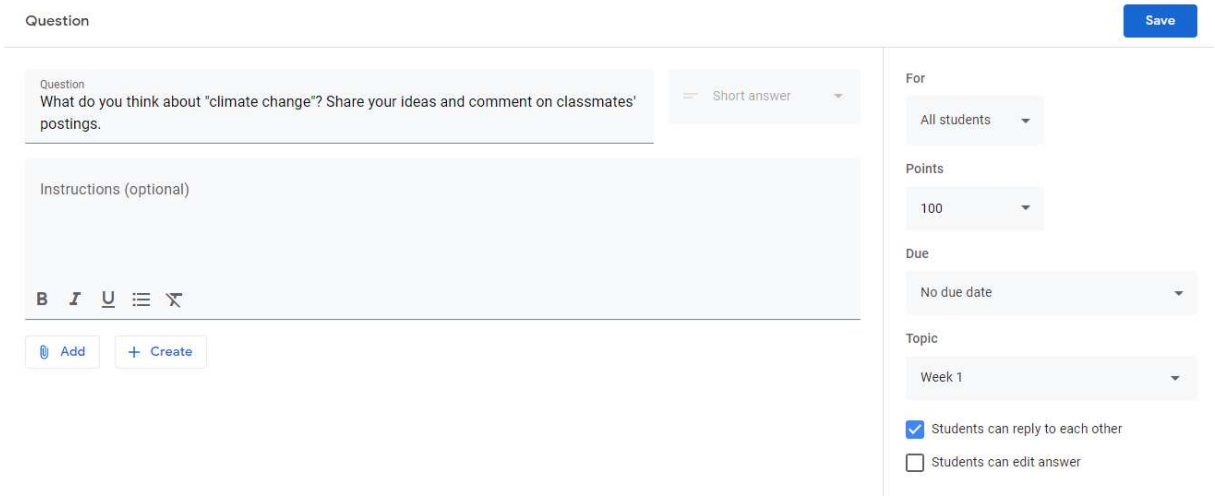
The “Classwork” Tab compromises all features that you can add to the classroom. You can collect assignments or have a quiz over the virtual classroom. You can share documents as well. If you would like to have modules that contain each week's activities you can use “topic” for each module.





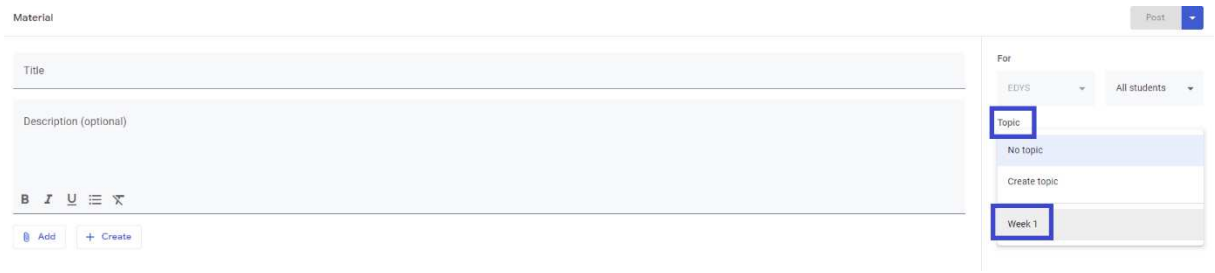


When you want your students to discuss a topic you ask a question over the classroom. Students make a post or reply to his/her classmate's post. It enables to have a discussion forum for collaboration and brainstorming. As “Week 1” was selected, the question is listed

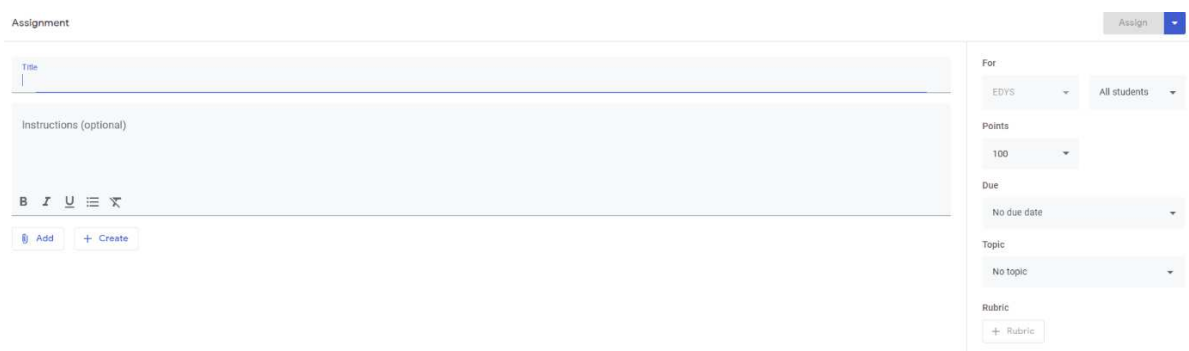


under this module.

All class materials would be shared via the classroom. Students get to access them when they need them. You choose the related module to classify the documents properly.



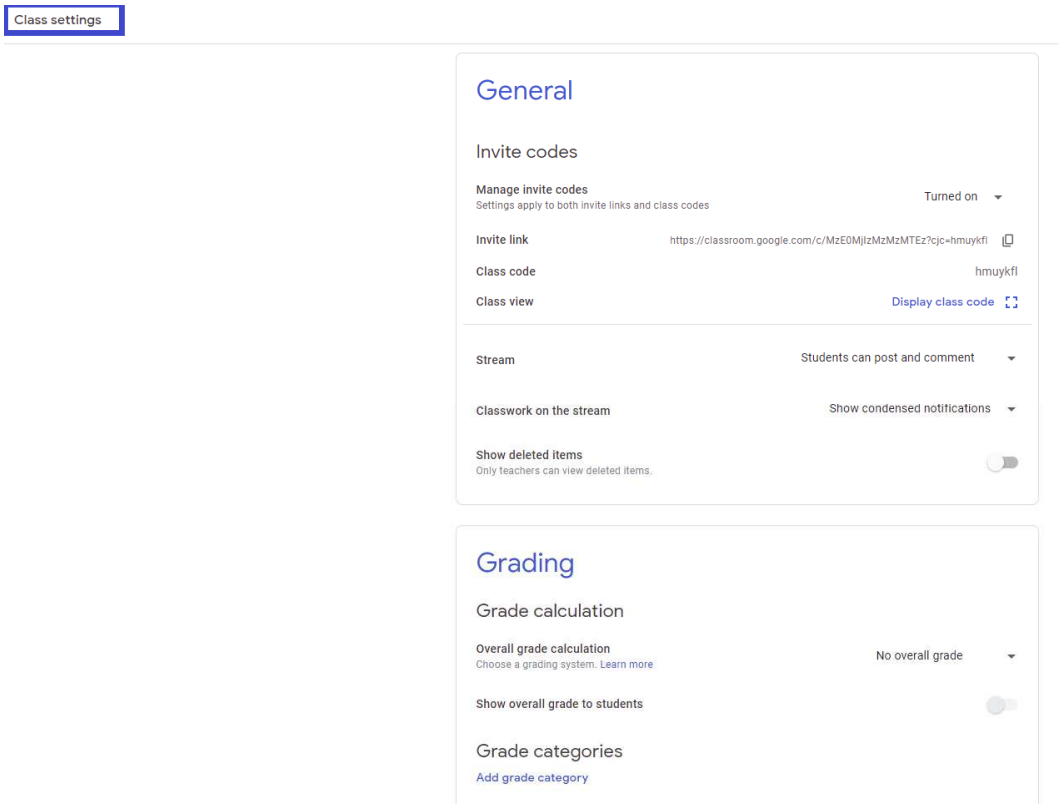
As it is stated, you can collect assignments in the classroom. You may add a rubric that students acknowledge how the assignment will be graded.



2.1.3. Tips for using in learning environments

Facilitate and have control over the learning process

The role of teachers in an online learning environment is to facilitate the process that takes place. You may review students' postings. Your feedback would help to direct a discussion on the intended purpose.



CONCLUSION

The digitalized world provides us with numerous advantages. These advantages have the characteristics of empowering teachers in reaching various learning objectives as well as enriching educational environments. It is required to improve pre and in-service teachers' technological competencies and technology integration skills so as to successfully integrate these advantages into educational environments. Diverse organizations have proposed several models to enhance these skills. Based on these models, improvement of the teachers' skills would enable the integration of technology into education. In addition, it is also a

necessity for successful technology integration to improve pre and in-service teachers' awareness of the various tools and knowledge, and skills about their features and how to use them.

In this part of the book, several online tools developed for various aims have been introduced. How they can be used in an easier manner and which tools can be the best choice for diverse learning objectives and a learning disability have been explained in detail with examples. In this regard, the introduced tools in this part were categorized as follows: the tools for Developing Multimedia Materials for Learning Disabilities, the tools for Digital Assessment for Learning Disabilities, and virtual environments and collaboration tools.

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The materials in the Handbook were developed by:

Part 1: LEARNING DISABILITIES

Chapter 1: LEARNING DISABILITIES: DEFINITIONS, CLASSIFICATION, THEORIES

Asociacia Dyslexia – Bulgaria (DABG) - Bulgaria

Chapter 2: DYSLEXIA – THE MOST COMMON SPECIFIC LEARNING DISORDER

Klaipeda University

Chapter 3: EARLY IDENTIFICATION OF LEARNING DISABILITIES

Latvijas specialo pedagogu asociacija (LSpecPA) - Latvia

Chapter 4: TEACHING STUDENTS WITH LEARNING DISABILITIES

Spoleczna Akademia Nauk (SAN) - Poland

Part 2: TECHNOLOGIES IN EDUCATION

Amasya University - Turkey

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