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# CURRENT STUDIES IN SOCIAL SCIENCES 2022

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**Oya TUNABOYLU**  
**Özkan AKMAN**

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## FOREWORD

This book, which has been prepared with a multidisciplinary approach, consists of 15 chapters and has been prepared by expert academics who will contribute to the relevant fields.

In the first part; Using literature in language teaching has long been an established area of practice. The authors stated the reasons that rationalize the widespread use of literary texts. Titles with regards to the the place of literature in different teaching methods along the years, the approaches to the use of literature in language classrooms and different genres in literature were followed by a sample lesson at the end of the chapter.

In the second part; The author explained the importance of estimation in our daily lives. The estimation strategy was mentioned as a reasoning technique that we constantly refer while reaching at a decision. In the chapter, three types of estimation strategies were presented as computational, measurement and numerosity.

In the third part; the authors highlight the importance of the ecology where teachers perform teaching practice. They argued that teachers including those who work at vocational high schools need a supportive environment to develop and hone their teaching skills. To this end, the authors shared types of professional activities and maintain their argument with an emphasis on practice activities.

In the fourth part; Güneş questioned the function of government in society with relation to the services provided by providing the types of poverty, the author stated that the concept of social work has evolved through the centuries by turning the meaning of ‘citizen’ into ‘customer’.

In the fifth part; Samur defined the concept of culture in its basic form. Along with the concepts of corporate and organizaional culture, the author situated his argument in sports field with an emphasis on sports clubs. The author mentioned the ways and potential benefits of establishing organizational culture at clubs.

In the sixth part; Lorabi pointed out how technology could be used to measure visual-spatial perception in sports with regards to soccer. The author ephasized the role of EEG and multimedia to undertake reliable measurements. Lorabi argued that multimedia is used as a measurement tool although it is widely opted for communication purposes.

In the seventh part; The author explored the relationship between the science of mathematics and cosmetology. Frederick-Jonah, following his argument for the necessity of basic mathematical knowledge for everybody, stated that those who work in the fild of cosmetology need basic mathematical knowledge to undertake their professional duties.

In the eighth part; In this chapter Derman argued that Word Association Test is a data collection tool oped for by researchers working in science. By using this test, students’ knowledge structures could be identified in chemistry classes. The test helps students create mind maps which in turn eases out the learning process.

In the ninth part; Emphasizing the significance of Nature of Science (NOS) and Scientific Inquiry (SI) Kapucu argued that science teaching requires a number of knowledgebases along with scientific and pedagogical bases. As a concept, NOS includes dimensions varying from philosophy of science, history of science, sociology of science and psychology of science. In

order for students to internalize the topics, teachers need to materialize the content by using creative teaching methods. Using documentaries in science classes offers affordances on the part of students.

In the tenth part; The authors reviewed the effects of the pandemic in spheres of education, health and other areas such as agriculture. Demirci et al displayed the effects of the Covid-19 in world countries. They ended with recommendations to consider.

In the eleventh part; Parallel to the technological advances, the sectors are going through changes. To this end, the authors argued the unavoidable place of Artificial intelligence (AI), machine learning predictive analytics in financial industry. Ali and Suri in this chapter stated that innovations such as AI has an undeniable potential to provide customers with individualized and targeted campaigns along with other benefits.

In the twelfth part; Underlining the value of education, the authors explored the possibilities to enhance the quality of education by introducing a business model into education. Varga and Saary stated that excellence in education could be established via some models. In the chapter, proposing the flagship university model they mentioned the steps and benefits of this model.

In the thirteenth part; Following a detailed country-wise description of Canada, Karaman raised some points as to why students should choose the country for studying and living. In the chapter it is stated that the largest foreign population in Canada is comprised by Indians followed by Chinese and Vietnamese as of 2020. The author argued that Canada as a prosperous country places high importance on education by investing in schooling across the country. Therefore, Canada is a resourceful country for students.

In the fourteenth part; Aydın-Karaca et al explored the concept of creativity with relation to mathematics education. The authors argued that problem solving and problem posing activities could be integrated into the mathematics education with an emphasis on model eliciting.

In the fifteenth part; The authors first presented the historical background of one of the oldest sciences, algebra and then defined algebraic thinking. They specifically focused on four levels of algebraic thinking and recommended some ways to develop this thinking process.

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## LITERATURE IN LANGUAGE CLASSES: A MARRIAGE OF HAPPILY EVER AFTER

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### 1. Introduction

There are many different answers to the question, 'what is literature?' Eagleton (1996) answers the same question with a quote from Roman Jakobson in his book titled "Literary Theory: An Introduction": "it is an organized violence committed on ordinary speech." In other words, literature transforms and intensifies language, which makes it different from everyday language (Eagleton, 2014). Selden (2016), on the other hand, argues that literature allows us to look at life from a different perspective. In fact, literature is a direct reflection of the world we live in. In this world, change is constant and inevitable. People and their needs are also constantly changing, and these changes have led to the search for different methods of language teaching in this modern age where the need to know a foreign language has increased so much. In our age, people, especially language learners, need to learn about other cultures, values, traditions, and history of different societies. Thankfully, literature is an invaluable resource in this respect. Lazar (1993) argues that literary texts have many possible contributions to language learning. A few of them are:

1. They are motivating, fun, and educational.
2. They are full of cultural elements.
3. They facilitate the language acquisition process.
4. They increase students' language awareness.
5. They develop students' interpretation skills.
6. They encourage students to express their feelings and thoughts.

Slater (2011) argues that literary texts should be used as authentic resources in language classes to support students' cultural, linguistic, and personal development.

This chapter will first present the history of the relationship between literature and language education, and then will mention various approaches to the use of literature in language teaching, and the use of different literary genres such as short story, novel, play, and poetry in language classes. A sample lesson plan will be added to the end of the chapter with an intention to showcase as to how a literary piece could be exploited in a language classroom

## **2. Language Teaching and Literature: A Story So Far**

Language and literature have such a long and deep-rooted history that it is very difficult to treat them as independent concepts. According to Kaplan (2005), the relationship between language and literature is a direct connection, as individuals forming the society share a common culture that they create through their language, and transfer this culture from generation to generation, from nation to nation. The means of this constant interaction can only be realized through language itself. On the other hand, literature is one of the most important mediums of this transmission and is a kind of art nourished by language.

The use of literature as a technique to teach both basic language skills (i.e., reading, writing, listening, and speaking) and language areas (i.e., vocabulary, grammar, and pronunciation) is not a new approach to foreign language learning and teaching. In fact, the history of integrating literature into foreign language teaching dates back hundreds of years.

The Grammar Translation Method is a technique that originally emerged to teach classical languages such as Latin and Greek, and therefore it is also called the "classical method" (Chastain, 1988). One of the main purposes of this method, which has been predominantly used in teaching other foreign languages since the 19th century, is to reach the level of reading and appreciate the literary works written in this language (Richard & Rodgers, 2001). According to this method, "literary language is superior to spoken language" (Larsen-Freeman, 1986, p. 15). Therefore, the translation of literary passages is one of the techniques teachers use when applying the Grammar Translation Method. In this technique, students translate a literary text written in the target language into their mother tongue and focus on the vocabulary and grammatical structures in this text (Larsen-Freeman, 1986).

However, since the early years of the 20th century, the Direct Method, which aims to purify the education of modern languages from the Greek and Latin pedagogy of the grammar-translation method and to teach language skills by associating concrete objects with actions "directly," has gained popularity (Kramersch & Kramersch, 2000). The most important principle of this method is that translation is not allowed. The meaning of words is taught through demonstrations and visual tools without the need for students' mother tongue (Diller, 1978). Thus, the importance and dominance of literature in language teaching begin to decline. After WWI, the Direct Method was replaced by the Audio-lingual Method, which caused the literature to almost completely lose its influence in the language teaching process. Schaffer (1944) defended the Audio-lingual Method, which states that a foreign language can be taught to students through imitation and reinforcement. He said: "We need a more intimate connection between life and academic studies"; we should do away with "empty sonnets and glistening nonsense" (Vittorini, 1944, p. 276).



The absence of literature in language teaching continued until the 1970s when Communicative Language Teaching emerged. This method suggested that students should be exposed to authentic materials in language teaching, thus paving the way for reintegrating literary texts written in the target language into language teaching (Aydinoğlu, 2013). Since then, the importance and function of literature in language teaching have been reconsidered. Studies on how literature can contribute to English language education have attracted the attention of teachers and researchers. The results of some studies, for example, Collie & Slater (1987), McKay (1982), and Zyngier (1994), suggested that literary texts should definitely be used in foreign language teaching.

### **3. Approaches to the Use of Literature in Language Teaching**

#### **3.1. Language-based approach to the use of literature**

There are a variety of different approaches to the use of literature in language classrooms. It is essential for teachers and students to learn about these approaches to increase the effectiveness of using literature in the language learning process.

One of the leading approaches to using literature in language learning has been proposed by Carter & Long (1990). They divided their approach, which they called the Language-Based Approach, into three different categories:

##### ***3.1.1. The Cultural Model***

This model focuses on literature's ability to represent a society's culture. Thanks to literature, learners have the opportunity to learn about cultural elements such as the daily life, traditions, and history of the societies described in the literary texts they read. In this way, they become more tolerant of cultural differences and more open to recognizing and understanding different cultures, ideologies, perspectives, and values (Collie & Slater, 1987).

##### ***3.1.2. The Language Model***

According to the language model, considering the fact that literature is formed by language, literary texts can be considered a unique resource for students to observe the actual use of language. Teachers can demonstrate exemplary uses of a particular grammatical structure through literary works. Students can increase their vocabulary, improve their reading and interpretation skills, and see many different uses of language, as literary texts are also authentic texts.

##### ***3.1.3. The Personal Growth Model***

It is a student-centered model and prioritizes the student's personal development through literature. In addition to the cultural and linguistic development aimed in the previous two models, students should be individuals with high awareness who can critically approach, evaluate and interpret different themes, events, and characters they encounter in literary texts (Bibby & McIlroy, 2013).

#### **4. Using Short Stories in Language Teaching**

Short stories not only meet the need for "authentic material" that emerged with the spread of Communicative Language Teaching but also enable students to gain awareness of different cultures and societies. Because they are shorter than novels, short stories are much more useful in the classroom environment. They can contribute to the development of four basic language skills of students from all proficiency levels (Sarıçoban & Küçüköğlü, 2011). Short stories can play an important role in the development of students' critical thinking skills as well as their language skills. Students can find the opportunity to evaluate the plot and characters in a short time and examine the events from a critical point of view (Oster, 1989). According to Wright (1995), "we all need stories for our minds just as much as we need food for our bodies." Pardede (2011), on the other hand, argues that short stories can be both an entertaining and linguistically and culturally informative activity for students. It is possible to use short stories in many different ways in language lessons to develop all language skills. For example, as a writing activity, students may be asked to continue the story or write a review about it. In addition, if there is an audiobook version of the story, it can easily be used as a listening text. On the other hand, students can be asked to retell the story and given opportunities to improve their speaking and pronunciation skills. Teachers may also use these stories to teach a new grammatical structure or a new set of vocabulary inductively.

#### **5. Using Poems in Language Teaching**

Poems differ from the other literary genres with their complex and unusual writing styles, frequent use of literary devices such as metaphors, and different sentence structures (Khansir, 2012). These differences can create opportunities for students to have different and fun learning experiences (Llach, 2017). Many studies show that poems can be used as an effective resource in many different ways in language teaching (Tomlinson, 1986; Hess, 2003; Khansir, 2012). According to Tomlinson (1986), poems contribute six different values to the educational context. While the first three of these values below are associated with academic success, others relate to students' affective skills, such as creativity and motivation:

1. Educational value,
2. Achievement value,
3. Skill development,
4. Affective value,
5. Individual value,
6. Stimulus value.

Writing and reading activities through poetry will support students' linguistic development. In addition, the different word uses and grammatical structures offered by the poem enable students to look at these language areas from a different perspective (Susikaran, 2013). It improves students' discourse skills and vocabulary (Liao, 2018). It contributes to developing listening, speaking, and comprehension skills (Mittal, 2016). It helps students recognize literary

devices such as exaggeration, metaphor, and sarcasm that they frequently encounter daily (Saraç, 2003).

Moreover, the topics of the poem, such as love, death, emotional pain, happiness, and the cultural elements it contains, are also very important for the emotional development of students (Tosta, 1996). The intensely emotional lines of the poems can encourage students to think empathetically and creatively (Çubukçu, 2001) and encourage them to be actively involved in the language learning process (Aladini & Farahbod, 2019).

Poems can be read aloud by the students as a chain drill activity, thus contributing to developing students' pronunciation skills. Furthermore, students may be asked to prose the poem and write a story inspired by it, or a classroom discussion activity can be organized about aspects of the poem that students can relate to in their own lives. It can be a very enjoyable and instructive experience for students to examine 18th-century English through the poem "The Ancient Mariner" written by Samuel Taylor Coleridge and to discuss themes such as sin and punishment with students. Poetry's openness to different interpretations can lead to classroom discussions and increase students' social interaction.

## **6. Using Drama in Language Teaching**

"Drama is concerned with the world of 'let's pretend'; it asks the learner to project himself imaginatively into another situation, outside the classroom, or into the skin and persona of another person" (Holden, 1982, p. 1). Since one of the main purposes of foreign language teaching is to encourage students to be active participants in the language learning process and to activate them emotionally and physically, drama is one of the most effective methods that can be used for this purpose (Üstündağ, 1998). Due to the nature of drama, students have to work collaboratively and interact socially with each other in a fun, creative, and stimulating environment. Through drama, students use body language as well as target language to express their imagination, creativity, and language potential.

According to Owens and Barber (1998), drama can be used not only for learning but also to make the classroom environment interesting and enjoyable. It also helps to diversify learning activities for a teacher who aims to address different learning styles in the classroom. At first glance, it may be thought that drama only contributes to developing listening and speaking skills, but it can also be very useful in developing reading and writing skills (Clipson-Boyles, 1998). For instance, when students are asked to write their own dramas, it will contribute to the development of students' creative thinking skills as well as their writing and reading skills.

Even Shakespeare's famous plays can be turned into a great tool for students to develop their cognitive and affective skills as well as their language skills. For instance, students may be asked to write and play a parody of the tragedy *Romeo and Juliet*. As another activity, students may be asked to write down what they might be in a scenario where Romeo knows that Juliet is not really dead and does not drink the poisonous potion that led to his death. One can only imagine the joy and excitement these activities will bring to the classroom.

## 7. Using Novels in Language Teaching

Novels are authentic sources that can be very useful in terms of language teaching because they contain the social and cultural characteristics of the target culture. They offer students the opportunity to gain insight into other people's lifestyles and daily lives by comparing them with their own cultures.

According to Vural (2013), novels can contribute to language classes in many different ways since they are authentic materials and can be a source of inner motivation for students. Moreover, it showcases cultural diversity and promotes the development of critical thinking skills. However, the effective use of novels in language classrooms depends on teachers choosing a novel suitable for students' needs and proficiency levels. While choosing the novel, the teacher may need to consider the students' experiences in an environment and prevent possible "cultural shocks" that may be encountered in the classroom. Jane Austen's *Pride and Prejudice* is a novel that reflects the characteristics and cultural and social norms of the period in which it was written. Through this novel, character analyses can be made in the classroom, discussions can be made on the value judgments of British society and the daily lives of people living in the 19th century, or students can be encouraged to write critical articles on these issues. Moreover, as a listening activity, the movie version of *Pride and Prejudice* can be watched in class, and the differences between the novel and the movie can be analyzed.

## 8. A Sample Lesson Plan

The literary work chosen for use in the language classroom is a simplified version of Jane Austen's *Pride and Prejudice* (Easy Classics). While preparing this lesson plan, the authors have prepared it to be applied to intermediate-level 9th-grade Turkish EFL learners.

- Age of students: 15-16 years old
- Students' proficiency level: intermediate
- Education year: 10th grade (first year of high school)
- Social background: middle class

*Pride and Prejudice* is a novel of manners. In this type of novel, a certain social class's social customs and traditions are explained in detail. In these novels, social norms and traditions have a great deal of control over the characters (Harmon, 2012). Therefore, it can be claimed that it is an ideal novel genre for a teacher who aims to increase students' cultural awareness while teaching the target language. Since the novel's language was simplified enough to suit the level of the students, metalinguistic explanations were not needed.

### 8.1. The activities

The activities included in the lesson plan are divided into three main categories suggested by Lazar (1993):

- a) Pre-reading activities
- b) While-reading activities

## c) Post-reading activities

It should be noted that in order to make the reading process easier for the students, the students read the novel by dividing it into two parts. While Part 1 covers the first four chapters of the novel, the remaining four make up Part 2.

**8.1.1. Activities for part 1***8.1.1.1. Pre-reading activities*

Through these activities, students are motivated to read and become curious about the story's topic. The teacher reveals the students' background knowledge on the topic by asking various questions. Moreover, students can be taught new vocabulary and grammatical structures they may encounter while reading the story at this stage.

Exercise 1: The title of the novel *Pride and Prejudice* is written on the board. *What do you think of these two concepts, and what might be their significance in the story?*

Exercise 2: The teacher asks the whole class the following questions, and the students give answers orally:

- a) *Does anyone know anything about this novel? Have you ever heard of Jane Austen?*
- b) *The protagonists of our story are the five sisters, Elizabeth, Jane, Mary, Kitty, and Lydia, respectively. What might happen to them in the story based on their names and the order in which they were born?*
- c) *What do you know about balls that used to be held in England? Have you seen these balls in the movies you have watched so far?*
- d) *What do you think was the role of women in society in the 19th century?*
- e) *Do you have any idea how women dressed at that time?*

**Homework:**

*Read the first four chapters of the novel.*

*8.1.1.2. While-reading activities*

According to Lazar (1993), at this stage, students understand the plot and characters of the story. In addition, they encounter words they did not know before and recognize the language and writing style of the literary text. Considering these features, the following activities are planned for the students.

- **Exercises to understand the plot**

Exercise 1: *Read the first four chapters and come up with titles for each chapter.*

Exercise 2: *Working in pairs, write a summary of Chapter 1 and present it to the class.*

Exercise 3: *Listen to your friends' summaries and identify the missing parts in your summary.*

● **Exercises to understand the characters**

Exercise 1: *Rank the characters in the book's first part from the most important to the least important to the story.*

Exercise 2: *Answer the following questions related to Part 1:*

1. *What is Miss Bennet's most important purpose in life?*
2. *Why did Charlotte accept the marriage proposal made by Collins?*
3. *Who do you think are the antagonists of the story?*

Exercise 3: *Describe each member of the Bennet family with two adjectives.*

● **Exercises to teach new vocabulary**

Exercise 1: *Underline the words that make it difficult to understand the story while reading the first part.*

Exercise 2: *Work in pairs and match the following words with their meanings.*

a) tempt	1) embarrassing someone too much
b) mortify	2) making someone want to do something even though they know it is wrong
c) conceal	3) something you say when greeting someone
d) salutation	4) hiding something or someone

● **Exercises to work on the language**

Exercise 1: *Circle the best option to connect the sentences.*

- *Mrs. Bennet deigned not to make any reply **but/and** unable to contain herself.*
- *Miss Bennet will receive every possible attention **while/when** she remains with us.*
- *It is very improbable that they should meet at all **unless/if** he really comes to see her."*

8.1.1.3. *Post-reading activities*

According to Lazar (1993), through post-reading activities, students should be able to interpret the reading text, understand the author's point of view, develop their language skills, and express their thoughts on the text. The following activities are planned in accordance with these purposes:

● **Exercises to interpret the text**

Exercise 1: *"It is a truth universally acknowledged, that a single man in possession of a good fortune, must be in want of a wife."*

*What does the quote above say about the role of women in society at that time?*

- **Exercises to improve language skills**

Exercise 1: *Write a 100-word letter to one of the characters in the novel and give them some advice about their life.*

Exercise 2: *In pairs, interview one of the characters in the novel that interests you the most. Student A becomes the interviewer, while student B roleplays this character and answers questions in front of the class.*

- **Exercises to understand the author's point of view**

Exercise 1: *What do you think about the idea that women have to marry to be happy? Do you think the author wrote this novel to support or criticize this idea?*

### **8.1.2 Activities for part 2**

#### *8.1.2.1. Pre-reading activities*

Exercise 1: *Do you think Elizabeth's prejudice against Darcy will be overturned in the second part of the story?*

Exercise 2: *For which characters do you think the story will have a happy ending and for which ones will the story end with an unhappy ending? Make a list.*

#### **Homework:**

*Read the remaining chapters of the novel.*

#### *8.1.2.2. While-reading activities*

- **Exercises to understand the plot**

Exercise 1: *Were your predictions about the course of the story correct? What were you wrong about?*

Exercise 2: *As you read, underline where you think the story's turning point is.*

- **Exercises to understand the characters**

Exercise 1: *Which of the characters in the story do you think are "proud" and which are "prejudiced"?*

Exercise 2: *What do you think of Mrs. Bennet's relationship with her daughters?*

- **Exercises to teach new vocabulary**

Exercise 1: *Underline the words that make it difficult to understand the story while reading the second part.*

Exercise 2: *Work in pairs and explain to each other the meaning of the words in the story that you think are the most interesting.*

#### *8.1.2.3. Post-reading activities*



- **Exercises to interpret the text**

Exercise 1: *Compare and contrast the male and female characters' perspectives on the concept of marriage.*

Exercise 2: *How does the concept of social class affect the story's characters, especially the relationship between Elizabeth and Darcy?*

- **Exercises to improve language skills**

Exercise 1: *How do you think this story would have ended if it had taken place in Turkey? Write an article of 150-200 words.*

Exercise 2: *Imagine Mrs. Bennet being here. What would you say to her to convince her that not every married woman is actually happy? (Group discussion)*

- **Exercises to understand the author's point of view**

Exercise 1: *What does the author think about the society she lives in? Write a slogan that summarizes the author's opinion.*

## **9. Conclusion**

In language classes, literature can be a very important resource for students to get to know the culture of the target language and to observe the actual use of the language. Literature can also be used as a more motivating and entertaining tool for students to learn languages. Moreover, these authentic materials will enable students to see different uses of language and will also improve their vocabulary and grammar skills. As seen in the sample lesson plan in the previous section, the activities done through literary texts can be planned in a way that will improve the students' four basic language skills. These activities will be very beneficial not only for the academic success of the students but also for their personal growth. For example, they can acquire a lifelong reading habit that will make every stage of their life easier for them. In addition, by analyzing literary texts, students will have the opportunity to increase their empathy for others, as well as their critical thinking skills and imagination. Last but not least, thanks to literature, students can go a long way toward becoming 'global citizens' who embrace cultural differences and accept them not as threats but as valuable resources.



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**1. Introduction**

Let's say we have decided to buy a T-shirt. Is this question not the first question that comes to mind when we go to a store or shop online: "Which one of the sizes S, M, L, XL fits me better"? We have an estimate about this question for ourselves. Like this one, thousands of questions run through our minds on a daily basis, and we make up an idea about the approximate value of most of them. We even have an idea of the approximate value of the salt content of the food we eat. Perhaps in a rainy day, we decide either to walk or to get on a vehicle by estimating how wet we can get from the amount of raindrops falling on the ground and the speed of falling to the ground. As you can see, estimating the approximate value of an event during the day also affects our daily decisions. In this context, we can define estimation skill as an individual's ability to make a quick decision to adapt to daily life easily. Boyraz & Aygün (2017) state that each individual can make predictions, but not all predictions need to be close to the actual value. Therefore, they argue that the concepts of estimation and estimation skill ought to be considered as different concepts. In this context, if the concepts of estimation and estimation skill are merged, the estimation skill can be expressed as 'the competence that enables the individual to produce an estimate close to the real value by performing mental activities without using any tools or equipment' (Boyraz & Aygün, 2017, p.168). Micklo (1999), on the other hand, defines estimation as knowing the size or quantity of something quickly without the actual counting or measuring process.

In fact, the ability to estimate makes it easier to adapt to daily life and saves us time. For example, the media uses estimates rather than exact amounts, as seen in "150 million pesetas (Spanish currency) for a school population of 63 thousand students" instead of "148,739,426 pesetas for a school population of 62,879", to make information clearer and more understandable (Segovia & Castro, 2009). Estimation has a critical role in mathematics education as well as in our daily lives (Munakata, 2002). In the past, as it is known, mathematical calculations were made with paper and pencil at length. However, considering that individuals need to make quick and accurate decisions in order to adapt to the skills of the

21<sup>st</sup> century, the importance of paper-pencil calculations decreases. In this context, pupils are expected to keep up with the current times by making mathematical calculations. Instead of understanding that “Every mathematical problem has only one correct answer”, pupils need to be taught that the answer to a problem can be expressed within the limits closest to the real value (Köse, 2013). The estimation skill, which is intertwined with daily life, play an important role in acquiring many skills such as gaining the sense of number, deciding on the appropriateness of calculation methods, establishing relationships between operations and concepts, etc. (National Council of Mathematics Teachers [NCTM], 2000). Since the use of estimation skills has an important place in daily life, estimation is also included in many mathematics teaching programmes (Australian Education Council [AEC], 1994; Department for Education and Skills [EDCTM], 2005; Ministry of National Education [MoNE], 2005).

In the literature on mathematics education, estimation skills are classified differently. Segovia and Castro (2009) essentially classified the estimation strategy in two different ways, computational and measurement estimation. Segovia and Castro (2009) state that there are two types of sizes in measurement estimation, continuous and discrete, and evaluate numerosity in accordance with this size type. For instance, the case of continuous magnitudes is encountered in how we evaluate someone else’s height compared to our own. Estimating the number of people attending a demonstration is given as an example for the case of different sizes (numerosity). Hogan and Brezinski (2003) classified estimation strategies in three different ways: computational estimation, measurement estimation, and numerosity. Figure 1 shows the classification of estimation strategies. These three estimation strategies differ among themselves in relation to the sub-strategies. For example, Reys et al. (1982) classified the strategies used in computational estimation in three ways: changing the numbers in the process (reformulation), changing the operations (translation) and making arrangements to provide approximation in the result (compensation). On the other hand, Hildreth (1983) dealt with measurement estimation strategies in two ways as clue and foreknowledge. In addition, benchmarking and comparison strategies are widely used in measurement estimation (Joram et al., 2005). On the other hand, while Crites (1992) analyses numerosity, he classified it in three ways such as basic benchmark comparison, decomposition/recomposition, and numerical multiplicity estimation (eye-ball). Figure 1 shows the baseline of the estimation strategy and sub-strategies.

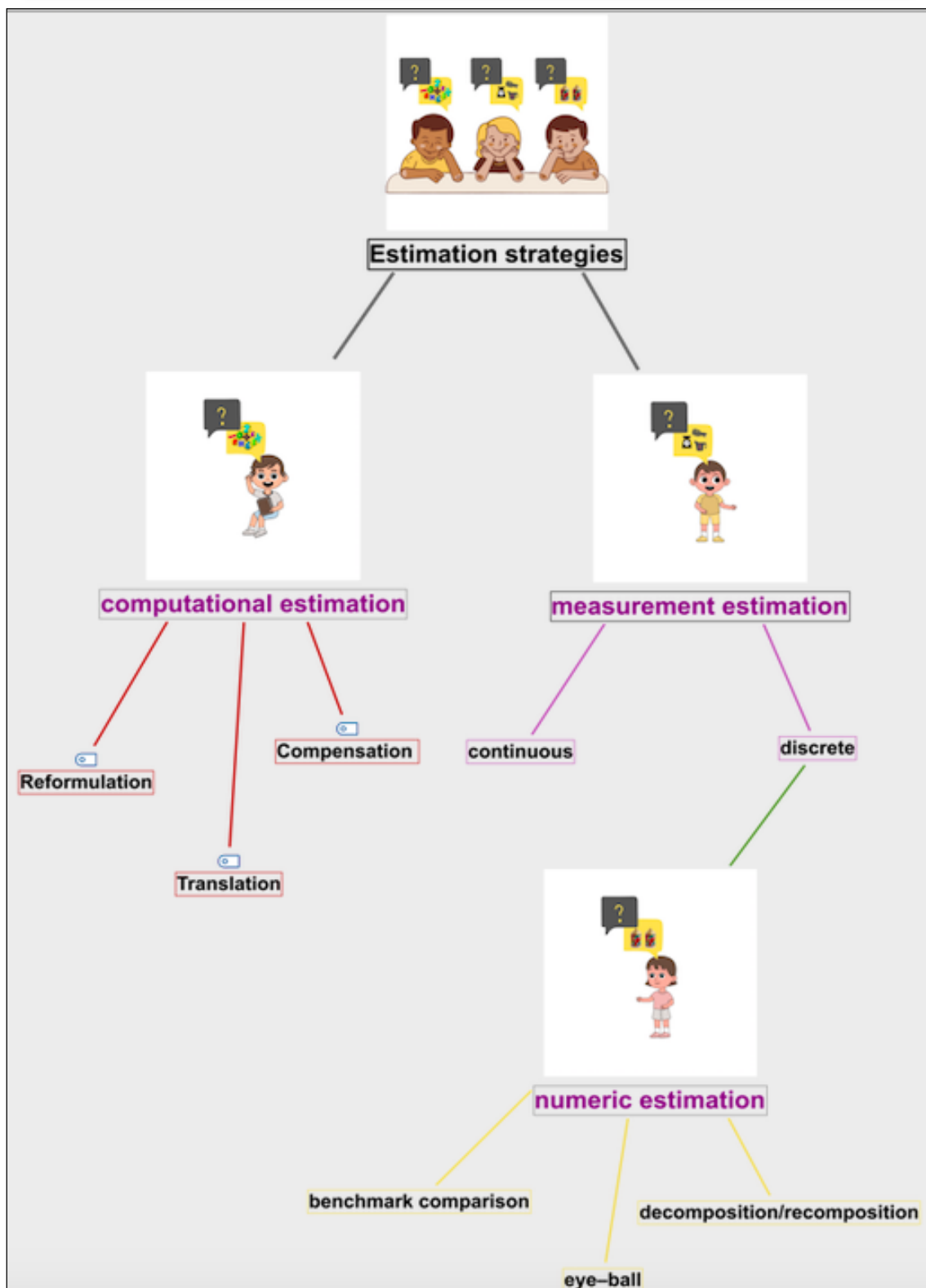
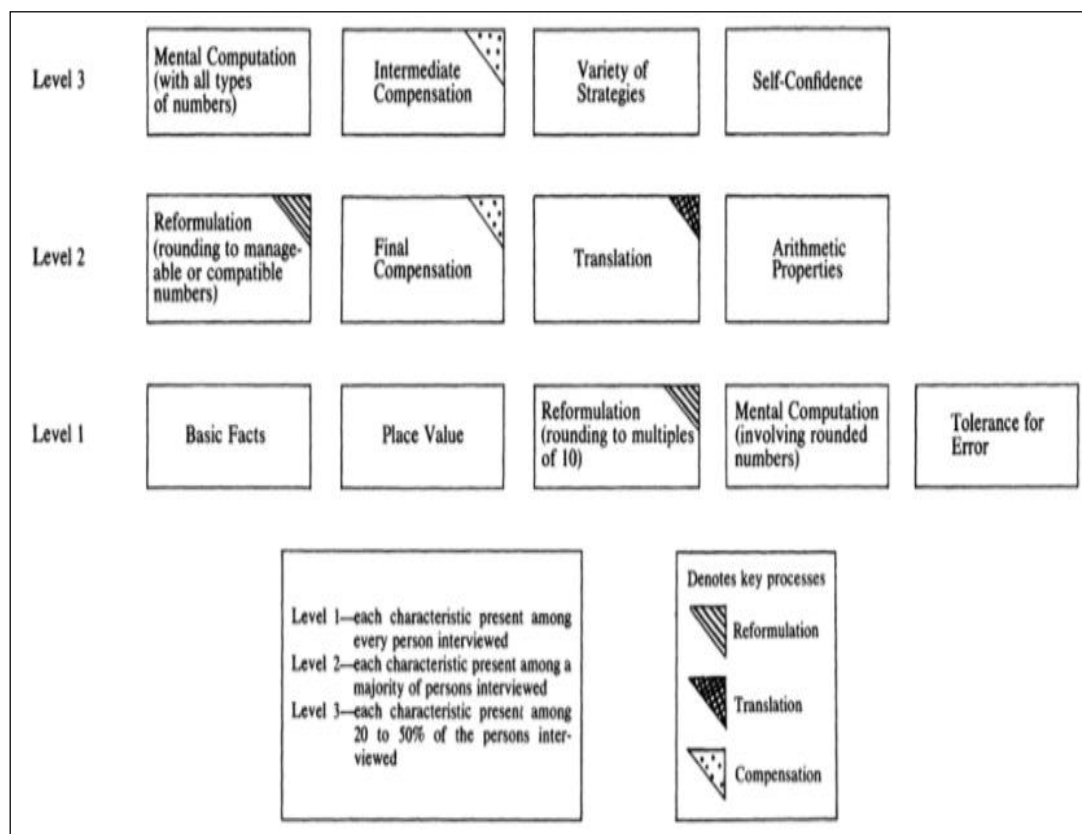


Figure 1. Estimation strategies

## 2. Computational Estimation

Computational estimation is an invaluable tool for children’s daily and academic skills (Case & Sowder, 1990). Wherever there are numbers that are at stake in our daily life, computational estimation is performed there without even thinking about it. For instance, when we take a taxi, we look at the taximeter and give the taxi driver an approximate value of money that we think we may need to pay. For this reason, Dowker (1992) defines computational estimation as the process of giving reasonable and approximate answers to mathematical problems without performing actual calculations. Aslan (2011) defines computational estimation as obtaining a logical result by performing mental operations. Heinrich (1998) also states that computational estimation is a multi-step process that takes place by using the appropriate operations from addition, subtraction, multiplication and division after some mental calculations (rounding etc.). Computational estimation is one of the reasoning techniques because it is based on certain mental procedures (Case & Sowder, 1990). The most general classification of computational estimation is the one that Reys et al. (1982) divided into three as reformulation, translation, and compensation. The characteristics that pupils ought to have in order to be good computational estimators by using these three strategies in computational estimation are summarised below (Figure 2).



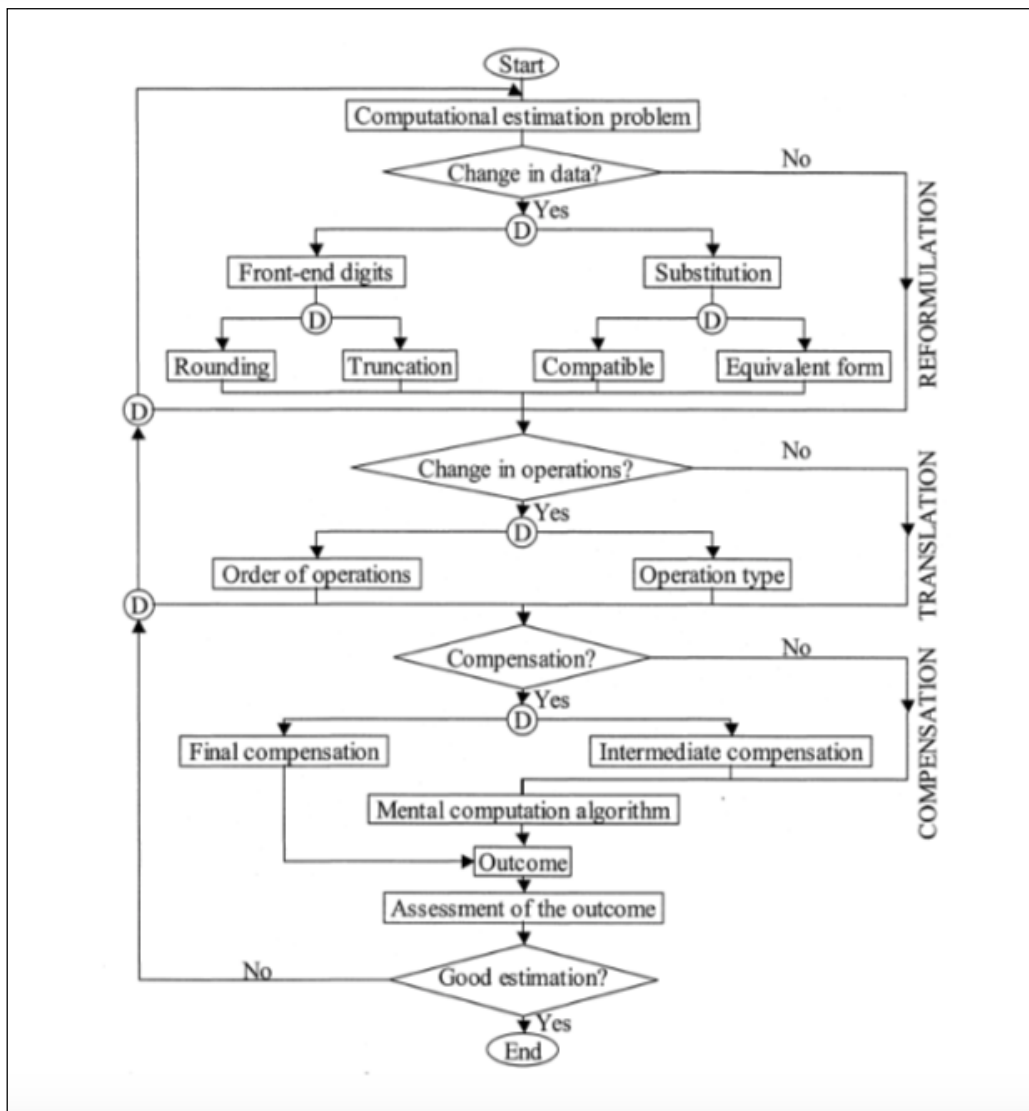
**Figure 2.** Requirements for a good computational estimator (Reys et al., 1982, p. 197)



As seen in Figure 2, swift and accurate recollection of all operations are essential facts (Basicfacts) to be a good computational estimator. In addition, the understanding of place value is important in determining the correct results of different operations of arithmetic. Also, it is necessary to transform the numerical data in a problem into a mentally manageable format (Reformulation) such as rounding numbers to multiples of 10. Likewise, the rapid and efficient use of mental computation is also important in order to express the estimations with accurate numerical information. It is necessary to consider that some errors can be tolerated in accordance with the meaning and purpose of the estimation (Tolerance for error). It will also facilitate the estimation by allowing adjustments to approximate the result generating from reformulation of the problem. Unlike reformulation, it may also be necessary to change the numbers or change both the numbers and the operations (Translation). While doing these, it is important for pupils to have knowledge of number properties including distribution, association and change, order of operations, and how to use operations (Arithmetic properties). Finally, pupils need to have self-confidence about making the predictions correctly. As can be seen, pupils' self-confidence is as important as considering the margin of error when making computational predictions (Reys et al., 1982).

Many steps are taken in our minds when making computational estimation. When we encounter a problem based on computational prediction from daily life, our mind starts operations with interpreting the data in the problem. From these data, it needs to be decided whether a change will be made about the numbers or about the operations. For example, if the numbers are to be changed, rounding can be performed. For changes related to operations, translations are made on different operations that do not change the result. The mind then tends to check if it undertakes this performance correctly or incorrectly, and makes a series of changes as described in Figure 2. The flow chart in mind, showing how the computational estimation process takes place, is shown in Figure 3.





**Figure 3.** Computational estimation process (Segovia and Castro, 2009, p.534)

Then, how are reformulation, translation, and compensation suggested by Reys et al. (1982) used in computational estimation? How should these mental arrangements be implemented? What strategies enable pupils to sense that they get closer to the result? Can the same strategy be used in every question? Strategies for computational estimation that explain the answers to all these questions are explained below with examples. In the following years, sub-strategies of these strategies were formed and some of them were revised (Çakır, 2019; Tekinkır, 2008; Uygun, 2022).

#### *Numbers Arrangement Strategy*

1) Rounding: It is the most commonly used computational estimation skill in the literature (Berry, 1998). Pupils usually round numbers to integers of 10 and 5 to arrive at the result. Levine (1982) examines rounding as Rounding Two Numbers and Rounding One Number. In this case, a number is sometimes rounded to the numbers given in the question; sometimes two numbers can be rounded up.

$500+127 = ?$ : When estimating the result of this operation, the number 127 is rounded to 100. 500 is added to estimate the result as 600. Thus, a number has been rounded.

$81 \times 93 = ?$ : When estimating the result of this operation, the result of the operation is estimated by multiplying the numbers 80 and 93 or by multiplying the numbers 81 and 90. Thus, one of the numbers can be rounded.

$5638: 19 = ?$ : When estimating the result of this operation, it is seen that both numbers are rounded in the estimation of  $5640: 20 = 282$ .

2) Using digits: It is the estimation made by considering the first or last digits of the numbers.

For example, when adding the numbers of  $4.6+5.5+6.2+9.8+6.1 = ?$ , the sum of  $4+5+6+9+6$  is firstly found. The result found is corrected by working on the digits after the comma. Since the sum of 0.6 and 0.5 is approximately 1; the sum of 0.2 and 0.8 is also 1, by adding 2 to 30, the result of the operation is estimated as 32.

When adding numbers of  $4252+6034+7123+5281+3254 = ?$ , the first digits of the numbers are firstly added:  $4+6+7+5+3= 15$ . Then, considering the possible place value of the result, the result is estimated to be about 15000.

3) Using Number Equivalent/Using matching numbers: It is to prefer more functional numbers by changing numbers. Levine (1982) refers to this change in his strategy definitions as the “known numbers” strategy.

$1292.8 + 71.2$  by  $1300 + 65$ , which is “known” to be 20.

#### *Regulation-Correction Strategy of Operations*

1) Regulation-separation while performing the operation: These undertaken adjustments while performing the operation are in the form of balancing and are related to the identifiable stages of the problem.

In the operation of  $79753 + 96421+92843+95609+89821+106409 = ?$ , numbers other than 79753 are rounded to 100000. 79753 is used to round the others up. In other words, the increase in numbers is offset by excluding 79753. The result is estimated at 600000.

2) Changing the order of operations: It is the execution of operations by changing the places of the numbers without disturbing the equality in order to gain ease and speed while performing the operation.

In the operation of  $(11/26) + (34/53) + (15/26) = ?$ , the operation can be undertaken by writing the first and third expression side by side.

3) Regulation-correction made at the end of the operation: It is the regulation-correction made by considering the relationship between the exact answer and the estimation after the calculations are performed. Thus, a certain amount is subtracted from or added to the initial estimate.

In the operation of  $82567897 / 43 = ?$ , if the number 82567897 is rounded to 86000000, the estimated result is approximately 1 000 000. However, the number rounded up need to be estimated to be less than 1 000 000 as it is smaller than the actual number.

5) Distribution strategy: In this strategy, pupils separate the numbers in order to predict the result of the operation.

Whilst estimating the result of the operation of  $53 \times 79 = ?$ , it is estimated by using the distribution feature as  $(50 \times 79) + (3 \times 79)$  or  $(53 \times 70) + (53 \times 9)$ .

6) Strategy of reaching from the part to the whole: It is the strategy in which the operations are divided into steps and sub-sections.

In the operation of  $4900 : 24 = ?$ , the number 4900 is approximated by using the multiples of 24 in the process. In this case, 240, 2400 and 4800 are approximated. 200 times 24 equals to 4800. If 4800 is subtracted from 4900, 100 is found. If the number 100 is also divided by the number 24, the result is estimated as approximately  $200 + 4 = 204$ .

7) Grouping: If the numbers in the operation are close to a certain value, the numbers are grouped according to this value and the result is estimated.

Each of the numbers  $7123 + 6997 + 7040 + 6985 + 7289$  is close to 7000. If 5 is multiplied by 7000, the result of the operation is estimated as 35000.

#### *Other Strategies*

These strategies are also used in other mathematical estimation strategies.

1) Random estimation: Pupils who make a random estimation answer by thinking about the expressions that come to mind randomly and are imagined in their minds.

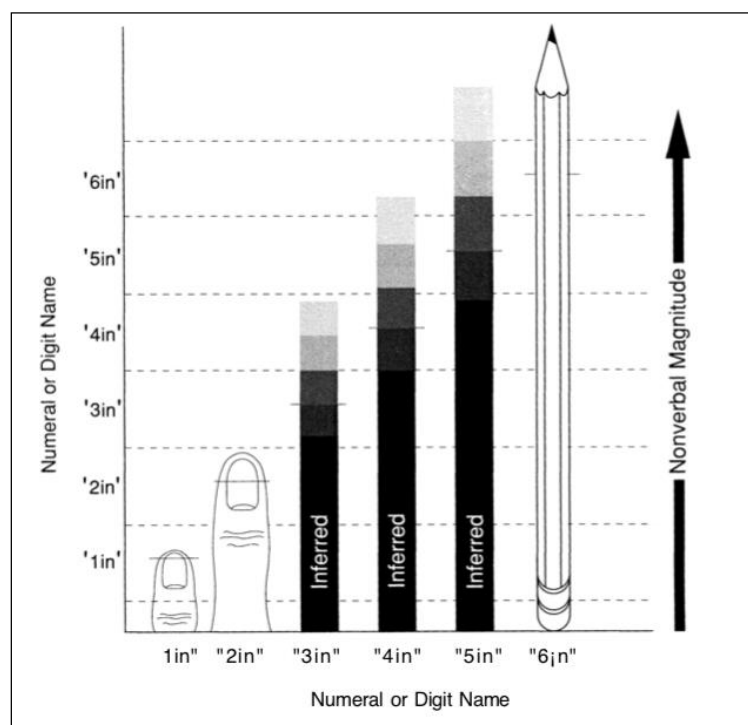
2) Based on existing knowledge and experience: It is to make estimations based on making use of pre-existing knowledge and experiences. For example, it can be performed by recalling the steps previously used to solve the operation and skipping those steps in the next operation.

A pupil who previously solved the problem of  $62 \times 55 = ?$  uses the result of that operation in order to estimate the operation of  $67 \times 50 = ?$ .

### **3. Measurement Estimation**

Measurement estimation is the approximation of the dimensions of objects without using any measurement tool. In our daily life, metres, scales, etc. measurement tools may not always be around us. Estimation options such as “How many apples should I put in the bag when I want to buy 1 kg of apples from the grocery shop?” or “How should I choose my pencil case to hold all of my pencils?” are constantly encountered in our daily lives. In this context, measurement estimation is generally defined as a type of estimation that provides estimates of length, height, weight, liquid capacity and similar samples. For example, it includes estimates such as tool or pen weight, the height of a building, the length of a rope, and the circumference of an area (Hogan & Brezinski, 2003). We use it in our daily life by estimating the size of objects without measuring. In this context, we sometimes make comparisons by taking a reference point. Joram

et al., (1998) devised a mental measurement line showing how reference points embody preverbal magnitudes by drawing on Gallistel and Gelman (1992). According to this mental measurement line, nonverbal quantities are indicated by objects and grey columns (Fig. 4). The variability in nonverbal magnitudes is represented by the variation in colour at the top of the grey columns. Written or verbal measurements (figures) are indicated by numbers in quotation marks at the bottom of the graph. The mapping from non-verbal quantities to digits shown on the left is accomplished by dividing the mental number line into segments labelled by measurement (numbers or digits). Figure 4 shows how the size of a concrete object matches numerical expressions.



**Figure 4.** Mental measurement line (Joram et al., 1998, p. 420)

In Figure 4, where the inch unit is used, a numerical expression matches the size of a concrete object, since we learn a bidirectional matching between preverbal magnitudes that represent numeracy and number words when we learn how to count. We use this matching in all areas of numerical proficiency tested verbally. It is known, however, that even though the conceptual foundations for physical measurement and measurement estimation are identical, the processes by which an estimator arrives at an estimate or builds a mental representation of a particular measurement are not the same. In this context, the person measuring with an instrument needs to know certain procedures. For example, the size to be estimated with the ruler is not aligned to be aligned (Gallistel & Gelman, 1992; Joram et al., 1998). Therefore, strategies for measurement estimation need to be well known. Strategies for measurement estimation are described below with examples.

*Using references*

Compared to pupils who do not use reference points, pupils who use reference points are known to have more accurate representations of standard units and length estimates (Joram et al., 2005). In using reference, an object, item, etc. things can be taken into account as in non-standard units of measurement. For example, tailors estimate how many meters of fabric they will use.

*Unit iteration*

It is to mentally apply repetitive units and count these units to estimate the length of the object. The ratio of unit size ought to be disaggregated to object size (Hildreth, 1983). Measuring the length of the door with repeated hand movements along the door is an example of this.

*Comparison*

This is a frequently used strategy for both length and area estimation (Satan, 2020). It is to estimate the object to be measured by comparing it with a unit or reference the measurement of which is known (Tekinkır, 2008). Their length or area is estimated according to whether one is smaller or larger than the other. An example of measurement estimation based on comparison is given below.

The villagers, who see the photos of the plots of their fields from the satellite system, want to have an idea about how many acres the fields will be before they receive the title deeds. It is known that the small plot belongs to the governor of the village and it has been determined that this place is 4000 m<sup>2</sup>. According to that, the large plot adjacent to the governor's is m<sup>2</sup>.



Source:

<https://parselsorgu.tkgm.gov.tr/#ara/idari/162497/247/5/1667600341549>

*Visualisation*

It is to estimate the object that is to be estimated by visualising it and comparing it to another object, the measurement of which is known (Siegel et al., 1982). In this strategy, which is especially used in measurement estimation, pupils made an estimation based on how long a ruler of 1 meter or 30 centimetres ought to be (Çilingir and Türnüklü, 2009).

*Estimating based on existing knowledge and experience (Prior knowledge - using information)*

It is to estimate by making use of prior knowledge and previous experiences, akin to computational estimation. For example, when parking between two vehicles, we use this type of estimation by recalling our previous parking knowledge in the process of deciding whether our vehicle will fit between two vehicles.

*Compression (Squeezing)*

It is an estimation strategy made by reducing the measurement result to a set of values (Hildreth, 1983). For example, when estimating the length of a stovepipe, it is to estimate as in more than 1 meter and less than 2 meters.

*Reaching the whole from the part*

The problem is divided into sub-problems and the answers obtained from these sub-problems are combined and the result of the whole is estimated (Aslan, 2011). For example, considering the numbers of tiles required to lay the floor of a bathroom, how many tiles are needed for all walls are estimated.

*Using subdivisions/ Fragmentation*

It involves making an estimation by decomposing or dividing the object to be measured into sub-units (Siegel et al., 1982). Unlike the part-to-whole strategy, it is used to measure objects that do not consist of parts (Uygun, 2022). For example, it is to estimate the distance between two provinces by dividing the distance between two provinces according to the distances between the districts on the road route.

*Random estimation*

It involves estimating randomly without using any logical process and strategy. For example, when estimating the length of the table, it is a random estimation to say 2 m without relying on any logic.

*Estimating by experiment*

It includes other estimation skills (Çilingir and Türnüklü, 2009).

**4. Numerosity Estimation**

How many words do you think this book you hold in your hand consists of? The first answer we give to this question is without counting the words one by one, isn't it? In our daily life, we are often faced with such questions. For example, when a teacher enters the classroom, they can estimate how many people are in the classroom without taking attendance. As can be seen,



the answers to the question of “how many” for the number of objects in any area are the main concerns of numerosity. So, how can we find the approximate value of a large group of objects without counting them one by one? In other words, how can we do the numerosity? As seen in computational and measurement estimation strategies, there can be found sub-strategies of numerosity in the literature. Crites (1992) made the most basic classification of the numerosity strategy by dividing it into three as benchmark comparison, decomposition/recomposition, and eye-ball. The numerosity strategies are described below, along with examples.

#### *Benchmark comparison*

It is an estimation by comparing the baseline measure. For example, imagine that pupils are asked a question about how many beans a jar will hold. Numerosity estimation is the pupils’ guesses that they make by comparing the popcorn kernels and bean kernels in the other jar of the same size. Thinking that the bean kernels are larger than the popcorn kernels, they estimate approximately how many beans the jar will hold. A base size comparison can also give an idea of the length of an object. It is possible to have an idea about the whole object by starting from a unit. For example, a link is approximately 1 inch long and there are 36 inches in 3 feet. In this context, the baseline measure comparison is based on the numbering of many points by visually comparing objects. Based on the initial numbering made visually, the remaining points are estimated and added to the numbered result. Below is an example where a baseline measure comparison can be used.

An approximation of the number of other books in a bookcase by counting the books on the top shelf in a bookcase. Finding the total number of books in the library by adding the number of books on the next shelf to the number of books we count first.



Source:

<https://www.evrensel.net/haber/381882/dersimde-kutuphane-ve-muze-kuruluyor>

#### *Decomposition/recomposition*

It is the estimation of the total multiplicity by making an estimation about a part or small subgroup of a group of objects in a community. Fragmentation or subgrouping ought to be intended to give an idea of the large group to be estimated. For example, to estimate how many

dots are used in the text, first estimate the number of points used in the whole text by counting the dots in a line.

#### *Eye-ball (numerical multiplicity)*

In the numerical multiplicity estimation strategy, visual scanning and heuristic perception are at the forefront. For example, the use of expressions such as “it seems” to estimate the popcorn in a jar is an example of heuristic perception. With the numerical multiplicity estimation strategy, we can make quick and accurate decisions by counting larger numerical multiplicities by grouping them. Below is an example where the numerical multiplicity estimation strategy can be used.

How many salmons are produced daily in a salmon farm? To answer the question, we first need to estimate the number of fish in a pond. By grouping the number of fish in the pond, we can make an estimate of the great multiplicity.



Source:

[https://www.ntv.com.tr/galeri/ekonomi/borcka-barajindan-dunyaya-somon,XHM\\_q6f\\_Qk6CBfjukyAVA/xgyN-RQIVk6izLf9OS60Xg](https://www.ntv.com.tr/galeri/ekonomi/borcka-barajindan-dunyaya-somon,XHM_q6f_Qk6CBfjukyAVA/xgyN-RQIVk6izLf9OS60Xg)

## 5. Conclusion

The estimation strategy is a reasoning technique that we use constantly in daily life, either consciously or unconsciously. The individual decides on their own which estimation strategy to use in an event in daily life. The estimation strategy shown in the examples given to computational, measurement, and numerosity can vary from person to person as the cognitive schemes in each individual’s mind are different. Also, in a daily life situation, more than one estimation strategy can occasionally be used. When estimating in the real sense, a rote-based approach is avoided and one draws from their own mathematical insights. In addition, there may be different estimation strategies other than the estimation strategies listed above. Uncovering these strategies in mathematics classrooms is of great importance.

Examining computational estimation as one of the estimation strategies, examples of computational estimation need not be merely computational. Numbers must have a value in daily life. Only then, the pupil will be mentally active, acknowledging the value of calculating and estimating. When examining the measurement estimation, it is understood that estimation strategies differ within themselves. For example, a baseline measure comparison can be in the



form of comparing both different objects and the units within the object itself. On the other hand, if there is a transition from non-standard measurement units to standard measurement units, pupils are supported to easily employ strategies such as unit repetition, etc. If the transition in mathematics curricula is presented as such, pupils' estimation skills can improve. Another important issue in mathematics curricula is that very little attention is given to the teaching of numerosity. In this regard, activities in which pupils can use different estimation strategies need to be included in mathematics courses. In fact, with the help of such activities, random estimators can gradually start using strategies such as use of reference points and comparison.

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## EFFECTIVE PROFESSIONAL ORIENTATION AND THE ROLE OF TEACHERS IN ITS FORMATION

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### 1. Introduction

The world of the 21st century, in its excellent and admirable global connectivity, has also uncovered problems that cannot be limited by geographical zones or border lines. The world, not only due to the pandemic, but also due to new war conflicts or the catastrophic state of the environment, has moved to the point where the primary place in the search for answers to the quality of the future is given to the sciences that were pushed to the margins in the past decades or centuries.

From the 17th century to the present day, the sciences have concentrated strongly on mastering the external nature – the industrial revolution and the scientific and technical revolution have moved human knowledge to the truly excellent and sometimes breath-taking development of electronics, Nano electronics, and information and communication technologies, the impact of which has been reflected in many areas of human efforts, including the protection and care of human health – to medicine.

In this dominance of the direction of the sciences of the whole world to control the external nature, we forgot to try to control social relations in a meaningful way, and what is completely surprising, we forgot or completely resigned to self-control, self-evaluation or what can be called simply the mental hygiene of a person.

The absurd effort to change and adapt the outside world primarily to our comfortable life received a clear answer especially in recent years: the pandemic, wars, the alarming state of the environment across the entire world (Fukuyama, 1992). Even those places where people can only get to sporadically or not at all (Antarctica, Himalayas, etc.), are destroyed and show significant signs of damage. And so every wise, rationally thinking person realizes that the solution for the future of humanity are the sciences, which give a "human" dimension to material-technical progress. Sciences that give to rapid technical and scientific progress what we can call an objective, meaningful, scientific basis.

Anthropological, psychological and pedagogical sciences are the sciences of the future, because above all, these sciences have a chance to open the door to the future in solving to solve the most current problem – the problem of man. Anthropological, psychological and pedagogical sciences, of course in cooperation and with regard to the acceleration of natural or technical sciences, can return a person to the required value hierarchy, in which all values are harmoniously connected in such a way that they act not only on the mind of a person, but also on his heart (Merton, 2000).

In the search for an answer to the question how to grasp a meaningful world of values, upbringing and education have a dominant place. Although the narrative that teachers are drawing the contours of the world 20-30 years from now with their ordinary daily work sounds very bravely, it is more than true. Parents instil should instil love in their offspring. Love creates the goodness. Teachers through their work continuously build on the foundations acquired in the family, and have a balanced effect not only on the non-cognitive, but also on the cognitive side of the pupils' personalities. And it is a meaningful balance that is a prerequisite for such a value hierarchy, which should be a sufficient guarantee or pillar of a quality future. So, how to achieve this? How to prepare future teachers to handle this difficult task?

At the beginning we will focus on the historical context. The Slovak University of Technology, where our workplace is located, which provides the training of teachers of professional technical subjects, can rely on three global priorities when referring to the phrase "technical education". The first priority is the fact that on our territory, in then Austrian monarchy, the first technical university in the world was founded in 1762, where the most recognized capacities of the world of science of the 18th century worked.

The second, no less important fact is that our native is an excellent philosopher, pedagogue, theologian, polyhistorian, whom contemporary world pedagogical science refers to as "teacher of the nations", Jan Amos Komenský. He was born in 1592 and lived his creative life in one of the most difficult centuries in Europe – the 17th century. He devoted his whole life to scientific work, he is the logical successor of F. Bacon's work. He devoted himself to permanent dynamic education as a lifelong cultivation of a person - he dealt with the idea of pansophy. The testimony of his genius is the invitations of the then monarchs across Europe - he accepted the invitation of the English king Charles I to London, Cardinal Richelieu immediately invited him to Paris. He met René Descartes in Leyden, Holland, from where he went to Sweden at the invitation of the Swedish king.

Jan Amos Komenský is the founder of modern didactics:

- ✓ Consistently revised teaching methods together with didactic principles
- ✓ Recommended defining the content of education so that it corresponds to scientific development
- ✓ Respected the entire educational curriculum and at the same time appealed to intersubject relationships
- ✓ Specially focused on the needs of language teaching and its understanding

- ✓ In didactics, he excluded discipline from the system of teaching aids for the first time, limiting it to morality and ethics
- ✓ Introduced the classic class-hour system as we know it today all over the world.

In the work *Mundus moralis*, he strongly calls for self-reflection as a basic prerequisite for a teacher – to be able to manage one's work, detect pluses and minuses, critically specify one's mistakes and overcome them. The third fact, which is related to the country of which we are the successor state – Czechoslovakia, is that it was here that the term that is known today without exception to the whole world – the term robot – was first used in the work of the writer Karel Čapek. The term is mentioned in writer's dramatic work R.U.R (Rossum's Universal Robots) presents this concept as a humanoid creature for the first time. Today, the concept of robot and words derived from it such as robotics, robotisation, or subsequently automation belong to the essential conceptual equipment not only of the world of technology and technical education, but this concept has penetrated into all areas of everyday human action and effort.

## **2. Establishment of the First Technical Academy in the World**

The need to establish a university resulted from the development of Slovakia's economy in the middle Ages, conditioned by its mineral wealth - especially gold, silver, copper and iron. Slovakia became visible as early as the 14th century, when the Kremnicka Mint – founded as early as 1328 – minted gold and later silver coins. Gold Kremnica ducats and later silver toliars were a sought-after and respected form of currency throughout Europe for several centuries. Thanks to mineral resources, Slovak mining and metallurgy in the 15th-16th centuries experienced a unique boom with a positive impact on the development of the entire spectrum of natural science disciplines such as mineralogy, geology, botany, geography, but also physics and mathematics. Unfortunately, there was no university in Slovakia at that time that could become a centre of scientific life. For this reason, many Slovak scholars and scholars could only find employment at foreign universities. For example, Ján Sambucus (1531-1584) from Trnava was one of the most important European humanists with an interest in botany and medicine. Juraj Henisch from Bardejov served as rector of the University of Augsburg, where he published the work Overview of Old and New Geography. The Slovak Jan Jesenius (1566-1621) performed the first public autopsy at Charles University in Prague, the oldest university in Central Europe, founded in 1348 by Charles IV. As rector of Charles University, he published a special analytical Latin treatise on the autopsy. Other natives of Slovakia also worked at Charles University, professors Daniel Basilius – mathematician and physicist, Peter Fradelius, who wrote a Latin treatise on plants – In Praise of Botany.

Slovak scientists sought refuge in the universities of Europe, but on the contrary, Slovakia at that time attracted many European scientists. The stimulus for European scholars was mainly developed mining, but also the abundance of hot and mineral springs in the territory of Slovakia. In the 16th century, Juraj Agricola, a German humanistic doctor and naturalist dealing with the study of mining, geology, metallurgy and mineralogy, worked in Slovakia. He is considered the founder of mineralogy as a science. He wrote the first manual of mineralogy On the nature of minerals (*De natura fossilium*, 1546) and the work Twelve books on mining (*De re metallica*



libri XII, 1556). This publication also contains important data on mining in the central Slovak mining area (Špania dolina), which was provided to him by Ján Dernschwam (1494-1567).

Slovakia was also visited at that time by the famous physician Paracelsus, who was referred to by his contemporaries as the "Luther of medicine" (Lutherus medicorum). The main goal of this Swiss doctor's work in Slovakia was the mining and processing of ores. He visited the territory of Slovakia repeatedly, for the purpose of researching the mining of precious metals and their subsequent extraction from ores, he visited mining areas in central and eastern Slovakia (Banská Bystrica, Smolník), in 1537 he was in Bratislava. The result of his research was the book *De tinctura physicomum*, where he subjected the essence of cementation to a thorough analysis. Cementation is a method of obtaining copper from the so-called cementing waters.

In view of technical progress, it was no longer possible to rely only on empirical methods of passing knowledge from generation to generation. The onset of the modern age and progress in the economy clearly specified the need for the creation of technical education. Scientific discoveries found application in the everyday reality of mining and metallurgy. Slovakia is proud of its traditions, many of which are unique in the world. In 1627, in Banská Štiavnica, the world's first mine blasting was carried out to separate rocks. Gunpowder stopped being just a tool for killing, it finally saw "peaceful" use in Europe. In the years 1720-1722, Slovakia became the first country on the European continent where atmospheric fire machines similar to Newcomen's machine, used in England in 1712, began to be used. Metallurgy and mining needed qualified experts, so technical schools were founded in Slovakia in the 17th century and in the 18th century by the logical and meaningful outcome of the economic situation. The institutionalized form of organized technical education took off vigorously at the beginning of the 18th century. As early as 1735, a mining vocational school (we would say secondary school today) was founded in Banská Štiavnica under the supervision of Samuel Mikovini. Samuel Mikovini, cartographer and mining expert of European stature, received his professional education in Germany. He first trained as an engraver in Nuremberg. Later, in the years 1721-1722, he studied mathematical sciences at the university in Altdorf, he received his cartographic and surveying education in Jena, where in 1723 he was the first Slovak to receive the title of engineer. During his not long but fruitful life, he collaborated with another important Slovak - polyhistorian and encyclopedist Matej Bel, who was called "the great ornament of Hungary" for his scientific work. Mikovini's collaboration with Matej Bel began with the development of maps and pictorial appendices to Bel's extensive work on Hungary *Hungariae antiquae et novae prodromus* (Messenger of Old and New Hungary, 1723) and culminated in the preparation of map materials for a series of monographs on Hungarian capitals *Notitia Hungariae novae historico-geographica* (Historical and geographical knowledge about contemporary Hungary, 1735), over which Emperor Charles VI himself, father of Maria Theresa, held a protective hand (Matula & Vozar, 1987) .

As a cartographer, Samuel Mikovini also dealt with theoretical mathematics – his mathematical considerations on the topic of squaring the circle, archeology and astronomy are noteworthy. In 1749, he even drew up plans for the construction of the royal palace in Buda (today's



Budapest). The versatile Samuel Mikovini developed his own cartographic method, which significantly improved the surveying cartographic procedures of the 18th century. As the manager of the mining school, he participated in decisions about the stamping of mine works, the construction of mining machines, mine warehouses, furnaces, smelters, but also water works. It was through the construction of the system of water artificial lakes that Mikovini forever entered the annals of European technical history. By building a system of water lakes – “tajchs” – Mikovini solved one of the urgent problems of mining at the time, to ensure enough water energy to drive mining and metallurgical equipment on the surface. Tajchs are still admired today for their original solution from an engineering point of view.

The traditions of Mikovini's school were continued by Queen Mária Theresia (1718-1780), who by decree of December 13, 1762, ordered the establishment of a technical college in Banská Štiavnica – the Banská academy. For the first time in the history of modern education, the teachers of the Banská Academy in Banská Štiavnica started teaching technical disciplines in a university manner. The school has become a center for the development of technology and mining science not only in Europe, but also in the world. The Mining Academy has world primacy not only in the date of establishment, but also in the selection of its students. Anyone who met the professional requirements could study at it, regardless of the student's genealogical roots. By making tuition at the academy free, the academy opened its doors to all gifted and talented students, regardless of their origin or financial background - an unprecedented fact in the 18th century. On June 13, 1763, the Department of Chemistry and Mineralogy was the first to be established at the Technical University in Banská Štiavnica. Its first professor was Mikuláš Jacquin, a native of Dutch Leyden. He started lecturing at the beginning of September 1764. The second department was established in 1765, providing teaching in the field of mechanics and hydraulics. The first professor of this department was Mikuláš Poda, a professor from Graz in Austria. In 1770, a third department was added, mining art and mining law. Christoph Traugott Delius, a German mining professor from Walhausen in Thuringia, was appointed as the first professor of this department. The developed mining industry in Banská Štiavnica and its surroundings gave the newly established university unique opportunities to perfectly connect theoretical teaching and its practical outcome.

Although our alma mater – the Slovak University of Technology is not an explicit successor of the first technical academy in the world (continuity was interrupted by political and economical conditions at the beginning of the 20th century), we proudly and respectfully adhere to this tradition within the more than 80-year history of our school we report. Individual faculties of the Slovak University of Technology in Bratislava – Faculty of Mechanical Engineering, Faculty of Materials Science and Technology, Faculty of Civil Engineering, Faculty of Architecture and Design, Faculty of Electrical Engineering and Informatics, Faculty of Information Technology, Faculty of Chemical and Food Technology – ensure the training of graduates in a wide range of technical disciplines. For 60 years (since 1963), our university has had a department that provides the so-called supplementary pedagogical education for undergraduates and graduates of our university. The goal of this workplace is to ensure adequate propaedeutic of technology in education levels ISCED 3, ISCED 4 by training qualified

teachers-technicians. Students of supplementary pedagogical studies are either graduates of technical university who return after practice and complete their education in the pedagogical-psychological-didactic field, or full-time STU students who, in addition to technical studies, have also studied supplementary pedagogical studies in the last two years. The study lasts four semesters, ends with final exams and the defence of the final thesis, and graduates receive a certificate of teacher qualification for teaching vocational subjects at the relevant technical secondary schools (ISCED 3, 4).

The subjects that our students complete are completely similar to the subjects that we can identify at any university preparing students for the future teaching profession. Pedagogy, psychology as core disciplines in the first year supplemented by the sociological and ethical basis of the teacher's work (the first two semesters of study), in the second year the core theoretical subject is didactics, supplemented by rhetoric, professional communication and a seminar on pedagogical practice (third and fourth semesters). Teacher professionalism is developed through pedagogical practice continuously and gradually in each semester of study in cooperation with training schools (Silverman, 2005). In the first semester of study, the student begins with orientational practice, which in the next semester passes into diagnostical practice. In the third, didactic-projective practice follows. The last one is integration-realisation practice, which is actually a holistic result in the final presentation of acquired teaching competencies.

### **3. Orientational Practice**

The student will be able to orientate himself in the environment of the secondary school - familiarize himself with the history of the school, the philosophy of education, the connection to professional practice, the local specifics of the environment, the application of graduates in the field, the organization of work and the school year, the structure of pedagogical staff, the school educational program, the status of professional subjects in the curriculum, their specifics and relationships to other teaching subjects, with pedagogical documentation, school plans, material equipment.

### **4. Diagnostical Practice**

The student will be able to diagnose and evaluate the teaching process in terms of:

- ✓ The quality of the teaching process, teacher competences – the teacher's readiness for the lesson, the strategies used in the teaching of professional subjects, the selection, interpretation and didactic transformation of the subject matter, presentation skills, management and organizational skills, the assessment of student performance, the creation of a positive climate and discipline in the classroom, authority, preferred approach and their relationship with pupils
- ✓ Getting to know students – their interests, knowledge level, attitudes towards learning and subjects, especially in the area of Supplementary pedagogical education student specialization, learning style, their background and the culture of the environment

- ✓ Analyses of the active involvement of students in teaching (pace and fluency, overview, management of students' study time, provision of supportive feedback, promptness when changing the exercise plan).

The output is records from the observation of lessons and an overall assessment of practice – analysis, identification of prevailing teaching strategies and their evaluation in terms of the application of didactic principles and principles, characteristics of one selected class and one selected pupil.

### **5. Didactic-Projective Practice**

The student will be able to prepare in writing for the teaching units (also for the relevant type of exercises, if the taught subject assumes this form) and demonstrate the following pedagogical skills:

- ✓ To orientate in didactically adjusted, but also unadjusted sources of knowledge – school education program, curriculum, textbooks, professional literature, Internet resources, etc.
- ✓ Carry out a didactic analysis of the curriculum of the thematic unit and the topic of the lesson
- ✓ Determine and select essential elements of the curriculum and interpret and organize them appropriately
- ✓ Formulate specific objectives of the lesson according to the selected taxonomy of objectives
- ✓ Choose suitable teaching methods and forms for the individual phases of the lesson and relevant learning activities of the pupils in view of the teaching context
- ✓ Select and prepare examples from practice, model examples, tasks, problems, case studies, formulate questions, etc.
- ✓ Based on the knowledge of the material equipment of the school, select and correctly integrate into the course of the lesson, didactic techniques and teaching aids, worksheets, tables, etc.
- ✓ Schedule the didactic cycle of the lesson
- ✓ Prepare a didactic test for a selected thematic unit with appropriate mathematical characteristics
- ✓ Create a computer presentation of the curriculum

Part of this part of the practice is also the student's assistance to the trainee teacher to the extent agreed upon.

### **6. Integration and Implementation Practice**

The student demonstrates the ability to implement the planned lessons within the taught professional subject independently and thus demonstrates the following pedagogical skills:

- ✓ Motivate and keep the student's attention
- ✓ Interpret and present the curriculum with the application of didactic principles and principles of rhetoric and communication
- ✓ Use optimal, diverse teaching methodical procedures, forms and material means
- ✓ Fluently and purposefully manage and organize own activities and the activities of the student
- ✓ Create a positive atmosphere and maintain discipline in the classroom in pedagogically legitimate, pedagogically, psychologically and didactically justified and proven ways
- ✓ Sensitively appreciate the efforts of pupils and evaluate their ongoing and final performances using optimal diagnostic, control and evaluation procedures
- ✓ Critically evaluate one's own activity and constantly improve it based on its conceptualization and feedback from the students and the trainee teacher.

The output is a written self-evaluation analysis of each lesson, a written evaluation and the final report of the trainee teacher, which are part of the pedagogical diary.

## **7. Self-Reflection**

It is not enough for the teacher to rely on the principles of general management conditioned by rational strategy and logic, the effectiveness of which shows general validity regardless of the specific context of the situation. Although these paths are explicit, and therefore definitely teachable, although they are based on the principles of logical, scientific thinking, they are insufficient equipment for a person for a common, everyday life situation that does not meet the possibilities of pre-defined qualitative and quantitative characteristics. In ordinary everyday life marked by hecticness, a person can rarely first assess the problem, then define the possible causes and then choose the appropriate way to solve the problem. His dominant task is to make quick decisions from the point of view of general or personal primary interests, and often simultaneously solve several problems at once. Such a situation requires from the individual a clear conceptualization of the solution to the problem, or problems in ways that go beyond their own prior knowledge or experience. Many times, the everyday situation demands from the teacher immediate planning with a minimum of additional information, a high-quality deduction that will allow them to act in the actual solution process, without any time loss. Linear progress in the teacher's work, as well as linear progress in the future ordinary life of his students, i.e. j. gradually moving through the problem identification, analysis and solution phase – should be the exception rather than the rule. In everyday life, problems are cumulative, interconnected and the environment is hectic, so phasing would be lengthy and counterproductive. Thus, the teacher makes decisions and follows the path of intuitive understanding of the situation with permanent feedback determined by constant reflection of his own actions in direct confrontation with the situation in the classroom. If teacher students are daily confronted with the level of such meaningful decision-making, if they perceive the

positive impact of such actions in class, they gradually seem to absorb the model of decision-making and non-violently imitate or adopt it (Sternberg, 2004).

An important role in this process is played by the so-called hidden (tacit) knowledge that refers to practical know-how and that does not have an explicit formal definition. Many psychological studies show that hidden knowledge is the category that:

- ✓ Distinguishes a beginner from an expert
- ✓ Determines the quality of immediate performance
- ✓ It is independent of the IQ level and of the cognitive and non-cognitive equipment of the personality
- ✓ Is relatively general within the field and in inter-field contexts, i.e. j. that people who have a lot of tacit knowledge about one aspect of field performance will also have a lot of tacit knowledge about other important aspects of field performance.

Thus, hidden knowledge with its meaningful application is one of the ways to achieve a high level of effective teacher influence on the student. They develop best on training activities modelled to improve performance or intensive effort with sustained motivation and sufficient resources over a long-term time horizon. If we transform the theory elaborated by Sternberg into the position of a teacher, then the professional work of teacher-experts can be classified as follows (Sternberg, 2004):

1. Experts spend much more time assessing the problem and less time solving it; for newcomers, or for beginners it is exactly the opposite.
2. Experts identify and categorize problems based on the in-depth principle, novices identify and categorize problems based on surface features.
3. Experts are able to perceive more information simultaneously.
4. Experts have excellent long-term and short-term memory for information relevant to the problem.

### **8. Cognitive Ease Versus Cognitive Effort in an Individual's Response to an Emergency Activity**

Self-reflection or self-regulation of an individual's behaviour naturally accumulates a whole constellation of thought processes in which the present and the past correct (create) the future. Self-reflection is a demanding, complex process, requiring constant energy of thought, as well as constant vigilance of the individual. Self-reflection is constant responsibility for oneself. However, carrying the burden of responsibility is extremely difficult and demanding, and like everything that is difficult, carrying the burden of responsibility must be learned. Where else but at school? With whom, if not with teachers? In self-reflection, the triggering of emergency activity at the subjective level can generally occur due to the operation of a whole spectrum of mechanisms. At a critical moment, the following stages of self-regulation of behaviour can be descriptively identified:

- a) Gradation phase
- b) Critical phase
- c) Reorganization
- d) Focal activity
- e) Latency, resting phase

#### *Gradation Phase*

The volume of incentives gradually increases, which naturally leads to the reorganization of the system into a new pattern of activity. Motives can be physical forces, impulses, motives, accumulation of causes and evidence.

#### *Critical phase*

It is precisely that moment when the system is on the border of change – "rolling over" into a new pattern of activity.

#### *Reorganization*

Reorganization is precisely the moment when the system adapts to a new pattern of activity. The trigger is usually a triggering event, which ends the previous system organization and sets the system up for a new phase. A trigger event is also referred to as a cut-off point. The event or the limit point can arise in the system itself - an internal event, or it can come from the outside – an external event. The fact that the same event, internal or external, may not have the same impact on an individual's actions is important for the awareness of the activity. The decisive factor is the mutual intersection of the critical phase and the event - that is, if the individual is not in the critical phase, the event is not, or it doesn't have to be the trigger for change.

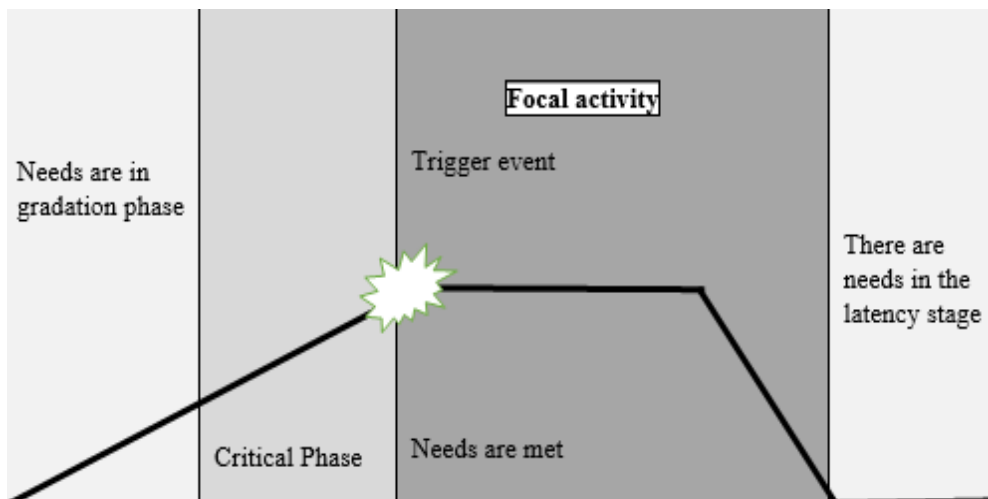
#### *Focal Activity*

This activity actually represents a fast event, which is very difficult to consciously control or slow down.

#### *Latency, Resting Phase*

The Transition Story Ends and a Period of Peace Begins.

The individual phases of self-regulation of behaviour are graphically represented below (taken from Sternberg). Although the process appears simple on the surface, in reality vast machinery of the mind is at work that allows or does not allow various triggers, threshold effects, and other phenomena to trigger emergency activity. According to renowned experts, triggering an "emergency activity" is actually a highly adaptive, efficient way of deciding when and how to behave with meaningful effect for the immediate situation. Emergency activity and its adequate launch is one of the important elements of the correct, expected solution for the situational problem.



**Figure 1.** Source: Sternberg, R. J. why Smart people do stupid things.

Scheme of self-regulation according to R. J. Sternberg

To solve immediate situations in the classroom, teachers have the latest findings of cognitive psychologists about the so-called cognitive ease, the basic parameters of which can be categorized as follows:

- ✓ Repeated experience;
- ✓ Clear display;
- ✓ Priming support;
- ✓ Positive perception.

## 9. Conclusion

It follows from the above that sentences whose structure is simple and comprehensible, which are printed or written in a clear font, with a colour accent on the most important elements of the content and are repeated at the same time, we can process fluently with adequate cognitive ease. On the contrary, when reading texts that are complicatedly formulated, printed in blurred, faded fonts, unformatted, or written without text structure, we experience the so-called cognitive effort. The author of these findings, Daniel Kahneman, together with Amos Tversky, received the Nobel Prize for pioneering work in the field of human decision-making. They described two systems in the field of decision-making in thinking and subsequent action - system 1 and system 2, with a specific analysis of the advantages or disadvantages of both systems in the decision-making process. Since each of the mentioned systems illustrates the errors in decision-making in a very meaningful way, on the basis of consistent revision of the model of System 1 and System 2, it is possible to prevent errors in decision-making through conscious training. Likewise, according to the mentioned authors, the moment of predictability can be taken into account when these systems are thoroughly respected, which is extremely important when dealing with any life situations (Kahneman, 2019).



As part of the seminar, we apply the processing of System 1 and System 2 in human decision-making to pedagogical practice, which is helpful for the quality of the immediate decision in a consistent sequence of decisions in the teacher's work. The situations modelled at the seminar allow future teachers to choose adequate emergency activity training so that it supports a highly adaptive way of decision-making:

- ✓ Choose a not precisely and clearly defined set of circumstances of the immediate situation in the classroom, so that teachers gradually get used to solving in unclear, not precisely defined situations;
- ✓ To focus on the development of those management teacher competencies that are important in the act of decision-making with the meaningful application of the theory of teacher-experts so that they choose the most appropriate decision-making strategy and continuous reflection.

I introduced our contribution with facts about the three world priorities in the education of the country from where we came. We dedicate the end of the post to the country that is the host of this conference - and not only the city of Istanbul, but the whole of Turkey. All of us who have participated in conferences several times in different parts of Turkey, we already know that it is a charming country where endless the beauty of the natural scenery reflects the goodness of the hearts of the people who live here.

A perceptive observer identified that in their respect for traditions, in their humility, in their daily human struggle, but also in their selfless generosity. Let me conclude with a quote from a Nobel Prize winner for the literature of Orhan Pamuk from the book in which he paid tribute to the city of Istanbul and the power of human love, Museum of Innocence. *“Museums are not meant to be walked through, but to be experienced. They are created from collections expressing the soul of this experience. They are no longer museums, but only corridors and halls when the collections are taken from them”* (Pamuk, 2011).

Parallel? Without good teachers, even schools they become just classrooms and corridors. Let's prepare for practice such teachers who are able to give the "soul of positive experience" to the school so that the students carry their message with them whole life! So that they try to change themselves in their professional life and at the same time look for beauty and usefulness where their duty in life directs them.

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## THE RELATIONSHIP BETWEEN POVERTY AND SOCIAL WORK

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### 1. Introduction

Poverty is one of the rare social phenomena where different disciplines work differently on the same problem. Poverty is an economic concept, because poverty is directly related to household income. Poverty is a religious concept. In Islam and Christianity, poverty, which means detachment from the blessings of the world, is praised and encouraged. When poverty is associated with malnutrition and the consequences of poverty are considered in terms of disorders on the organism, one can see how it is related to medicine. Poverty is a psychological concept. Because there are different behavioral patterns that poor people acquire. These patterns can be introversion or they can turn into outward aggressive behavior. Poverty is also closely related to urbanization and architecture. There is a concept called spatial cleavage in the literature. Poverty is a sociological concept. Because poverty is linked to another important sociological concept: inequality. Poverty is also a concept that concerns social services and social policies in terms of intervention.

Although poverty is a phenomenon seen in every society in the historical process, poverty debates in the modern sense date back to the early 17th century. The poverty-based debates initiated by 17th century thinkers within the framework of property rights contributed to the development of liberalism. While defending private property, liberal theorists also emphasized that the poor should not be excluded and that social welfare was as important as personal welfare. In the early industrialization period, while many thinkers were optimistic that poverty would decrease with advancing technology, the Poor Laws of the same period punished debtors in a cruel manner (Stedman, 2005).

The first well-established law for the poor was the Poor Law, enacted in 1601 during the reign of Elizabeth I in England. The law, also known as the Old Poor Law, was inclusive of all people who did not own property and local authorities were responsible for the law. In this context, the broad and ambiguous content of propertylessness used to define poverty was reinforced by the Speenhamland system introduced in 1795 and lasted until the 1830s. In order to find solutions to the new social problems created by the Industrial Revolution, a social service understanding based on philanthropy and volunteerism is observed until the end of the 1800s. In the late 19th century, the foundations of social work education were laid by the people who provided these social service activities. The first examples of professional social work education were in England in the 1890s, with courses offering theoretical and practical courses for volunteers, and

in continental Europe, in Germany in the same years, under the leadership of Alice Salomon, with courses with the same purpose. In 1898, with the opening of a summer school in New York and the establishment of Hull House in Chicago, led by Jane Addams, education began in this direction. In 1899, the Institute for Social Work Training, the first social work school, was opened in the Netherlands (Koşar & Tufan, 1999).

On the other hand, "settlement houses", one of the pioneering works of social work's method of working with the community and especially the technique of social action, started to be opened around the same time. The "magnanimous" daughters of the bourgeoisie opened settlement houses in poor neighborhoods and aimed to educate the poor by living there. In these houses, the first of which was opened in London under the name Toynbee Hall, the poor were instilled with awareness on issues such as "saving" and "frugality" (Zastrow, 2013). These first studies, which were the pioneers of the social work profession, brought Jane Addams the Nobel Peace Prize in 1931.

## **2. Definitions of Poverty**

Poverty is the inability of individuals to meet their physiological and social needs and to be deprived of the income, material resources and cultural resources necessary to live humanely. "The old term for poverty in our language is neediness. Poor means a person who cannot meet his/her needs" (Abay, 2004: 81). Arabic *fukara*, Ottoman Turkish *fakirs*, the word *fakir* has also passed into our language from Arabic and its etymological meaning is quite interesting. "The word *fakir* is an adjective from the root *fakr* in Arabic, which means to pierce, dig, break, and its original meaning is someone whose spine (*fakar*) is broken" (Altuntaş, 2002: 40).

### **2.1. Absolute Poverty**

Rowntree (1902) defined absolute poverty as the expenditures necessary to maintain only physical health. This definition includes food, clothing, rent, fuel and basic household needs.

### **2.2. Relative Poverty**

The most common expression used in the concept of relative poverty is the examination of the results of household income and consumption expenditures or similar surveys on income and expenditures by comparing household percentage groups with each other.

### **2.3. Poverty Line**

The poverty line is a relative line used to distinguish between the poor and the non-poor in a society.

### **2.4. Ultra Poverty**

"Ultra poverty refers to the situation of people who, despite spending all of their income, can meet only 80% of the daily calorie amount based on the absolute poverty criterion. It is argued that if the poverty of the ultra-poor lasts for more than five years, it is impossible to correct their situation and those in this category are defined as chronic poor" (Gül, 2002: 82).

### **2.5. Subclass Poverty**

These underclass or non-class groups are, according to Gans (1995): "They are elements outside the system, and the concept usually includes people who do not work, young women who have children out of wedlock and continue to receive state benefits, the homeless, beggars, alcohol or drug addicts, and street criminals. Since the concept is broad, groups such as those living in social housing, illegal immigrants, gang members, etc. are also included in the underclass. In general, this term, which lends itself to stigmatizing the poor, describes structures that have been excluded, pushed out of the system, which are now seen as dysfunctional for the system" (cited in Bauman, 1999a: 98).

### **2.6. Culture of Poverty**

The culture of poverty was coined by the anthropologist Oscar Lewis to describe the lifestyle of people living in poverty in the slums formed as a result of migration in the big cities of developing countries. According to him, locality among the poor disappears, and people with similar habits who deal with the same problems all over the world are included in this culture.

### **2.7. Urban Poverty**

It can be said that modern cities emerged after the Industrial Revolution. Industrialization in Western societies took place as a precursor to the phenomenon of urbanization. Simmel (1996), while discussing the situation of the urban individual, puts forward the concept of the metropolitan type of person. Simmel, who defines the metropolitan type of person as a person who reacts with his brain instead of his heart, attributes the dominance of rationality in the behavior of the individual to the certainty and objectivity brought to social relations by money, which is the only valid measure of value in urban life. According to Simmel, metropolitan life makes people cautious and insecure. The metropolitan man is alone in the crowd, he has no one to rely on but himself. This situation brings a kind of freedom and individualization to the individual. Urban life has transformed the struggle with nature for survival into a struggle between people. The intensification of the struggle between people naturally brings inequality and poverty.

## **3. Welfare State and Neo-Liberalism**

In the 19th century, after the market system that spread all over the world came to an end with a series of disasters such as the Great Depression, the rise of fascism and the Second World War, the welfare state was implemented despite all the impossibilities and scarce resources. In this environment of poverty and scarcity, social solidarity gained great importance. Although the term welfare state entered the English language in 1941, Germany pioneered the concept of the welfare state in the 1920s. The welfare state has three important points: providing a minimum level of income for individuals and families, reducing social risks and finally providing the best standards for all citizens (Gough, 2008).

Social welfare states can intervene in the national economy in various ways. This form of intervention varies depending on the internal structure and size of the state implementing this system. In addition to welfare states that seek market-based solutions, there are also welfare

states that can disrupt the functioning of the market with excessive interventions. In this context, "Ensuring the efficient use of resources in the country, preventing economic imbalances, increasing national income, ensuring full employment and many similar market-related tasks belong to the state. In other words, the state has the freedom to use money and credit applications, investments, full employment and social security regulations and economic planning as a policy tool" (Gökbunar & Kovancılar 1998: 252). The social welfare state has been effective in the development of a pluralistic and participatory democracy. Citizens, who gained political power over time, put pressure on governments in countries that adopted the social welfare state and ensured that public services were maximized. These demands have increased over time and reached the maximum level. In this context, one of the main criticisms of social welfare state practices is the public's desire for unlimited services. In addition, the fact that individuals who are socially guaranteed - such as unemployment benefits - do not want to work even though there is work, and that they tend to consume instead of saving, thinking that their future is guaranteed, is another glaring point. Another point that has been criticized is that aid leads to moral degradation and corruption such as bribery, corruption and torpil, especially in the political sphere.

In the welfare state model, the need for the state to play an active role in solving crises and socio-economic problems that cannot be prevented by the hidden hand of the market mechanism and to take direct responsibility for providing a more secure life for individuals has been widely recognized. In fulfilling these responsibilities, the state has not completely replaced the market, but the state has been entrusted with the responsibility of creating and directing the infrastructure necessary for the functionality of the market. Thus, while protecting the rights of the entrepreneurial class and providing the necessary conditions for production in the market, the state also developed social programs for other social groups. In this process, liberalism acquired a social dimension and the capitalist state became a 'social state'.

The capitalist state, in the form of the welfare state, served to smooth social tensions and legitimize the system. The contemporary capitalist state has had to spend more to provide the conditions necessary for the capital accumulation process to function, while at the same time reducing social tensions and keeping the legitimacy of the system out of question. This process manifested itself as the crisis of the welfare state and led to the restructuring of the capitalist state. This restructuring led to the replacement of the welfare state with an understanding similar to the minimal state of the 18th century. In this context, the minimal state is an analysis developed by neo-liberal movements. This system renders the nation-state dysfunctional and advocates the separation of economy and politics. Thus, a complete and absolute freedom of the market will realize individual freedom, which neo-liberalism regards as the most fundamental, ethical value (Şaylan, 1994).

While neo-liberal intellectual schools and think tanks strengthened the theoretical foundations of the new market-centered model of society and welfare, new right-wing governments carried these policies to the ground of implementation. By identifying with globalization and the new world order, neo-liberal policies have, on the one hand, strengthened their legitimacy at the national level with different names such as 'Reaganism', 'Thatcherism' and 'Ozalism' in country

experiences. On the other hand, they have been presented as non-alternative marketist models imposed on countries by international financial institutions as a necessary and obligatory condition of globalization in today's world economy (Gül, 2004).

The economic stabilization and structural adjustment programs imposed on developing countries by the IMF and the World Bank since the early 1980s have led to the impoverishment of hundreds of millions of people. Structural adjustment was used to collapse the economy of the former Soviet Bloc and the system of state-owned enterprises. As a result, social spending was cut and most of the gains of the welfare state were eliminated (Chossudovsky, 1999).

With the globalization process, socio-economic problems are increasing more rapidly than ever before. There is an intense debate all over the world about the future of the size and increasing cost of social welfare services. Doubts about the sustainability of social security systems, unemployment, poverty and poverty-related problems (beggars, street gangs, homeless people, rising crime rates, increased violence, commodification, organ trafficking, etc.) are on the rise and many people feel that their future well-being is becoming more uncertain. Declining protection against increasing risks and the weakening of the welfare state affect the poor the most. Many people perceive globalization as a threat, fearing job loss, diminishing economic security and increasing inequality, and distrust that in the future there will be inadequate protection against unemployment, old age and illness. In the 21st century, a new kind of Welfare State may not be as generous as before, but the victims of globalization will not be as dispossessed as in the last quarter of the 20th century (Gökbunar et al., 2008).

#### **4. Conclusion**

The necessity of the existence of the state has been questioned in relation to the current state of the world. The question of what should be the function of the state in society is one of the most debated topics in social sciences today. In relation to the social welfare state, it can be said that the Citizen has started to turn into the Customer.

Citizens expect more services from society, but they also want to have more influence over governments and pay less taxes. Governments now have to do things with better quality at less cost. In this context, associations and foundations established by volunteers to help the state are gaining importance (Gökbunar and Kovancılar, 1998). The most important reason for this is that the state cannot adequately meet all the social needs of the people. Modern developments such as globalization, technological advances, the rapid decline of agriculture, changes in the family structure, women's increasingly widespread participation in working life, and an aging population are indicators that poverty is transforming into a new form all over the world. The working poor have become an important problem not only in poor countries but also in rich countries.

Globalization has transformed the world into a big village of spending-indexed peoples, bringing with it huge capital accumulations and mass poverty. "While the number of unemployed people around the world has approached the one billion mark, millions of people are facing homelessness, malnutrition and health problems due to the cutting of social programs and funds due to the nature of structural adjustment programs, the process of reducing education



and health expenditures, in short, the liquidation of the social welfare state" (Soyak, 2004: 38). Unable to withstand global competition, nation-states are choosing the path of downsizing and abandoning social welfare state policies. Therefore, the poor seem to be left to the mercy of the market economy and non-governmental organizations in this period.

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## CULTURAL EXCHANGE CODES AND INSTITUTIONALIZATION IN SPORTS CLUBS

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### 1. Introduction

There are intense hesitations about where to start with those who see the change in the needs of society with the technological change and want to adapt it to their own institution. Unfortunately, institutions and people may not be aware of their own culture until they fall into such a situation and become aware of a new culture variable. This is one of the reasons why culture has been ignored for a long time by administrators or scientists.

In its simplest definition, culture represents the indirect assumptions that define the human condition and its relation to its environment. Just as the individuals who make up the society live by accepting the acknowledged values, beliefs and certain rules of the society, the employees in the organization live by admitting the culture of the organization and adapting to it (Kıral, 2008).

Corporate culture is an element that affects the way employees do their jobs, their approach to problems, their participation in decision-making processes, their relations with colleagues, their compliance with accepted rules and value judgments (Çelik, 2010).

Schein (1984) defines organizational culture as the way of understanding, perceiving and feeling a set of norms that have become embedded in the organization in order to achieve organizational goals. Organizational culture is a system of shared meanings that affect the working behaviors of employees in the organization (Joiner, 2001). Organizational culture consists of values, beliefs, symbols and myths that develop in the organization (Ouchi, 1980).

In summary, organizational culture consists of values, assumptions, expectations, and elements that require the organization and its members to comply. Because it is based on the attitudes of individuals within the organization, it reveals a basic characteristic of slow change. It builds on the indirect and imperceptible elements of the organization and encompasses core values and interpretations of how things are.

Organizational culture shows how some things will work in the organization, gives employees a different sense of identity belonging to the organization, and implies unwritten and unspoken behavior patterns and shapes somewhere in the organization. Cameron and Ettington (1988); O'Reilly and Chatman (1996); Schein (2010) agrees that organizational culture is a social cohesion area that brings the organization closer together. Camereon and Quinn, 2011) define

culture as what the organization values, a dominant leadership style, language, symbols, principles, routines, and success stories that make it unique. The point that should not be overlooked here is that each sub-unit includes the elements of the entire organization. Each unit is similar to a hologram in which it has the characteristics of the whole, as well as its own characteristics (Alpert and Whetten, 1985).

There are two approaches in organizational culture. The first of these is the sociological approach, which is organizations with culture, and the other is the anthropological approach known as organizations are culture. In general, many authors define organizational culture from a more sociological perspective, through values, assumptions, expectations, and issues that show the characteristics of the organization and its members.

Corporate culture defines common and accepted behaviors and relationships in the institution and facilitates finding appropriate solutions where there are no rules and issues that will motivate individuals. In addition, it guides the organization in the management of information within the institution, the transfer of values and the regulation of internal relations.

Corporate culture, within the approaches to cultural change, considers the mental structures that shape an organization, the interpersonal interactions and the link between concrete symbols or servitudes, and focuses on the current state of affairs in the organization rather than the temporary attitudes of people.

*The topics on which researchers agree on Organizational Culture are as follows:*

- ❖ Cultural organization is a social cohesion tool that connects each other.
- ❖ The concept of culture has helped them to distinguish the factors that affect the performance of their organizations positively or negatively.
- ❖ The conceptual and scientific aspect in organizational culture guides organizational managers in their efforts to increase effectiveness.
- ❖ At its most basic level, culture represents the implicit assumptions that define the human condition and its relation to its environment.

In addition to these, the elements of organizational culture include Indirect Assumptions, Conscious Contracts, Man-made and Distinctive Behaviors.

- ❖ Indirect assumptions are the human condition and its relation to the environment.
- ❖ Conscious Contracts and norms are rules and procedures that control human interaction.
- ❖ Artificial human-made objects are concrete observable subjects made by humans.
- ❖ Obvious Behaviors are explicit human behaviors. It is defined as the interactions of people. It explains how much people are encouraged to make the innovation or event happen.

Organizational culture and organizational identity are concepts that are often confused with each other. If we take a look at the difference between them briefly, we can say the following:

*In Organizational Culture;* slow change of the organization is a basic feature because culture is based on attitudes, indirect and unnoticeable elements of the organization, and includes the core values and interpretations of the organization.

*Organizational Climate;*

- consists of temporary attitudes, feelings and perceptions of people,
- It changes rapidly and dramatically,
- It is based on more specific, observable organizational characteristics,
- Expresses perspectives that often change as circumstances change and encounter information.

## **2. The Need for Organizational Culture Change**

Peter Drucker has stated that "we are in one of the periods of historical change, saying that people have difficulty in describing the world today, and that they are insufficient to explain the future by looking at the past".

Almost no one can predict what changes will occur in the next ten years, because the exponential pace of change makes it impossible to predict. In the current period of change, it is difficult for organizations and managers to maintain their current positions, making it difficult for them to foresee the future and follow a stable path.

Organizations that always try to be in a stable line are defined as organizations that do not want to change, and organizations in this position are generally seen as headstrong (Cameron & Quinn, 2011). With the rapid change of technology, unpredictable developments in the external environment make it difficult for organizations to predict the future or follow a stable path.

Together, we closely observe how the New type of Corona Virus (Covid19), which swept the world at the beginning of 2020, has changed almost every aspect of our lives economically, socially, culturally and psychologically.

Under the direct influence of Covid-19 on people's lifestyle, businesses are working on what measures they should take in order to continue their activities without interruption. Today, distance education and working, conferences via Zoom and e-mail correspondence, mobile collaboration applications via what's up are increasing. These practices make the formation and change of corporate culture felt.

Studies show that the most important reason for the disappearance of some well-established companies in the world's Fortune 500 companies in the last 10 years is considered to be the failure of initiatives for change. In this context, although the subjects such as Total Quality Management (TQM), Restructuring, Strategic Planning and Downsizing initiatives, etc., which are among the new age management approaches, are applied with great enthusiasm, since the issues in the vital culture of the organization are neglected, there are many studies done to increase organizational performance. many efforts seem to fail (Cameron and Quinn 2017).

After Covid-19, the main question to be asked is; it should be deciding how to change, rather than the decision of organizations whether to change or not. Recent studies show that the most important reason for the failures of companies is that neglected organizational culture also affects different organizational changes.

In addition, Cameron and Quinn (2017) argue that successful organizations that consistently make profits and whose financial values exceed their peers are concerned with personal beliefs, not the impact of vision and resource advantage. This belief has a strong influence on the performance and effectiveness of the organization.

Other advantages of successful organizations that attach importance to corporate culture;

- ❖ As the common meanings in the institution become clear, it reduces the uncertainties for everyone in the institution,
- ❖ As it provides information about the expectations to the employee or members, it provides the creation and maintenance of the social order.
- ❖ It ensures the uninterrupted continuity of practices by fixing the basic values and norms between generations with different age groups.
- ❖ By connecting members, it creates a shared sense of identity and commitment.
- ❖ It provides the motivation needed for the forward movement and to reach the vision and mission.

Companies that are successful with their cultural differences;

- ❖ defines expectations for its employees within the system of common meanings,
- ❖ make feel the core values and norms for harmony between different generations,
- ❖ creates a sense of collective identity and commitment for all employees, and
- ❖ undertakes the task of achieving the vision (Trice and Beyer,1993.)

In studies to increase organizational performance, the vital culture of the organization, ways of thinking, management styles, paradigms and approaches to problem solving are taken into account.

Organizational stagnation occurs in any organization where culture change slows, and this remains the usual option until culture change initiatives are implemented. Culture has effects not only on organizational effectiveness, but also on individuals' morale, productivity, health, etc. (Kozlowski, Chao, Smith, & Hedlund, 1993).

Many companies try to have timely information about opportunities and threats by constantly monitoring the developments in the external environment with their strategic management practices. The main reason for this effort is to transfer the changes in the external environment to its own system in a timely manner and to minimize corporate risks. In this process of change, the institutional culture should not be neglected.

In summary, in today's conditions where the technological ecosystem is constantly changing, it is necessary to consider the fact that the culture also changes and the change depends on the individual.

In organizational change initiatives; It should be considered that TQM, Downsizing, Restructuring, and Strategic Planning are not sufficient for change, and it is necessary to integrate them with approaches to change the culture of the organization.

In order to increase the organizational performance of sports organizations, it is necessary to look closely at the concepts that have a significant impact on cultural change.

### **3. Approaches to Organizational Culture**

There are three approaches that accept organizational culture as a variable related to defining and evaluating organizational culture, Comparative Management, Contingency and Culture as the Organization itself.

#### *Organizational Culture in Comparative Management Approach:*

This approach sees the organization's culture, which affects its basic attitudes and beliefs and value judgments, as a variable outside the organization. This approach also examines the similarities and contradictions in the attitudes and behaviors of people from different cultures, such as managers, middle-level employees, etc., within the relationship between culture and organizational structure.

#### *Organizational Culture in Contingency Approach:*

In this approach, it is accepted that organizational culture consists of beliefs and value judgments developed within the organization.

In the two approaches above, organizational culture is considered as a phenomenon that takes shape outside of itself but according to the external environment in which it is in contact and the characteristics and relations that emerge in its own practices.

#### *Culture The Organization Itself Approach:*

According to this approach, which is influenced by anthropology, culture is considered as the organization itself and is examined mostly with symbolic concepts and intellectual data.

As a result, within the framework of these approaches, the following organizational culture models were created and examined by scientists:

- ❖ Parsons Model
- ❖ B. Schein Model
- ❖ Kilmann Model
- ❖ Quinn and Cameron Model
- ❖ Byars Model
- ❖ Deal and Kennedy Model



- ❖ Miles and Snow Model
- ❖ Ouchi's Model of "Z" Culture
- ❖ Peters and Waterman's Excellence model

I think the Quinn and Cameron model is useful. In summary, we can say the following about this model. The Cameron and Quinn model investigates the culture that develops within the organization and its effect on organizational performance. In their study, the researchers examined the relationship between organizational success and culture with a model they called "Competitive Values". This model focuses on the empirical analysis of individuals' value judgments for organizational effectiveness.

Organizational Culture Evaluation Scale (OCA) is the most frequently used instrument-scale in the world to evaluate organizational culture. This scale is based on the Competitive Values Model. This scale can be used in institutions that want to know their own culture. This cultural definition can be applied to a small unit as well as focusing on the entire institution.

Organizational culture evaluation scale consists of 6 dimensions that represent the essence of culture and include the culture that the organization wishes to have in the present and in the future.

*These dimensions are;*

- ❖ The dominant characters and the basic assumptions that define the organizational bond,
- ❖ Leadership, interaction patterns for employee management,
- ❖ It expresses the direction of the organization with its strategic importance and success criteria.

#### **4. Cultural Codes and Their Contents in Sports Clubs**

Whether sports clubs are organized as a company or as a non-governmental organization, the cultural codes and contents that are considered necessary for the formation of corporate culture are as follows:

*Corporate purposes;*

- ❖ Adhering to the slogan 'Our children are our future', in an organization that considers raising athletes as the most important occupation,
- ❖ To be a football social enterprise that applies an economic model to ensure its sustainability,
- ❖ To be an exemplary football club with a high brand value that trains professional football players,
- ❖ Contributing to the children's being sporty individuals and preparing those who are inclined to play football for the football profession,
- ❖ Raising good individuals, exemplary citizens and qualified football players with an understanding of social responsibility,

- ❖ To implement a professional football player training program with numerical data in transparency,
- ❖ To make it clear that the main purpose of the club is to raise Professional football players.

*Perspective on business life;*

- ❖ Demonstrate participatory leadership in determining strategic direction,
- ❖ Taking calculated risks with steps and actions that will make a difference,
- ❖ Achieving sportive success with a work effort that is assertive in the competition and will end with a trophy,
- ❖ To enable employees to participate in decision processes,
- ❖ Focusing on innovation and change rather than traditional values,
- ❖ Giving importance to institutional memory and stability, (Do what you write, write what you do.)
- ❖ To have people and regulations that have determined the working system and can make objective evaluation / measurement and evaluation,
- ❖ To include strategic management practices,
- ❖ Continuing to work within the values of the club, regardless of the result, without compromising,
- ❖ Sharing up-to-date information that will facilitate the development towards a learning organization and applying it to business processes,
- ❖ Based on ethical values, quality service, trust and honesty in teamwork,
- ❖ To use continuous learning-development (TQM), process renewal, benchmarking and innovation management.

*Basic values;*

- ❖ Emphasizing quality,
- ❖ To keep up to date,
- ❖ Establishing and maintaining trust,
- ❖ To act in professionalism,
- ❖ Giving importance to impartiality,
- ❖ Acting in transparency,
- ❖ To protect the confidentiality of personal data,
- ❖ To be a willing participant in the activities,
- ❖ Being accountable in matters within its responsibility,
- ❖ Being accessible.

*Institution-specific values;*

- ❖ To create a management approach that puts people in the center,
- ❖ To be inclusive and have equal opportunity,
- ❖ To use club resources efficiently,
- ❖ To create a strong communication environment,
- ❖ Not to engage in a discourse, attitude or action against gender inequality, (Koç,2019)
- ❖ To behave in a gentlemanly manner,
- ❖ Having a sense of teamwork,
- ❖ Giving importance to unifying factors,
- ❖ Believing in a fair competition environment,
- ❖ Being managed professionally,
- ❖ Being foresighted and determined and able to take risks,
- ❖ Having the passion to achieve the most difficult,
- ❖ Working with trust, humility and honesty,
- ❖ Giving importance to learning, sharing and teaching.

*Beliefs;*

We work together, develop together, compete together, succeed together, reach the top together.

*Behaviours;*

- ❖ To stay away from grudge, hatred, violence and discriminatory attitude,
- ❖ Desiring to live in a profanity-free status environment,
- ❖ Contributing to increasing the presence of women and girls as role models and spokespersons,
- ❖ Belief in success and high mental endurance,
- ❖ Honest, determined, brave, altruistic, self-confident,

*Understanding and Rules;*

- ❖ Being committed to the establishment goals and common values of the company,
- ❖ To work to develop and update human resources,
- ❖ To identify potential administrative and technical staff in advance, to monitor their work, to support them with the necessary training and development programs and to ensure that they are trained to the management levels of the future,
- ❖ Turning to internal resources and making efforts to develop them,

- ❖ To determine the competency criteria for the duty areas in the institution, to ensure that the employees reach these competencies with their development plans.
- ❖ To determine wage policies according to position and competency criteria,
- ❖ To measure performance by creating clear and understandable measurement and evaluation systems,
- ❖ Designing the stadium, halls and facilities in accordance with contemporary dimensions,
- ❖ Involving employees in decision processes,
- ❖ Defining the unique story of the club brand,
- ❖ To act with team spirit as work teams in each unit,
- ❖ To be aware of the corporate culture and to contribute to its development.

### *Symbols;*

- ❖ To protect the club's crest, its founding date and the meaning of its colors,
- ❖ For example;
  - Red color: From the blood of the martyrs and veterans of the War of Independence,
  - Dark blue color: it takes from steel to represent hardness, durability and strength.

### *Corporate Principles;*

- ❖ Giving importance to institutionalization,
- ❖ Using the process approach within the system approach in management, giving importance to continuous improvement,
- ❖ Giving importance to gender equality, contributing to women's taking more roles as athletes and fans in sports,
- ❖ To use a fact-based scientific approach in decision making,
- ❖ Considering the needs and expectations of the fans, who are the most important stakeholders,
- ❖ Developing good relations with the sports press,
- ❖ To provide sustainable sportive success with controlled growth.

### *Institutional competency criteria;*

- ❖ To have up-to-date information,
- ❖ activating values,
- ❖ Having the ability to use technology,
- ❖ Acting according to values and attitudes,
- ❖ Being in observable behavior,

- ❖ Reaching superior performance.

*Personality of Personnel, Values, Attitudes;*

- ❖ Foresight, determination and taking risks,
- ❖ Having the passion to achieve the most difficult,
- ❖ Working with trust, humility and honesty,
- ❖ To include rest, learning, sharing and teaching,

*Distinctive Competition;*

- ❖ To be in technical skill proficiency, running and playing at high tempo in every match,
- ❖ To have developed self-discipline,
- ❖ Belief in Success,
- ❖ To have high mental resilience,
- ❖ Honest, Determined, Courageous, Altruistic, Confident
- ❖ Warrior Spirit-Having the ability to fight strength and stubbornness,
- ❖ Having athletes with high physical competence and technical standards.

### **5. Contribution of Institutionalization to Cultural Change**

Sports clubs operating in a globalizing world and an intensely competitive industry must have a flexible organizational structure that will embrace change in order to adapt to rapidly changing environmental conditions.

In recent years, sports organizations have started to express that they need to have good governance patterns in order to ensure their continuity in sectoral conditions, to grow and develop and to have a strong capital structure.

For the sustainability of the capital structure, it has become important to reach a low-cost capital source. The transparency and accountability features of institutions have become the most important criterion for accessing cheap capital.

In addition, sports clubs try to attach importance to strategic management practices, a correct risk and crisis management, and to establish a control mechanism in order to gain competitive advantage and adapt to change. Adaptation to change is much easier in a structure that tries to implement institutionalization criteria. In strategic management, internal and external factors are analyzed first and then long-term goals are clearly determined. Strategic management is a long-term approach, it has dynamism and continuity.

Changes in any step of strategic management (technological change in the external environment, change in human needs, etc.) require changes in the rest of the model. While managing this change, it is important to take calculated risks and to apply process management by getting feedback from the system thanks to the established audit system.

In order to achieve institutional success in sports clubs, they need to initiate and manage cultural change in their own institutions on time as part of the change. If professional sports clubs take important steps towards institutionalization in order to ensure continuity, it will be a development that will provide the cultural change they need to make on time. It has become important for sports organizations to develop their legal practices at contemporary scales and to have reliable financial reports in order to reach low-cost capital resources. It is an expected situation that the top management practices in sports clubs should be in a solid, transparent and fair position.

Institutionalization manifests itself as a social entity that gains importance with the influence of the environment. Regularly repetitive movements, systems that are social, controlled, and supported by reward and authority can be expressed as institutionalized (Minareci, 2007).

As a result, a sports organization operating in an institutional model should manage its relations with other institutions and organizations according to certain principles and rules, and its business relations with shareholders, board members, managers and employees should be arranged according to international norms.

In addition, modern management practices should be seen as contemporary practices that contribute to cultural change. It is seen that some of the following features in the modern management style are directly related to the culture.

*These are:*

- ❖ Strategic Direction Determination: Participatory Leadership,
- ❖ Approach to Corporate Culture and Values: Being competitive,
- ❖ Control and Accountability Approach: Result-oriented work,
- ❖ Talent Development: Process-oriented and bringing the best to the institution,
- ❖ Customer and Channel relations: Competition-oriented approach,

The inclusion of the above-mentioned issues in the management culture of an organization will be possible with the understanding of institutionalization. The following topics, which are included in the corporate governance principles, contribute to cultural change.

*Corporate Governance has four principles as transparency, accountability, responsibility and justice (Uyar, 2004):*

- ❖ *The principle of transparency:* It is the disclosure of sufficient and accurate information to the public, especially about the financial situation of the organization, management and shareholders.
- ❖ *The principle of accountability:* It is a clear definition of the ways of doing business in the organization in accordance with certain rules and responsibilities.
- ❖ *Principle of Responsibility:* It is to ensure that the activities of the organization comply with all kinds of legal regulations, social and moral values.

- ❖ *The principle of fairness:* The protection of all shareholder rights and the enforceability of contracts with suppliers.

*In summary; to be institutionalized;*

- ❖ the transformation of the organization into a certain life form with the rules it applies in a constant motion,
- ❖ the organization has a distinctive identity,
- ❖ highlighting its corporate identity rather than individuals, and
- ❖ Employees should be integrated with the organization.

Institutionalization is a process that must be managed in a planned way. In this process, organizational culture, strategies and interactions with internal and external stakeholders should be considered together.

*Institutionalization enables and sustains optimal governance practices. The sign of institutionalization includes:*

- ❖ All activities within the organization are done by procedures (who will do what, for what purpose, when, how and with whom).
- ❖ Information flow at all levels is uninterrupted for the continuation of organizational performance.
- ❖ There is harmony in the foreseen vision, mission, goals and strategies.
- ❖ All employees are included in decisions.
- ❖ Institutional success criteria are clearly explained.

Institutionalized structures have an effective communication environment. People position themselves professionally within this structure. Transparency allows different ideas to be shared easily. Although the institution puts people in the center, people always put the institution forward. Among the priorities of the institution, the development of people comes to the fore and people are invested. Because human development is considered as the development of the institution. Rewarding mechanisms are used to increase motivation. Management and employees see themselves as part of the same team and the culture of the institution strengthens this.

Authorities and responsibilities are equal and everyone takes responsibility for the work they do. Conflicts in task areas do not turn into conflicts, they are easily resolved. Corporate governance principles develop more easily in such a unique structure.

*For sustainability;*

- ❖ Crisis and risks are managed in a prudent, fair and value-creating manner.
- ❖ Inclusivity leverages strategic perspectives.



- ❖ For the right decisions, all components of the subject are analyzed and reasoned correctly within the scientific mindset.
- ❖ Auditing, which is the most important part of management functions, is never neglected.

It is understood that there is a strong correlation between institutionalization and current corporate culture. In institutionalized structures, the organizational culture has the flexibility to move from the current situation to the desired situation for the continuity of the organization, and the leaders who will direct the change take responsibility and manage the process. Although there are some difficulties in process management, there is not much resistance to change.

Sports Organization managers need to have information about the shared perspectives, values, moments, attitudes and meanings within the issues that will provide their organization with a competitive advantage. These concepts make themselves felt in a systematic structure.

*Implementing process management in a systematic structure provides the following benefits:*

- ❖ The business has rules, standards and procedures independent of individuals.
- ❖ Systems that monitor changing environmental conditions are installed.
- ❖ An organizational structure suitable for developments is formed.
- ❖ The methods and methods of doing business become organizational culture, and thus a different and distinctive identity emerges from other businesses.
- ❖ Contributes to the creation of an efficient business environment by making the business a system.

As a result, in the periods of social change, institutional culture change is considered important as an issue that should not be neglected. In order to facilitate this change, first trying to institutionalize in sports organizational structures and maturing modern management styles will also be the trigger of cultural change.

It is thought that the Competitive Values Model scale determined by Cameron and Quinn will be an appropriate method to determine the current and targeted corporate culture typology.

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# INSTRUMENTS AND TECHNOLOGIES FOR THE MEASUREMENT OF THE EFFICIENCY OF VISUAL-SPATIAL PERCEPTION IN SOCCER

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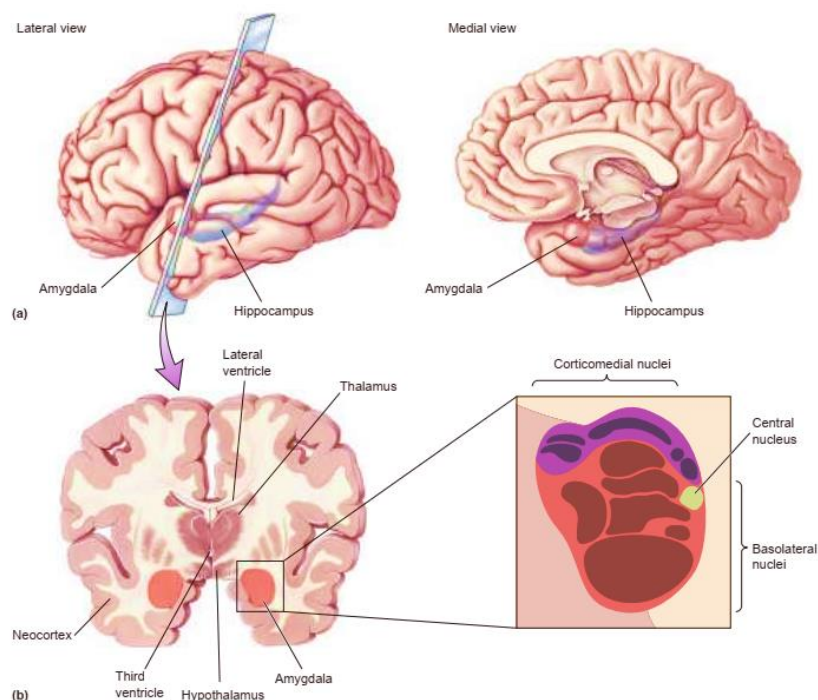
## 1. Introduction

The present comprehensive chapter is based on our reading and analysis of the performance of experts and academics in the field of sports sciences (Wang et al., 2019), cognitive psychology (Antonenko et al., 2010), neuropsychology (Kalbfleisch & Gillmarten, 2013) and physiological physiology (Landers, 1985), though tens of works and according to the restrictions and mechanisms imposed by the specialization in various fields of sports sciences. We shed light on the role of experts and specialists, as well as tools And measurement technologies that have known an accelerated development in the field of elite sports training, cognitive learning (Chikha et al., 2021) and sports psychological measurement in particular. The chapter tackles also a set of theories adopted by researchers, and modern techniques related to other sciences such as neuroscience, computer science, photography, medicine and radiology science. A particular attention is given to the role of these methods, technologies and measurements in addressing the outstanding questions in this field. The impact of the absence of technological tools in these measurements has been demonstrated, conducting to asking new questions and reformulating old questions, and leading to the development of new methods to explore issues related to mental training, especially the cognitive aspect of the athlete's performance (Park et al., 2015).

The researchers used modern technologies aiming to carry out deep and specialized measurements for the mental performance (Lau-Zhu et al., 2019) of the athlete in various individual and collective disciplines. This chapter considers the instruments and technologies used in measuring the efficiency of visual-spatial perception in soccer, such as the electroencephalography of the brain (EEG) (Antonenko et al., 2010; Biasiucci et al., 2019; Kalbfleisch & Gillmarten, 2013; Park et al., 2015; Wang et al., 2015, 2019) and multimedia (Ben Mahfoudh & Zoudji, 2022; Chikha et al., 2021; Dehn et al., 2020; Khacharem et al., 2013). The definitions, methods, importance, and purposes related to these tools are discussed in the present chapter, based on the most important scientific studies that used these tools in the field of our research. The chapter highlights how these instruments and tools are employed by the researchers in their research designs as well as their contribution to the improvement of the quality and credibility of research in this field.

## 2. Main Instruments and Technologies Used in Measuring the Cognitive Aspects in Soccer

Affective and cognitive neuroscience, contrary to the levels of other mental process analysis (cellular and behavioral neuroscience), seeks to understand the mechanisms responsible for higher levels of activity, such as attention, executive functions, and language (BEAR et al., 2016). In this way, stimulating the brain or neurological imaging measurements makes it possible to see the brain in the event of work and understanding the evaluation of topical activation and metaphysical activity of brain structures. The cerebral cortex, the amygdala illustrated in Figure 1, is shown to perform a primary role in the processing of memory and decision making (Amunts et al., 2005). The visual-spatial perception is based on this type of mental processes.



**Figure 1.** A cross section of the amygdala. (a) Lateral and medial views of the temporal lobe, showing the location of the amygdala in relation to the hippocampus. (b) The brain is sectioned coronally to show the amygdala in cross section. The basolateral nuclei (surrounded by red) receive visual, auditory, gustatory, and tactile afferents. The corticomедial nuclei (surrounded by purple) receive olfactory afferents (BEAR et al., 2016).

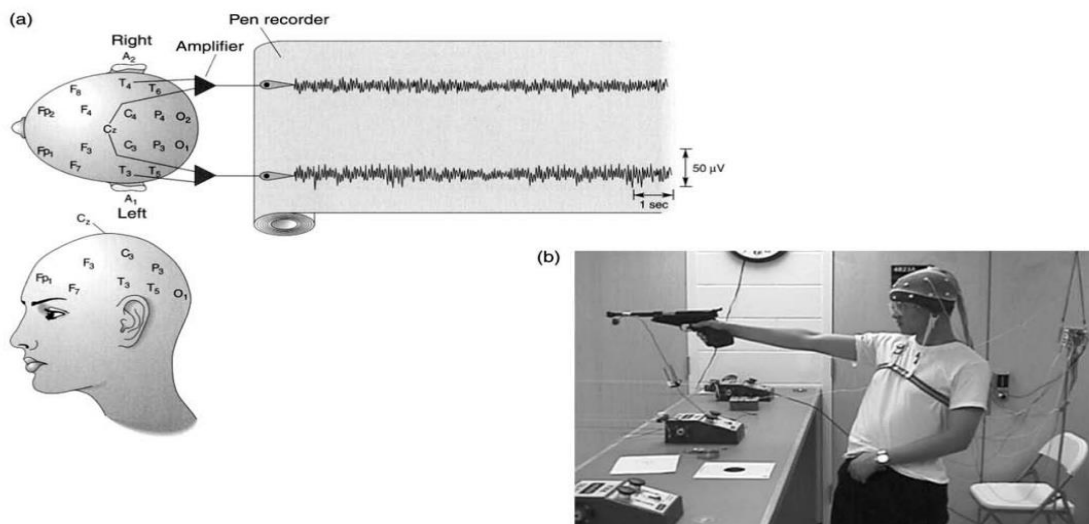
These measurements allow the researcher in the sports field to discover the changes in the cognitive and emotional functions, resulting from practicing sports activity or exposure to psychological pressure, as these changes are not visible and cannot appear through observation of behavior, or traditional tools (form, questionnaire, and simple observation). The brain processes involved in cognition and emotion can be detected with a high degree of accuracy using electrophysiological techniques and neuroimaging.

The accuracy of time indicates the sensitivity of the measurement to discover changes in brain activity as a time function and is very accurate in electroencephalography (EEG) and Magnetoencephalography (MEG). The spatial accuracy also indicates the ability to discover structures and processes in the brain, which is a feature of magnetic resonance imaging (MRI), functional magnetic resonance imaging (fMRI), positron emission tomography (PET) scanning, computed tomography (CT) scanning.

Although there are many tools that allow the brain to display during work, the EEG has an advantage over all other technologies where the researcher enables the measurement in the natural position to perform sports activity. For instance, and unlike the MRI where the device does not allow any movement to approach the targeted area and the considered position for the athlete undergoing the test, EEG allows the analysis while tasks are performed under the real-world conditions or virtual reality environments.

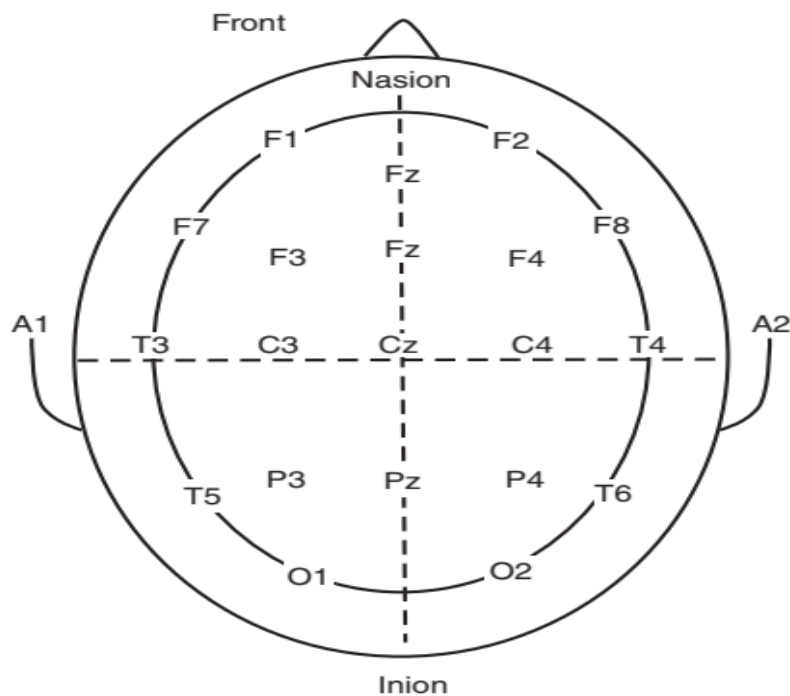
### 3. The Electroencephalography EEG

The electrical schemes of the brain represent a time series of electrical activity registered from the brain by placing electrical electrodes in certain locations on the scalp. Figure 2 shows the uniform EEG registration sites (A) and is monitored for EEG during the goal period that requires attention (B). The standard electronic mode system determines the locations of the poles based on the anatomical monuments on the head, which are indicated by the international system 10-20, as indicated on Figure 3, allowing the results to be compared for different individuals submitted to tests (H. Klem et al., 1999).



**Figure 2.** (a) Registration EEG, (b) The archer is monitored for EEG and eye movements during the fixed correction period.



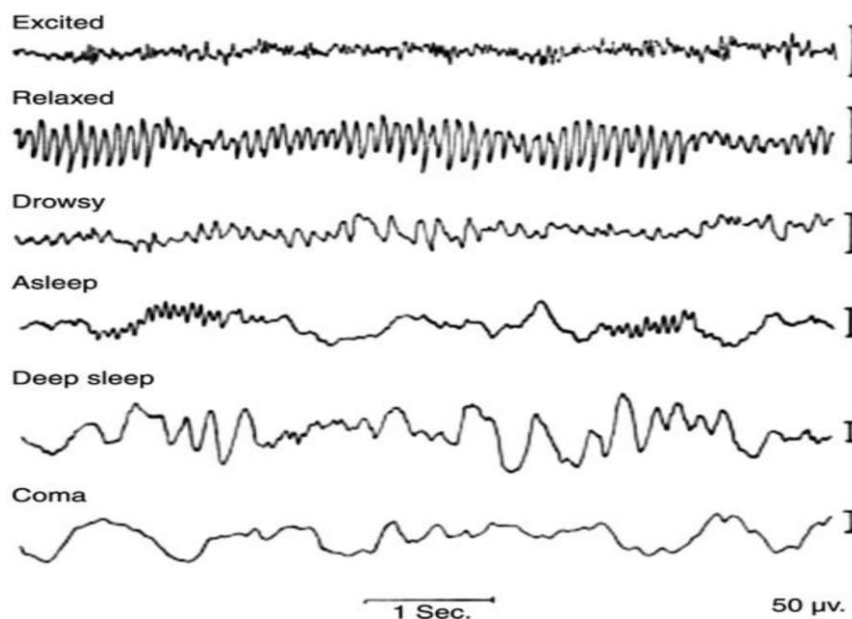


**Figure 3.** International System 10-20 to set the standard EEG sensor on the head, allowing to obtain differential amplification and the time chain caused by volatile voltage. The designation depends on the fact that the places of the electrode depend on fixed levels (10 % and 20 %) of the distance between the standard landmarks, such as nasion (nose bridge) and inion (occipital bone bone). The newest recording montage contains up to 256 sensors to localize the source or to solve the reverse problem.

EEG sensor uses wires fed from pairs of electrodes to loudspeakers, and reveals the transient or volatile assembly of the exciting and installed potential (currents) of tens of thousands of neurons, perhaps the glial cells located below the surface of the scalp inside the cortex, which generate electric charge or effort. The captured EEG sensors appears in the arrangement of part of a million voltage, or Micro Volt ( $\mu\text{V}$ ).

Samples are taken from the continuous transnational capabilities or analog signals, changing in size over time, converting them into digital values by analog to digital transformer (AD), and amplifying them from 20 to 50 thousand times, although amplification can be much lower using high accuracy AD transformers, due to their ability to distinguish between very small increases in the voltage. The current is then subject to differential amplification. Differential amplification is a process through which the electrical scheme of the brain is actually produced by creating a score of the difference in the voltage between the registration sites and the reference site that is usually placed in a non-brain area, such as earlobe measuring or tip of the nose. The differential amplification process allows the rejection of any common signals between the two sites, which is believed to be not brain in the first place, so that the amplified temporal chain reflects the electrical activity of the brain. EEG record is a two-dimensional

time series of voltage fluctuations (see Pan A, Figure 2) characterized by capacity and frequency. The frequency or spectrum range extends from 1 to about 50 rpm (Hz), with higher frequencies indicating greater activation. In essence, the raw EEG signal consists of a mixture of frequencies in the spectrum. It can decompose its basic components or pocket-frequency components to determine the activity degree. The complex record decomposition or EEG wave is called a period of time or a specific era of spectral analysis and is accomplished sporty by the fast Fourier transform (FFT). In this regard, low frequencies, as high-capacity Delta (i.e., from 1 to 3 Hz), Witta (i.e., 4 to 7 Hz), and alpha domains (i.e. from 8 to 13 Hz), indicate the relaxation of the situation, while the higher frequencies, such as low-capacity beta ranges (I.e. from 13 to 30 Hz) and Gama ranges (i.e. from 36 to 44 Hz) indicates topical activation (Figure 4).



**Figure 4.** The electrical scheme of the brain and associated arguments. The temporal series raised mainly consists of beta and gamma frequencies; The comfortable time series consists mainly of alpha frequencies; While the nasal time chain consists greatly from the frequencies of the Delta and Theta.

Topical activation results from simultaneous activity top capacity and is likely to be the consequence of similar neurological states in the brain's interest in the ROI. Regarding alpha strength, a similar case of nerve gatherings is likely to occur during the relaxation state, which leads to the collection of post-suspicious capabilities (and alpha coincides with the similarity of neurological conditions (for example, similar to members of the choir singing in complete harmony). On the contrary, a non-similar condition of nerve gatherings is likely to occur during the active participation in the task, which leads to differential customization of neurons, lack of synchronization or reduction of the strength of alpha or its capacity. The advantage of the electrical scheme is that it does not only capture rapidly changed events, but also can be used to discover the timing of communication between the different cortical areas by analyzing the

cohesion. It is assumed that the similarity in the EEG spectral content registered in different locations (i.e., high cohesion) indicates the cortical contact. EEG and Magnetoencephalography (MEG) can only be used to evaluate the timing or sequence of the alum's permanent network models. However, one of the main restrictions on the electrical plan is the problem of volumetric connection, or the spread of the electrical charge throughout the fluid of the brain so that stimulation, emotion and psychological physiology (albeit with low effect are captured by sensors. Beyond or at the top of tissue. For this reason, it is said that the brain electrolyte diagram is relatively weak in spatial accuracy compared to nervous imaging techniques such as functional magnetic resonance imaging and PET. However, both EEG and MEG are more performant than all the other nervous imaging techniques in terms of time accuracy.

Modern developments in EEG technology improved spatial accuracy using dense electrodes recordings that include up to 250 registration sites. The poles or dense sensors preserves allow the reversal of the reverse solution, i.e. estimating the site of the responsible or possible brain sources that are likely to be a candidate to determine the electrocardiogram registered on the surface. Records of these dense matrices can also be obtained with structural magnetic resonance of the electrical planning of the brain registered on the surface. In this way, the dense electrodes of the EEG registration allow the spatial survey of the cortical sources while taking advantage, at the same time, of the high time accuracy. In addition, EEG is the only method that allows the test of the studied participants in unrestricted settings and even in natural environments through the use of mobile registration systems or larger systems used along with virtual reality settings. All other nervous imaging techniques require the participant's reservation in the study so that the movement should be reduced while lying in a closed environment. Movement should also be reduced to record the electrical scheme of the brain free of confusion, but restrictions are dramatically reduced for all other technologies. In terms of cost, EEG is the most efficient technique in terms of saving time, effort and money as compared to other technologies.

Several studies in sports training have relied on EEG as a measurement tool. One of the most early studies in this field is a study of Landers (Landers, 1985), which valued the registration of EEG activity in four regions (T3, T4, O1, and O2, All Referenced to CZ) in the targeted period of time. The sample consisted of 15 high level shooters, in which the researcher relied on the comparison between the registration of EEG in the case of relaxation and the registration of EEG in the event of competition. The study concluded that the superior performance of the athlete is linked to mental relaxation, this study considered one of the most important problems presented in sports psychology, relying on the theoretical background of nervous cognitive psychology, aiming to avoid the athlete's exaggerated critical thinking and its impact on the high performance.

The study of (Konttinen & Lyytinen, 1993) is also one of the most important studies in this field, as slow electrical brain waves transformations were recorded before operating the front and side areas (C3, C4) and occipital, in addition to the heart rate (HR) and breathing, during the shootings of three archers. The study concerned the national elite team and 3 inexperienced adults. The average data from the pre-operation period reached 7.5 seconds 300 accounts per

second separately for three different test sessions. The heart rate slows down before starting with a peak at the launch point. The typical breathing pattern consists of self-confinement with a slow exhalation that precedes the pressure of the trigger. An increasingly erect negative displacement is found between the active electric electrodes and the reference of the masts before pressing the trigger. In the sniper's collection, the slow negative displacement was significantly greater on the front for less successful shots compared to the highest bullets.

One of the recent reviews (Wang et al., 2019) presented an interesting overview about the potential applications of dry EEG systems to understand the brain-behavior relationship in sports, invoking dry electrodes (Mullen et al., 2015), neural dynamics (Moreau & Chou, 2019), sports expertise (Wang & Tu, 2017), sports neuroscience (Thompson et al., 2008), and mobile EEG system (Lau-Zhu et al., 2019). The study hastaken these behavioral findings to highlight the relationship between context-general cognition and sports.

#### **4. The Multimedia**

Keeping pace with technological developments and the huge amount of information imposed on sports training in general and football in particular, information revolution has been integrated. This integration is carried out by adapting and applying various sciences such as computer science (kraibaa & Mansor, 2017), physiological psychology with science in sports and methods of measurement and evaluation. This prompted many specialists and researchers in the field of football to use advanced and modern technological devices to carry out tasks that contribute to increasing the effectiveness of sports training, particularly through accurate measurement.

Multimedia is one of the latest and most prominent technological means for learning and measuring in field of mental training. It is considered a form of communication, used in almost all fields, especially educational and mental training. It uses a combination of various content forms such as text, audio, images, animations, or 2D & 3D videos into a single interactive presentation. Multimedia can be recorded for playback on computers, laptops, smartphones, and other digital devices.

Multimedia is an easy-to-use method used to present a huge and complex amount of written, audio and visual information in a simplified and synchronized manner, as this was not possible several years ago. This would facilitate the educational process for both the teachers and learners, and facilitate the work in various fields of research, such as in the field of mental training in soccer, by giving them the ability to control all variables easily and smoothly.

Many studies concerned with mental training in football have relied on multimedia as an effective teaching and measurement method at the same time (Ben Mahfoudh & Zoudji, 2020, 2022; Chikha et al., 2021), and this made it an indispensable tool in the various stages of the soccer training process. In this section, we will discuss multimedia, its components, importance, and the most important studies that used multimedia as a measurement method.

One of the most recent studies is that of Ben Mahfoudh and Zoudji (Ben Mahfoudh & Zoudji, 2022). This study investigates the effect of visual-spatial abilities (VSA) and the level of

expertise on memorizing an animated soccer scene by using computer programs based on multimedia as a learning and measuring tool. Two computerized tests were created and displayed on a TOSHIBA L755-1GL laptop with a 15.6-inch screen. The control test contained six tasks to measure subjects' VSA, and the main test consisted in memorizing an animated soccer scene and reproducing it on a printed paper. The tasks were created using the Unreal Engine® software of the American Epic Games studio written in C++. For static VSA, three tasks were designed based on the taxonomy of (Linn & Petersen, 1985). The participants (N = 96) first performed a control test to assess their level of VSA, followed by the main test which consisted of recalling and reconstructing a displayed scene (figure 5). Results indicated a main effect of the level of expertise and the level of VSA on memorization performance. A significant interaction between these two factors was also found. Findings suggest that both VSA and the level of expertise must be considered to optimize the memorization of dynamic visualizations in team sports.

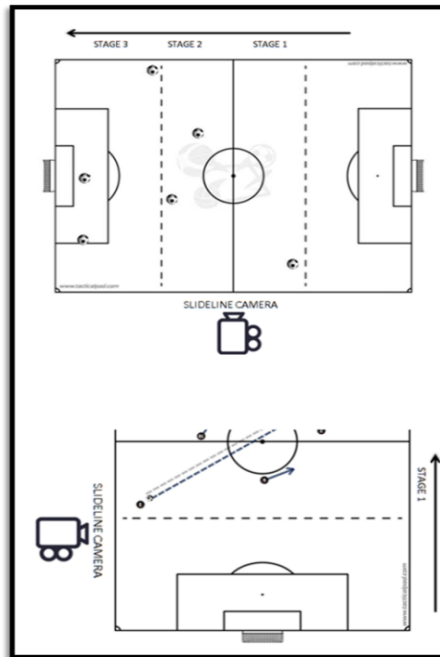
Besides, in the study of Chikha et al. (Chikha et al., 2021), the researchers investigated the mixed effects regarding the relation between spatial ability and visual instructions in primary young children, they particularly explored how young children with varying levels of spatial abilities integrate information from both static and dynamic visualizations. Children (M = 6.5 years) were instructed to rate their invested mental effort and reproduce the motor actions presented from static and dynamic 3D (figure 6) visualizations. They used for the learning and outputs a stimuli presented on a 17-inch LCD computer screen with a 1,280 × 1,024-pixel display. A 3-D game sequence titled “the passing game” was designed and developed using Macromedia Flash MX Professional 2004. For the measurements, they used MFTC test (Harrison et al., 2013), and CMTT test (Ceballos & Ehrlich, 2006). The results indicated an interaction of spatial ability and type of visualization. Children with high spatial ability benefited particularly from the animation, while low spatial ability learners did not, confirming therefore the ability-as-enhancer hypothesis. The study suggests that an understanding of children spatial ability is essential to enhance learning from external visualizations.

The study of Glavaš (Glavaš, 2020) examined the roles of basic concentration and visuospatial ability in adolescent soccer performance. The researcher measured participant's basic cognitive abilities with the Corsi block and the concentration grid tasks, soccer performance was measured in this study through five soccer skills. Concentration had no predictive role in elements of soccer performance, but visuospatial ability was significantly related to tactical abilities, technical skills, mental toughness, and situational awareness and thus, to overall soccer performance. These findings provided support for the importance of visuospatial ability but not concentration (as measured by the concentration grid) in young males' soccer performance.

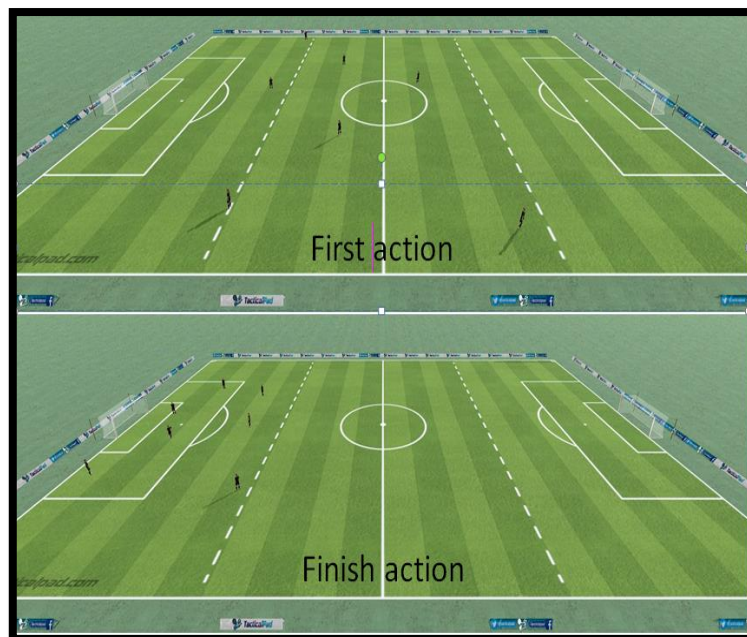
In the study of Bhargava & Cuzzolin (Bhargava & Cuzzolin, 2020), the researchers explored some of the applications of computer vision to sports analytics. Sport analytics deals with understanding and discovering patterns from a corpus of sports data. Analyzing such data provides important performance metrics for the players, for instance in soccer matches, that could be useful for estimating their fitness and strengths. Team level statistics can also be estimated from such analysis. This paper mainly focused on some of the challenges and



opportunities presented by sport video analysis in computer vision. Specifically, they used their multi-camera setup as a framework to discuss some of the real-life challenges for machine learning algorithms.



**Figure 5.** Schematic presentation of the empty soccer play, position of camera side-line and the direction of the play, position of passes and the stages on the soccer paly.



**Figure 6.** Schematic Representative diagram of a 3D animation dynamic scene to memorise.

## 5. Conclusion

The various recent studies in the field of mental training and visual-spatial perception relied on many measurement tools, the most important laboratory measurements have been treated in the present chapter, namely, EEG and multimedia.

The EEG allow the researcher in the sports field to discover the changes in the VSA capacities, resulting from practicing mental and cognitive exercises or exposure to psychological pressure. Its values are very accurate, and help to identify the influencing factors during the experiments, which the researcher can control and isolate.

However, the EEG methodology in the visual spatial perception of soccer player would be incomplete without some discussion of neurofeedback.

Through our review, it has been also noticed that many researchers used multimedia as a measurement tool, while it is considered an educational tool and a means of delivery and communication, rather than a means of measurement, Objectively, multimedia can be used as an aid to measurement in the field of visual-spatial perception, provided that the conclusions are not made exclusively based on laboratory studies, but also with tests on the field and evaluation of their impact on the football player during the competition, and the results the player may achieve through these experiments.



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## **MATHEMATICAL KNOWLEDGE IN THE ACQUISITION OF SKILLS OF BARBING, BRAIDING, AND MAKEUP**

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### **1. Introduction**

Mathematics is a fundamental concept in education and life in general. It's determined to a large extent the quality and standard of modern life. It can be said to be a scientific area of study, concerned with shape, relationship, quantity, and uncertainties and is widely noted for its precise, systematic, and organized framework (Ojose, 2011).

The role of mathematics in our daily lives is widely varied and broad (Okafor & Anaduaka, 2013). The importance of mathematics has remained prevalent throughout history and over time, as the nature of the field is not static, but ever-changing and adapting to the changes in the world.

Mathematical knowledge has been noted time and again for its worldwide applicability and usage in all fields, areas, and knowledge domains. This is the major attribute of the subject that makes it so important; as mathematics is often involved even when carrying out minuscule operations in everyday life. An individual unconsciously does several computations and calculations at the back of their mind, every day, and is bound to experience certain difficulties without basic mathematical knowledge. (Mkomango, Liombo, & Ajagbe, 2012).

Mathematics is an integral part of world progress and entails the foundation and basis for universal knowledge and understanding. Apart from its unending role in daily lives, mathematics has also been noted as a necessary tool in discovering the laws of nature, events, and phenomenon around us (Khan, 2015). Kravitz (2013), noted that knowledge of mathematics is required if an individual desire to live effectively in modern society, as it has over time, become necessary if one is to do the essentials of living.

Thus considering its universal applicability, it is worthwhile to assume that its knowledge plays a role in the acquisition of all manner of entrepreneurial skills including cosmetology.

Cosmetology is a field of work concerned with the maintenance of skin, hair, and nails. Cosmetologists are concerned with the aesthesis of an individual; dealing largely with appearance and beauty. It is one of the common fields of entrepreneurship in today's world. It encompasses the field of barbing, makeup, hairdressing, etc. (Houston Training Schools [HTS], 2020).

Cosmetology like every other profession or field of work is characterized by various skills and techniques, needed to be mastered if one is to be successful in the field. Those skills range from those general to the whole cosmetology fields and those specific to each of the cosmetology domains.

Given the above, this study was designed to explore three popular domains of cosmetology; barbing, braiding, and makeup, and the role mathematics plays in acquiring the necessary cosmetology skills.

## **2. Importance of Mathematics**

The concept of mathematics has been associated with a wide variety of definitions over time. Ziegler and Loos (2017), defined it as a science that deals mainly with abstract structures while exploring fields like quantity, structure, space, and change. It is a universal field encompassing all fields of study and knowledge domains, dealing with order, number, their operations, relationships, and is characterized by computations, calculations, and problem-solving (Jayanthi, 2019; Unameh, 2011).

Mathematics influences us and is prevalent all around us daily, in different forms, with it playing subtle roles in all aspects of living (Mkomango et al, 2012). This includes even simple activities like waking up to an alarm, telling the time, money management, and record-keeping, etc. Individuals are confronted daily with a wide range of scenarios that are put to test and require their mathematical knowledge and competence. Roohi (2011), states that the influence of mathematics is also felt in nature, as symmetry and patterns are found all around us and are associated with various natural phenomena like a change of day to night, rising of the sun, and so on. Its successful study and understating can also be personally satisfying and empowering.

Pua and Macutay (2020), states that mathematics and the knowledge and skills derived from it are essential if one is to live properly and effectively in today's modern society. Though its influence is by nature silent and hidden, mathematics helps shape our world in various ways (Amirali, 2010). Ambrosio (2008), states that there is a formidable link between mathematics and the major elements and issues of modern society.

Mathematics encompasses a wide range of domains and fields including the natural sciences, medicine, finance, engineering, and social science. The scientific world [TSW] (2018), states that all other knowledge domains, no matter their nature is dependent one way or another on mathematics. Its knowledge is also fundamental to all manners of vocational areas like carpentering, bricklaying, tailoring, baking, etc. All vocational fields are characterized by daily quantitative processes (Roohi, 2011). In today's scientific world, individuals with a thorough mathematical knowledge are in an infinitely better place for gainful employment and useful opportunities, as science is the vehicle of the future.

Mathematics is also the framework for and an indispensable tool for scientific and economic advancement, as it is the basis for all science subjects. Mathematics is the language of science technology, engineering, and research and is integral to their creation and continued development. The mathematical proficiency of any nation largely determines its level of

scientific and technological development. (Wanjiru, 2015). Ojose (2011), states that mathematics has become so intertwined with the modern world and our current contemporary life; which is characterized by complex systems and structures, that it is required if we are to communicate and comprehend the information all around us.

Mathematics also plays an indispensable role in the building up of the mental faculty. VaraidzaiMakondo and Makondo (2020) are averse that mathematics is an integral part of human thought and logic and key to their continued development. Its study imbues in an individual various psychological and intellectual benefits including problem-solving skills and insights. The mental benefits of mathematics do not just end with the building up of problem-solving skills, but also include the development of reasoning, creativity, critical, analytical and fast thinking, and even communication skills (Jayanthi, 2019). The development of the mental faculty by mathematics is due to the active mental work required in solving mathematical problems.

The mathematical sequences aid an individual's constructive and creative processes. Mathematics is also important in infrastructure development due to its influence over all forms of engineering (Frye, Baroody, Burchinal, Carver, Jordan, McDowell, 2013).

Thus, it is beyond obvious that mathematics plays a vital role in our everyday living, and we will be lost without its knowledge. The necessity of mathematics has and will only continue to increase.

### **3. Cosmetology and Mathematics**

The entrepreneurial skills of barbing, braiding, and makeup all fall under the broad heading of cosmetology. Cosmetology is a profession that typically refers to all fields that deal with beautifying a persons' hair, face, skin, or nails. Houston Training Schools [HTS] (2017), described cosmetology as a career path or field concerned with all forms of beauty treatments, no matter the type of process. Some other fields in cosmetology apart from the traditional barbing, braiding, and makeup include massage, electrolysis, aromatherapy, electro-therapy facials, etc.

At first glance, the presence and utilization of mathematics in cosmetology might not be too obvious, but the fact is that every good cosmetologist needs to possess above-average skills in mathematics, as this is usually transferred to and needed when carrying out various forms of cosmetology procedures (Merchant Circle, 2021). This view is upheld by Dwilson (2021), who state that being a skilled cosmetologist requires a bit of mathematics, and a formal degree in cosmetology from institutions nowadays requires a certain amount of mathematics classes.

The most obvious application for mathematics in cosmetology is in business and money management, as mathematics is needed in all businesses and careers no matter the type. For cosmetologists it is needed in making decisions like the number of clients to see a day to meet financial goals, best products to purchase; taking note of quality versus the prices, etc. Cosmetologist uses mathematical concepts such as ratios, percentages, and angles regularly in all services they perform (Wilcox, 2020).



But the role mathematical knowledge plays in cosmetology goes way beyond business and money management. It can actively influence their skills and competencies. Chapin-McGill (2018), states that if one is to be successful in the beauty industry, such person needs to acquire sharp mathematics skills. Mathematics is needed in carrying out every activity from measuring chemicals, to sterilizing solutions, to managing the whole business.

### **3.1. General cosmetology skills**

All cosmetologists, no matter the type of expertise, require some specific skill set if one is to be successful at the job. These skills go beyond those associated with their domains and are of numerous categories (Indeed Editorial Team [IET], 2020).

Some of those skills needed by all cosmetologists that are related to mathematics include; flexibility, creativity, customer service, ability to visualize ideas, product knowledge, time management, organization, computer, and technical skills

Flexibility is a skill in cosmetology, which refers to the ability to stay informed and aware of current trends in cosmetology especially those connected to ever-changing techniques and modern technologies and equipment (Andrew 2018). New technologies and techniques that enhance processes are continually been introduced to the world of cosmetology and any good cosmetologist is expected to be on par with the latest development. Flexibility also involves adequate competencies with computer and technical skills, utilizing them in the work environment, and being able to adapt to innovations.

Creativity is another vital skill every cosmetologist is expected to possess. This is particularly useful in almost all situations and usually involves a cosmetologists' ability to come up with their style, techniques or designs, when performing various cosmetology procedures such as styling hair or applying makeup. It also involves being able to make their spin on existing designs, adapting them to their use while adding their touch and flair. Dorsey College (2021), cited creativity as the major key to success in cosmetology, stating that any cosmetologist requires some artistic flairs, making it a major career for creative-minded people. The best cosmetologist builds reputations through coming up with interesting variations to trends or in creating their trends. A subset of creativity is the ability to visualize ideas. This involves being able to create a visual and diagrammatic representation of ideas in an individual's mind, even before creation. This is especially useful to decide the best procedure on style to use or create on the individual that will suit their appearance and reap better results.

Due to the nature of the job, a cosmetologist is in contact with people daily, and as such faces continuous scenarios where they are expected to communicate with individuals and maintain effective social interactions for the smooth running of the business. Thus any capable cosmetologist requires customer service skills, which are expressed as communication skills (IET, 2020). A cosmetologist must strive to create a welcoming and friendly environment for their customers, and approach situations in a friendly and reasonable manner. They must learn how to speak and interact with their clients, understand and work with them to provide the service required. A good cosmetologist is expected to ensure that the customer is satisfied with their service, and as Dorsey College (2021), noted, this can only be achieved through active



communication and listening. As a subset of communication, cosmetologist also needs to build networking skills, which is needed in connecting with other professions and clientele.

Another skill required for cosmetology is product knowledge. A good cosmetologist is expected to have comprehensive and detailed knowledge about the various tools and products utilized in their domains or fields, and processes. This skill is especially needed when recommending or describing products to clients, or in deciding the best product to use on a client. Product knowledge goes way beyond just knowing the physical descriptions but also involves an in-depth understanding of other variables like the chemical composition, durability, longevity, etc. (Murphy, 2019).

Another important cosmetology skill is time management. A cosmetologist needs to be versatile in their work environment and situations. They should be able to schedule and use time properly. There are also several cosmetology tools and products that require planning with time if they are to be used properly. This involves situations like calculating how much time it will take for the dye to absorb to hair, time to get tools properly sterilized, etc. cosmetologist needs to manage time properly to ensure schedules are being kept appropriately, and customers are properly serviced (Akesha, 2018).

Being organized and orderly is another vital skill required by a cosmetologist. Cosmetologists are typically expected to possess adequate organizational skills, both in their appearance and in maintaining their workplace. This involves organizing their workplace to make it safe and sanitary, and proper storage of tools, products, and equipment. Along with proper storage, being organized may also involve keeping and maintaining product inventory. (Wilcox, 2020).

### ***3.1.1. Mathematical knowledge in general cosmetology skills***

As implied earlier, mathematical knowledge is not only present but needed in acquiring cosmetology skills. Some of the applicability of mathematical knowledge to the general cosmetology skills is discussed below;

Creativity is one of the major skills needed by a cosmetologist no matter the type. And as the scientific world [TSW] (2018), states, mathematical knowledge is a major factor in the development of creative thinking and problem-solving abilities. This view is upheld by Roohi (2011), who states that the nature of mathematical knowledge aids in the development of constructive and creative thinking ability in an individual. Mathematics equips an individual with better problem-solving abilities through the development of creative thinking.

Mathematical knowledge is also needed in building effective customer service and communication. Wanjiru (2015), noted that knowledge of mathematics is an integral part of crafting and understanding information and hence communication. Mathematical knowledge is needed by every individual if they are to be equipped with the 21<sup>st</sup>-century skillset, among which is effective communication and relation. Jayanthi (2019), also avers that a mathematically knowledgeable individual is equipped with better communication skills.

Another major skill needed by all cosmetologists is organization ability. This is another area where mathematical knowledge comes into play. As TSW (2018), states, mathematics is the

pillar of organized life in the present day. For the aspect of the organization that involves keeping product inventory, the cosmetologist requires mathematical skills such as addition and subtraction, and the ability to forecast the amount of time a salon goes through a particular product (Merchant Circle, 2021). Mathematics also helps in finding, understanding, and developing all patterns, a skill that is needed for individual all-around development (Zorfass&Grayi, 2021). And as severally noted, mathematics is a major constituent of creative, constructive, and critical thinking, all of which are skills that boost an individuals' organization. The development of mental faculty by mathematics also boosts an individuals' flexibility (another skill needed by cosmetologists), making them more susceptible and adaptable to changes and ways of dealing with them. Stat-Analytica (2020) supports this view, stating that knowledge of mathematics equips an individual with broader perspectives of solving problems, dealing with situations, and adapting to changes. Mathematical knowledge is also needed for computer and technical advancements, and this is important because cosmetologist is expected to be current with the latest trends and technologies in their fields.

Mathematical knowledge is also universal and applied to all fields (Hadanova&Nocer, 2016), this plays a role in cosmetology skill that requires an individual to be knowledgeable about their products. Mathematics might become necessary in decoding and understanding (among others), variables like the chemical constituents of a product utilized in their fields. AU (2006), supports this stating that mathematical knowledge is usually carried over and utilized in all knowledge domains.

Time management is also another major cosmetology skill, which requires mathematical knowledge. Mathematical knowledge is needed for effective time reading, tracking, management, and budgeting of time. Williams (2020), states that mathematics knowledge imbues in an individual, effective ways to manage and save time. Starr (2017), noted that without mathematics, the cosmetologist will find it difficult to manage time, which is especially needed in this field, as the beauticians have to be precise to cultivate a steady business. Simple mathematics functions like division are used to partition the cosmetologist day into fractional equivalents and stick to them thus enhancing performance over time (Chaplin-McGill, 2018).

Considering all this, it is obvious that mathematical knowledge is needed if an individual is to acquire the general skills needed by all cosmetologists.

### ***3.1.2. Mathematical knowledge in barbing***

Barbing is a popular brand of cosmetology, basically concerned with cutting and trimming hair. Barbing is largely associated with the male gender, but the nature of its service is mostly unisex. Over time, the barber's job has grown beyond just cutting off the hair into desired styles, and has come to include other services like hair dying, curling, etc. These extra services are nowadays offered along with normal barbing at salons for clients Mitchel (2020).

Hair barbers need to be skillful with measurements and estimation if they are to carry out more complex styles. A hair barber should be able to estimate and approximate the amount of hair they will be cutting and the angle through which the hair will be manipulated if they are to execute hairstyles properly (Merchant Circle, 2021). Clippers used in styling men's hair are

also indented with numbers and have various length attachments that are measured in fractions of an inch, which the barber needs to be familiar with, as different clipper choices allow for light or deeper cutting.

When cutting the hair, the barber needs mathematics knowledge like geometry and trigonometry to determine how a cut will work concerning the hair length, the hair growth pattern, density, elasticity, and even the shape of the scalp. They need to be familiar with angles, shapes, and various other mathematics principles to determine what hair cut will work best on each client. When cutting hair, barbers employ the principles of geometry and proportion to cut and frame a hairstyle to the clients' faces and features (Davis, 2021). Many popular haircuts are based on geometric angles. Starr (2017), cited geometry as the most needed area of mathematics for barbers. There is also the presence of symmetry patterns when barbering hair, as the stylist usually has to cut around an imaginary axis that helps to establish a balanced finished product.

Knowledge of angles is especially important when cutting the hair into layers with scissors for dealing with curly or textured hair. Chaplin-McGill (2018) states that each time a barber cuts hair, he analyses the head and takes measurements unconsciously. This is especially prevalent for complex cuts and styles where the cut must hit certain angles in a precise, orderly fashion.

Over time, there has been a steady rise in hair coloring, which is sometimes done by the barber. For this purpose, the barber is usually responsible for mixing the dyes and colors themselves and applying them to the individual. To get the right color sometimes involves mixing a variety of liquids or powders and water. The barber has to decide which ratio to mix to get the desired result. This procedure involves knowledge of measurement and fractions, especially to calculate the quantities to be mixed, and the quantity needed to the hair (Dwilson, 2021). Starr (2017), states that creating colors for hair requires accuracy and forethought, and these properties are enhanced with a proper understanding of mathematical concepts like measurement and fractions

### ***3.1.3. Mathematical knowledge in braiding***

Braiding is another major area of cosmetology. It's a type of hairdressing that involves partitioning and weaving the hair into a variety of patterns, sometimes employing the use of hair extensions (Dr. Y, 2016).

Merchant Circle (2021), states that hair braiders and stylist needs to be proficient with measurement and estimating. They also need to be proficient with angles, as braiding usually involves positioning the hands at an angle to the hair. In the case where external attachments are being used, the hair braider also needs to be able to measure correctly the length of the attachment needed to achieve the desired style or pattern.

Hair braiders utilize the knowledge of geometry to divide and partition the head into shapes and figure out the correct positioning for those shapes (Davis, 2021). Akasha (2018), states that the neat final product of braids is only possible due to the stylist utilization of knowledge of mathematical concepts like angles.

One of the major parts of braiding, no matter the type is patterns. There exist various patterns in braiding, and this range of patterns constitutes the various styles. As Zorfass&Grayi, (2021) noted, mathematics includes the study of patterns that can be found everywhere, even in nature.

UKEssays (2018), cited a study by Glimer, which was set to uncover the mathematics unconsciously utilized by braiders of black hairs. The study observed and interviewed hair stylists at work in their salons along with their customers. The study noted that the major type/concept of mathematics unconsciously utilized by hair braiders and weavers was 'tessellations'.

Tessellation is a mathematical concept that involves filling up a two-dimensional space by congruent copies of a figure that do not overlap. Tessellations are formed by the combination of translation and rotation of fundamental shapes. The study noted that the concept of tessellations was most evident in the creation of box and triangular braids in the salons they visited.

Inbox braids, the scalp was the center of the tessellations, as it was divided into various similar-sized rectangles, forming a pattern that resembled brick walls. When making triangular braids, the hair was partitioned into small segments shaped like equilateral triangles. The hair inside those triangles was then drawn to the point of intersection of the bisectors for the angles of the triangles. Thus the presence of mathematics when making box and triangular braids is evident (UKEssays, 2018).

Sometimes braiding involves adding layers to the hair through extensions or weaves, and this entails a part of mathematical knowledge (Mitchel, 2020). The concept of addition is utilized to determine how many of those layers need to be added to achieve the desired look and the length of those extensions.

#### ***3.1.4. Mathematical knowledge in make up***

HTS (2017) described makeup artists as individuals which job entails enhancing the face usually employing the use of colors. This is another cosmetology domain that requires the knowledge of mathematics in its skill acquisition. Dwilson (2021) noted that knowledge of geometry is needed by make-up artists to determine how color and light interact with skin tones.

Sometimes, makeup artists are responsible for mixing cosmetics and colors to be used on their clients and are responsible for determining what ratio of the mixtures would produce the desired result. This process usually requires an understanding of measurements and fractions, if one is to get the proper color or design required. Makeup artist usually pairs colors to highlight or diminish tones to achieve the look the client desires, all these require a certain amount of calculations and computations in the cosmetologist's mind (Murphy, 2019). Percentages are also used in mixing colors and materials for facials (Chapin-McGill, 2018).

## **5. Conclusion**

Mathematics is a universal field of study encompassing all fields and aspects of living. Cosmetology is one of the most popular areas of entrepreneurship, in today's modern society. Since the knowledge of mathematics has been cited to be relevant in all fields, it is natural to

conclude that its knowledge is also prevalent in three of the most popular cosmetology domains; barbing, braiding, and makeup. Thus this study explored the field of cosmetology and examined the role mathematical knowledge plays in its skill acquisition. Mathematics was shown to be prevalent in the acquisition of skills for the whole of cosmetology and even in the distinct domains. Thus, it is obvious that if one is to be efficient cosmetology, such a person requires at least a basic understanding of mathematics.

## **6. Recommendations**

Based on this literature, the following recommendations are made;

1. Mathematical knowledge and its relevance in all fields should be explored.
2. The development of mathematical knowledge and skills should be encouraged, as it is an integral part of living.
3. Individuals who desire a career in cosmetology need to be equipped with basic mathematics knowledge and mathematics.
4. Programs designed for the acquisition of cosmetology skills should be designed in a way that enables the participants to view the necessary skills from a mathematics perspective.

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# A TECHNIQUE TO PROBE THE LEARNERS' KNOWLEDGE STRUCTURE IN THE CONTEXT OF SOLUTION CHEMISTRY TEACHING: THE WORD ASSOCIATION TEST

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## 1. Introduction

The content of science and its connection to ideas contribute to the learning process. Student learning is influenced by learner's representation and organization and learner's epistemology and ability level (Tyson et al., 1997).

As stated by Liu and Ebenezer (2002) a renewed interest in students' conceptions has resulted in a phenomenal increase in research studies on a large variety of science concepts (Driver & Erickson, 1983; Wandersee et al., 1994 cited in Liu & Ebenezer, 2002; p, 112). The popularity in student conceptions research has also engendered an interest among pioneer scholars in the field that overmany studies are purely descriptive, and the theoretical underpinning and practical implications are insufficient. Liu and Ebenezer (2002) also stated that, pioneer scholars feel that there is a need for an integrative theory or theories for describing and predicting students' conceptions (Wandersee et al., 1994). Two research emphases on students' conceptions have risen in the literature. One focuses on the qualitatively different ways of sensation natural phenomena by students, thereby the research endeavor is to develop descriptive categories of students' conceptions. Typical examples for this research emphasis are Ebenezer and Erickson (1996) and Renstrom et al. (1990). The other emphasis is explicitly cognitive psychology orientated and focuses on describing cognitive structures of students' conceptions. The examples are West and Pines (1985), Derman and Eilks (2016) and Derman and Ebenezer (2020).

Cognitive approaches about learning theory underline the importance of the interaction between the learner and the environment, the construction of a set of concepts and schemata through experience (Ausubel, 1978; Anderson, 1980, cited in Wilson, 1990). These networks are the cognitive structure of the individual. According to Tsai (2001), student knowledge gained from science courses is stored in the long term memory hierarchically and represented as a *cognitive structure* in their memory.

Though there is no single accepted meaning of it, the term of cognitive structure is well-founded (e.g. West, Fensham & Garrand, 1985; West & Pines, 1985; White, 1985; Bahar & Tongac, 2009). The facts, concepts, propositions, theories, and raw perceptual data are represented as individual's cognitive structure which also includes the individual's personal organisation of

their knowledge (White, 1985). However, there is a limited amount of information about how these representations take places based on neural structures (Taber, 2008).

There are different terms like *structural knowledge* (Jonassen *et al.*, 1993 cited in Liu and Ebenezer, 2002) or *knowledge structure* (Nakipoglu, 2008) to describe *cognitive structure*. The knowledge about how concepts within a domain are interrelated is structural knowledge, and it is also defined as the content-specific cognitive structure which deals with the essential element of students' conceptual understanding by being different from declarative knowledge. Studies on structural knowledge leans on how the conceptual understanding is structured in terms of inter-relationships between and among concepts instead of describing students' conceptions in categories (Liu & Ebenezer, 2002).

In the last decade, different research techniques such as word association, concept mapping, interviewing etc. have been used as research techniques (Lee, 1986; 1988). Gunstod (1980) highlighted some issues in terms of the method used to investigate cognitive structure of respondents (learners). White (1979) also explored some of these issues like the interactive nature of the purpose, the assumed model and the dimensions of cognitive structure of concern and the methodology used.

For example, there is a possibility of a cognitive structure probe itself affecting the cognitive structure. With methods based on interviews or the detailing of thought processes, the introspection is likely to cause some change in a respondent's cognitive structure.

Rumelhart and Norman (1978 cited in Gunstone, 1980, p. 46) proposed three broad modes of learning of complex topics: (1) accretion (the addition to knowledge/cognitive structures involving the topic), (2) restructuring (the reorganisation of knowledge/cognitive structures involving the topic), and (3) tuning (the smoothing of performance resulting from continued use of knowledge/cognitive structures related to the topic).

In addition to the information above, Taber's following perspective to determine cognitive structure in science education research would be beneficial for the pedagogy:

*If research in science education is to inform pedagogy it is important to distinguish between ways of thinking that are well-established and tenacious and likely to impede new learning unless challenged; and ideas that may be romanced when a learner is asked an unanticipated question about a topic that she has previously given little thought to, and might well never be generated, let alone committed to, in the absence of being asked what seems an obscure question" (Taber, 2008, p. 1031).*

Çalık et al. (2005) mention about researchers examined solution chemistry and related studies to identify students' conceptions and their difficulties in using different research methods. Likewise, Fensham and Fensham (1987) conducted research on students' conceptions of the nature of solution using three phenomena: solids dissolving in water, reaction between chemicals in solution, and the influence of various factors on the rate of reactions by using clinical interviews.

Ebenezer and Erickson (1996), and Ebenezer and Fraser (2001) investigated grade 11 students' conceptions of solubility and first year chemical engineering students' conceptions of energy in

solution process respectively via using a “phenomenographic” tradition of individual interviews. In their study, Pınarbaşı et al.,(2006) used multiple choice concept test as “Solution Concepts Test” to investigate the effect of conceptual change text-oriented instruction over traditional instruction on students’ understanding of solution concepts (e.g., dissolving, solubility, factors affecting solubility, concentrations of solutions, types of solutions, physical properties of solutions) and their attitudes towards chemistry.

In another study, Adadan (2014) examined probe the progression of particular solution chemistry concepts (e.g., saturated and supersaturated solutions) with the help of interviews. By using a different method which is free writing technique, Liu and Ebenezer (2002) explored grades 7 and 12 students’ conceptions of solutions descriptively and structurally.

## 2. Theoretical Perspective

One of the main goals of chemistry education is to support students develop an understanding of concepts and use them when solving a problem in a new situation. It is a fact that students frequently find solving chemistry problems difficult. According to Uzuntiryaki and Geban (2005), a major obstacle to solve chemistry problems can be the lack of understanding of chemistry concepts.

There are some requirements in chemistry learning like intellectual thought and discernment. Therefore, students must have logical thinking ability to reach comprehension (Blake and Norland, 1978) as the content is full of many abstract concepts such as dissolution (Çalık et al., 2005; Stavridou & Solomonidou, 1989; Abraham et al., 1994; Ebenezer & Gaskel 1995; Çalık, Ayas & Coll, 2007; Adadan & Savaşçı, 2012; Adadan & Savaşçı, 2014), particulate nature of matter (Liu & Lesniak, 2005; Adadan, Trundle & Irving, 2010) and chemical bonding (Othman, Treagust & Chandrasegaran , 2008).

Since a great number of students do not understand some basic concepts of chemistry, they may fail to understand the more advanced topics including reaction rate, acids and bases, electrochemistry, chemical equilibrium, and solution chemistry (Uzuntiryaki & Geban, 2005; Çalık et al., 2005; Adadan & Savaşçı, 2012).

As these concepts are abstract and theoretical, they seem problematic to students (Ebenezer, 2001). That is why, it is crucial to understand the chemical processes such as melting, evaporating, dissolving, diffusion, electron transfer, ion conduction, and intermolecular bonding (Ebenezer, 2001).

The study of the behavior of solution concepts has been a fundamental part of junior and senior high school science and chemistry courses for many years (Çalık et al., 2005; Çalık, 2005; Adadan & Savaşçı, 2012). Much of the research exploring learners’ ideas about, and understanding of, science topics has been framed in terms of ‘misconceptions’, ‘alternative conceptions’ or ‘alternative frameworks’ (Taber, 2002; Duit, 2007; Taber, 2008).

By taking these into consideration, it can be said that the study of the behavior of solution concepts has been an essential part of junior and senior high school science and chemistry courses for many years (Çalık et al., 2005; Çalık, 2005; Adadan & Savaşçı, 2012). Therefore,

studies on learners' understanding of science topics have been outlined in terms of 'misconceptions', 'alternative conceptions' or 'alternative frameworks' (Taber, 2002; Duit, 2007; Taber, 2008).

Nonetheless, these conceptions assume that learners have a steady way of thinking and understanding a subject as the general view suggests that 'conceptions' represent structures kept in memory in some form, and activated as whole (Taber, 2008).

Nakhleh (1992) suggested that after a student integrated misconceptions into his cognitive structure, these misconceptions interfere with subsequent learning. The student is then left to connect new information into a cognitive structure that already holds inappropriate knowledge. Thus, the new information cannot be connected to his/her cognitive structure and misunderstanding of the concept will occur.

According to Nakhleh (1992), misconceptions hinder later learning when a learner integrated misconstructions into his cognitive structure. Then, they are expected to connect new information into a cognitive structure that already holds unfitting knowledge. In such a situation, the new information cannot be associated with his/her cognitive structure and misinterpretation of the concept will arise.

Griffiths et al. (1988) proposed three steps needed to overcome student alternative conceptions. Diagnosis is the first one as a central step. After that, prescriptive and remediation come respectively. Most of the learners have misconstructions about solution process and the diverse aspects of solution chemistry (Teichert, Tien, Anthony, & Rickey, 2008; Haidar & Abraham 1991; Çalık et al., 2005; Çalık, 2005; Mulford & Robinson, 2002; Ebenezer & Gaskel 1995; Stavridou & Solomonidou, 1989; Uzuntiryaki & Geban, 2005; Çalık et al., 2007; Adadan & Savaşçı, 2012).

In a study conducted by Abraham, Williamson and Westbrook (1994), the concept of dissolution with the original five concepts was added with the sample of 9th grade physical science students, 11th and 12th grade high school chemistry students, and college students who were enrolled in their first semester of general chemistry course at a university. In this study, it was observed that only a few students in the college chemistry had some comprehension of chemical change, periodicity, or phase change, while the use of particulate terms (atoms, molecules and ions) increased across the grade levels.

In a different study, Cosgrove and Osborne (1981) interviewed secondary students in New Zealand to determine students' conceptions of the solution process. When the students were shown a tea spoon of sugar dissolving in water, they were asked, "What happens to the sugar?" This study revealed that younger ones generally stated dissolving as melting while the older ones connected the process with the suitable technical term, but had no sound scientific concepts behind these terms.

In a similar study, Longdon, Black and Solomon (1991) compared 11–12 and 13–14 year-old students' understandings of dissolution; they found out that understanding of the particle interpretation enriched in parallel with advancing age. Similarly, Mulford and Robinson (2002)

accentuated that learners had the misconception that total mass of the solution is lighter than sum of the mass of solute and solvent.

Other studies also reported that students referred to the interaction between the solute and the solvent in the dissolution process, they thought it to be a chemical change (Prieto et al., 1989; Stavridou & Solomonidou 1989; Haidar & Abraham 1991; Abraham et al., 1994; Ebenezer & Gaskel 1995).

Blanco and Prieto (1997) studied with 12–18-year-old students to investigate how stirring and temperature affect the dissolution of a solid in a liquid, and they reported a poor progress in the development of chemical understandings in terms of the effects of stirring and temperature processes.

In addition to students' having difficulty in how stirring and temperature affect the dissolution process, Blanco and Prieto (1997) stated that upper level students explicated, "Heat yielded currents that dragged at the salt." Their conclusion was by direct observation of the mechanical events students start to think the phenomenon of solution do not occur without mechanical events, so the development of chemical concepts was rather poor. Students explain the process with "melting" or "density" (Haidar & Abraham 1991; Lee et al., 1993; Abraham et al., 1992; Ebenezer & Erickson 1996; Ebenezer, 2001).

Learning chemistry vocabulary can be challenging for many students (Song & Carheden, 2013) because it has both scientific and everyday meanings. Because of the resilience of alternative conceptions (or misconceptions) that are embedded in larger conceptual frameworks, developing a scientific conceptual understanding is rather difficult (Treagust & Duit, 2008).

According to Hewson and Hewson (1983), the knowledge students possess before instruction may play an important role as a significant source of learning difficulty experienced by them. Likewise, everyday language (Prieto et al., 1989; Ebenezer & Erickson 1996), formal reasoning ability (Haidar & Abraham 1991; Abraham et al., 1994; Uzuntiryaki & Geban, 2005), instruction (Haidar & Abraham 1991; Uzuntiryaki & Geban, 2005) and pre-existing knowledge (Haidar & Abraham 1991; ; Uzuntiryaki & Geban, 2005; Abraham et al., 1994) are significant in the development of students' concept learning related to solutions.

### **3. Word Association Test (WAT)**

Word association test, which is commonly used in science teaching research to determine and map the concepts in students' cognitive structure, the relationships between the concepts and their conceptual structures, is a data collection tool and it is used by many researchers (Shavelson, 1972; 1974; Bahar & Hansell, 2000; Bahar & Tongaç, 2009; Nakipoğlu, 2008; Schizas, Katrana & Stamou, 2013).

As for Shavelson (1972), the rank of students' answers shows at least a significant part of the structure within the semantic memory, and between concepts in a WAT. Johnson (1967, 1969 in Gunstone, 1980, p. 46) is known to be the first researcher who used Word Association as a technique for exploring aspects of the content and structure of an individual's knowledge in a specific content area.



Johnson carried out a series of studies with high school students taking physics course and found out a positive correlation between problem solving performance and number of associations related to the problems. Similarly, Shavelson (1972) conducted a study in which high school subject were instructed to think like a physicist by using a one minute response time WAT test.

Bahar, Johnstone and Sutcliffe (1999) administered WAT to identify students' cognitive structures in elementary genetics. WAT has been used for various purposes in science teaching research. These studies showed that using WAT is a strong method since it reveals the types and numbers of the concepts in the learners' cognitive structures and also it reveals the relationship between them.

In another study, Isa and Maskill (1982) designed an investigation to find out whether WATs would identify dissimilarities between main science words being learned in two different (Malaysian and Scottish) cultural settings, and they reported that the tests noticeably differentiated between the two cultures, the Malay students commonly created more associations than the Scottish students.

By using WAT, Bahar and Tongaç (2009) tried to explore the effect of different teaching approaches on students' cognitive structures (N=110) related to circulation system. They applied WAT as a pre and post tests to all study groups. It was observed that the post-WAT mind maps obviously displayed significant difference about complexity and branching. In the light of this information, it was concluded that the teaching approach might seem to have an effect on the associations between concepts in their minds.

In a similar study, Nakipoğlu (2008) analyzed the knowledge structure of non-major science students about atomic structure through WAT. In this study, WAT was applied as pre-test and post-test before and after teaching. The analysis indicated that teaching had affected the students' knowledge structure since the differences observed in the students' knowledge structures before and after teaching.

Schizas, Katrana and Stamou (2013) conducted a case study and examined how secondary school students' understand the concept of "decomposition". By using Network analysis method, they tried to measure, represent and analyze structures and uses of science jargon and notation. The analysis demonstrated associative relations "in which concepts are represented by nodes and individuals' associations retrieved from memory serve as linkages between nodes".



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## PRACTICES INVOLVING THE USE OF DOCUMENTARY IN TEACHING THE NATURE OF SCIENCE

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### 1. Introduction

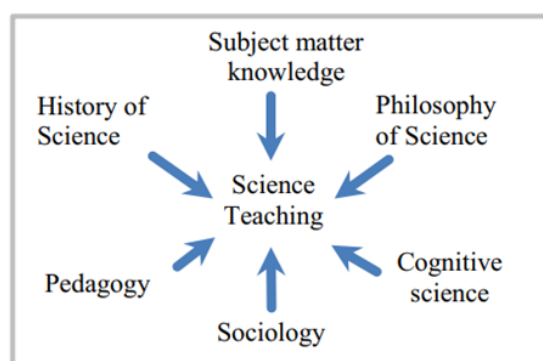
Science, which is an effort to understand the natural world, is a human activity and therefore open to interacting with personal, social, and cultural beliefs. Understanding scientific knowledge's nature and structure is essential for science students (McComas, 2020; Lederman & Lederman, 2019). Questions like "what is science" and "how do scientists work" are part of the science programs worldwide. The nature of science appears as a guide in understanding the exact meaning of science (McComas, Clough, & Almozroa, 1998).

### 2. Nature of Science

The nature of science (NOS) is a critical component of scientific literacy, which improves students' understanding of science concepts and enables them to make informed decisions about personal and societal issues involving science (NSTA, 2022). Lederman (1992) described NOS as "the values and assumptions inherent in science."

Understanding NOS and Scientific Inquiry (SI) provides a guiding framework and context for scientific knowledge. Without understanding NOS and SI, students will only learn science through results and as a body of facts-knowledge without context (Robinson, 1968).

NOS is seen as the blend of the philosophy of science, history of science, sociology of science, and psychology of science (McComas, Clough, & Almazroa, 1998). Therefore, to comprehend and teach the features of NOS, science educators should have competence in subject matter knowledge, philosophy of science, cognitive science, sociology, pedagogy, and history of science (Galili, 2019).

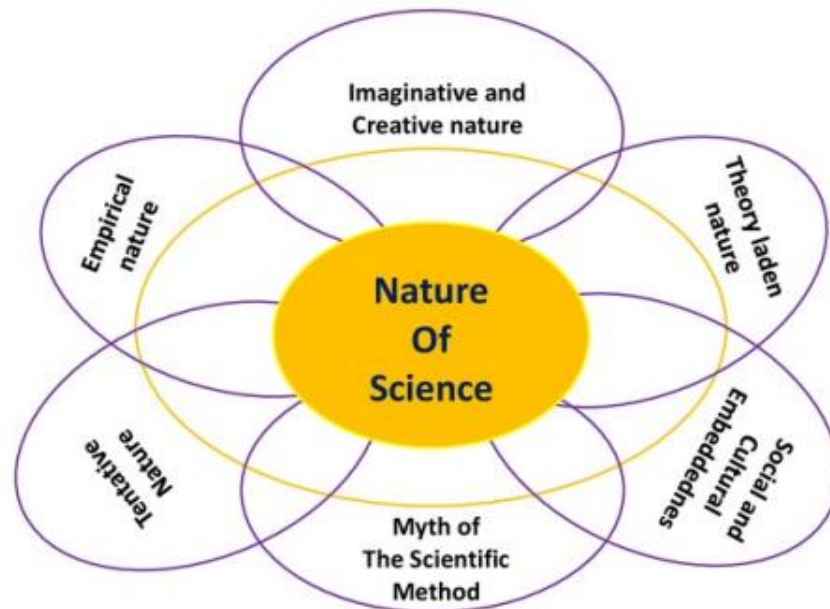


**Figure 1.** Competency areas associated with NOS (Galili, 2019)

### 3. Tenets of NOS

NOS covers various topics related to the history, philosophy, and sociology of science; thus, it is a complex concept. Therefore, there is no consensus among experts. Nevertheless, NOS has seven fundamental tenets (a) empirical nature of scientific knowledge, (b) scientific theories and laws, (c) the creative and imaginative nature of scientific knowledge, (d) the theory-laden nature of scientific knowledge, (e) social and cultural embeddedness of scientific knowledge, (f) the myth of scientific method and (g) the tentative nature of scientific knowledge (Lederman, Abd-El-Khalick, Bell, & Schwartz, 2002).

Experts have a consensus about the tenets of NOS that can be taught to students (Bell et al., 2000; Lederman, 1999; Lederman & Abd-El-Khalick, 1998; Smith et al., 1997). These are; scientific knowledge is variable, based on observations of the natural world, subjective, a product of imagination and creativity, affected by the social and cultural environment, and includes observation and inference (Figure 2). As these tenets do not require specialization in science, they are considered appropriate for teaching from primary to secondary education.



**Figure 2.** Tenets of NOS (Hsien, 2016)

*Scientific knowledge is tentative:* Scientific knowledge can be abandoned or changed in line with new evidence and technological advances (Lederman, Abd-El-Khalick, Bell, & Schwartz, 2002). The history of science reveals both evolutionary and revolutionary changes. Old ideas are replaced or completed by new evidence and interpretations (NSTA, 2022). In science, new or old theories are constantly tested and refined and occasionally thrown aside (American Association for the Advancement of Science [AAAS], 2022). Therefore, scientific knowledge is tentative and open to change.

*Scientific knowledge includes logical, mathematical, and experimental inferences:* Science is based on observing nature and interpreting observations. Scientists use experiments when they



cannot make direct observations and test the acquired knowledge at the end of the process. However, scientists also encounter situations that cannot be directly experimented with or observed. In these cases, indirect observations or inferences are used. For example, atomic models were suggested using the knowledge resulting from a series of deductions. In history, many scientists, including Mendel, Darwin, Archimedes, Newton, Galileo, and Einstein, used observations, experiments, logic, and mathematics to reach scientific knowledge.

*Scientific knowledge is subjective:* Scientists have different knowledge, beliefs, cultural background, education, expectations, prejudice, and experience. Since science is a human endeavor, acquiring scientific knowledge is affected by people's thoughts, knowledge, experiences, and prejudices. No matter how much an objective point of view is desired in interpreting the data, the subjective point of view is inevitable (Chalmers 1999). Different scientists can explain the same physical phenomenon differently, and these different explanations can also lead to different results. For example, scientists have different views on the dinosaurs' extinction, the Earth's formation, and evolution. Regarding the extinction of the dinosaurs, some scientists argue that it was caused by a meteor hitting the earth, while others suggest that volcanic eruptions caused it. There are many theories about the formation of the Earth. One of them is the Big Bang Theory. Regarding evolution, some scientists pretend that the origin of life resulted from RNA molecules in a meteor coming from outer space. In contrast, some scientists claim that RNA molecules were formed by chance, originating from the primordial organic soup formed in the seas, with the effect of the UV wavelength in the sun's rays, and they were again put in a sheath by chance. Scientists suggest ideas based on experiments and observations performed to reach scientific knowledge.

*Imagination and creativity play an essential role in acquiring scientific knowledge:* Creativity is a personality trait present in the generation of scientific knowledge. Scientists need imagination and creativity when interpreting and deducing what they see. Creativity and imagination of scientists are essential at all stages of the research process. Many scientists use their imagination and creativity throughout the whole research process. For example, Friedrich August Kekule von Stradonitz (1829-1896), one of the founders of modern organic chemistry, found the "benzene ring" after a dream.

*Observation and inference are different things:* In general, all scientific knowledge is a combination of observations and inferences (Chalmers 1999). However, observation is something going behind noticing. It is the process of cognizing something through the senses. Scientists use their senses and different tools (i.e., microscopes, scanners, or transmitters) when making an observation; then, they use them to collect and record data. The interpretation of the obtained data is inference. Many scientists such as Mendel and Darwin made long-term observations to reach scientific knowledge. Students of all ages pay attention to the weather forecast. Weather forecasters make observations, and their predictions are inferences.

*Scientific knowledge is affected by the social and cultural environment at the development and implementation stages:* Contributions to science can and have been made by people worldwide. Science affects the society and cultures it is in; at the same time, it is also affected by them (AAAS 1993). It is known that many scientists in history were influenced by the environment



and culture in which they lived. For example, the church and scientists at the time did not like Darwin's assertion that species are not immutable and Galileo's heliocentric theory of the universe. For this reason, many scientists were forced to give up their thoughts, tried, and even sentenced to death throughout history.

*Scientific theories and laws are different types of knowledge:* Laws are generalizations or universal relations about how certain aspects of the natural world behave under certain conditions. They describe the relationships between the observations of the natural world. The difference between theory and law is similar to the difference between observation and inference. Theories are inferred explanations of some aspects of the natural world (Abd-El-Khalick et al., 1998). Laws are descriptions of events that occur in nature, whereas theories are inferences based on observable events. For example, Mendel's inheritance laws are explained by the chromosome theory. We can give examples of scientific laws and theories (Mendel's Laws of Inheritance, Newton's Laws of Gravity, Chromosome Theory, and The Theory of Evolution). Laws and theories play different roles in science - so students should remember that theories may not become laws even with additional evidence. The tentative or volatile nature of scientific knowledge also means that laws and theories can change.

#### **4. Misunderstandings about NOS**

People develop ideas about science from their experience, previous education, popular media, and peer culture. Unfortunately, many of these ideas are common misconceptions or myths about NOS. Some of the misunderstandings about NOS in science education are: experiments are the only way to achieve scientific knowledge; science and its methods can answer all questions; scientific knowledge will not change; science is a solitary pursuit; science does not involve imagination and creativity; scientists are objective; scientific models are accurate; hypotheses turn into theories and laws (McComas, 1998; 2000).

One of the most common misconceptions is the existence of the scientific method. The scientific method is often taught to be a step-by-step protocol that all scientists follow when doing science. Students define the problem, form a hypothesis, make observations, test the hypothesis, draw conclusions, and report the results. In reality, however, there is no linear way of doing science; scientific research is fluidal, reflexive, context-dependent, and unpredictable. Scientists approach and solve problems in countless ways using their imagination, creativity, prior knowledge, and perseverance (Hsien, 2016).

#### **5. Approaches to Teaching NOS**

Sometimes we assume that students will learn about NOS simply by making scientific inquiries. Therefore, it is helpful to emphasize NOS's tenets in teaching science. There are three different approaches to NOS teaching: the indirect approach, the historical approach, and the clear-reflective approach (Abd-El-Khalick & Lederman, 2000a; Khishfe, & Abd-El-Khalick, 2002). The direct reflective approach has been widely used recently (Demirbas, 2016).

*Indirect reflective approach:* It is based on the idea that individuals' understanding of NOS will improve by participating in scientific activities (Abd-El-Khalick & Lederman, 2000b;

McComas, 1996). This approach aims for individuals to understand science and the tenets of NOS by working like scientists; students are expected to make inferences individually during the activity. However, this approach is ineffective in gaining the qualities of NOS (Khishfe and Abd-El-Khalick, 2002; Lederman, 1992). One of the reasons behind it is the misperception that people will automatically acquire the right concepts about NOS (Abd-El-Khalick & Lederman, 2000a).

*Historical approach:* It uses history to develop individuals' NOS understanding (Lederman, 1998, 2007). Scientific developments are discussed in the historical process. In this approach, the development of scientific knowledge over time is taught through case studies based on scientists' life and works (Khishfe & Abd-El-Khalick, 2002). Addressing the microscope's invention and the cell theory while teaching the cell subject is an example of this (Demirbas, 2016). Many studies show that this approach is effective for NOS teaching (Abd-El-Khalick, & Lederman, 2000b; Fouad, Masters, & Akerson, 2015; Kim, & Irving, 2010; Rudge, Cassidy, Fulford, & Howe, 2014).

*Direct reflective approach:* It emphasizes scholarly activity and inquiries to develop individuals' NOS understanding (Akerson, Abd-El-Khalick, & Lederman, 2000; Lederman, 2007; Schwartz, Lederman, & Crawford, 2004). This approach aims for individuals to think, discuss and question the characteristics of NOS. Research has shown that a straightforward approach is more effective than an implicit approach in developing NOS concepts among students (Abd-El-Khalick & Lederman, 2000a; Khishfe & Abd-El-Khalick, 2002; Khishfe & Lederman, 2007).

## **6. Using Documentaries in Science Education**

Films, one of the mass media tools, appear as an effective and enriched learning tool, and movies are used for motivation in teaching specific subjects. The new generation's familiarity with visual media plays a role in the effectiveness of films. Thanks to movies, students have the opportunity to analyze many controversial issues (Stoddard, 2009).

Short-term films have genres such as fiction, documentary, experimental, animation, commercial-promotional film, and video clips (Aladag & Karaman, 2018). Documentaries is a movie genre. Advances in technology, communication, and internet networks make it easier for teachers to access various films. Akbas (2011) named short films aimed at the gains in the curriculum as "educational films". Therefore, teachers can use educational films in their lessons. However, there are factors teachers should pay attention to while using movies in their lessons. These are: Choosing the movies regarding the learning outcomes of the course, considering students' development level, and realizing the movie activity in a planned way (Oztas, 2009). A planned short film activity consists of preliminary preparation, implementation, and evaluation stages (Aladag & Karaman, 2018). In addition, students should be able to take notes while watching the movie, the classroom should not be darkened completely, and the movies should not be too long (Lumlertgul, Kijpaisalratana, Pityaratstian, & Wangsaturaka, 2009).

Before the documentary film, the teacher asks students to watch the documentary film carefully; takes students' comments on documentary short films after watching the entire film; stops the film from time to time and asks about the things that the students do not understand in long documentary films; and finally, establishes a discussion environment around the issues that should be emphasized (Seckin Kapucu & Cakmakci, 2017). As a result, teachers should prepare pre-movie, movie-time, and post-movie activities (İscan, 2016).

This study has tried to present an example of how some subjects covered in the science curriculum can be taught to students by using documentaries within the framework of the tenets of NOS. First, the documentaries that can be used to teach NOS have been reviewed here. Afterwards, the speeches in the documentary were analyzed and associated with the tenets of NOS, science course units, and achievements. The documentaries mentioned in this study can be used in lessons to teach students the tenets of NOS. The concepts and documentaries suggested for the "DNA & Genetic Code" unit in the science curriculum are shown in Table 1.

**Table 1.** Examples of Documentaries Involving DNA & Genetic Code Unit in the Science Curriculum

Grade	Subject Area	Units	Concepts	Documentaries	Tenets of NOS
			Heredity	Science & Life-Mendel	<p>Scientific knowledge includes logical, mathematical, and experimental inferences.</p> <p>Imagination and creativity play an essential role in acquiring scientific knowledge.</p>
8 <sup>th</sup> Grade	Creatures and Life	DNA and Genetic Code	DNA and Genetic Code	Science & Life-DNA	<p>Scientific knowledge includes logical, mathematical, and experimental inferences.</p> <p>Scientific knowledge is tentative.</p> <p>Imagination and creativity play an essential role in acquiring scientific knowledge.</p>
			Adaptation and Evolution	Charles Darwin & Tree of Life	<p>Scientific knowledge is tentative.</p> <p>Scientific knowledge is subjective.</p> <p>Imagination and creativity play an essential role in acquiring scientific knowledge.</p> <p>Observation and inference are different things.</p>

Documentary films are associated with the tenets of NOS (Table 1). Accordingly, *Science & Life-Mendel*, *Science & Life-DNA*, and *Charles Darwin & Tree of Life* documentaries are recommended for teaching the concepts related to the "DNA & Genetic Code" unit in the science course (heredity, DNA and genetic code, adaptation, and evolution). Lesson plans and activity examples related to documentaries in teaching NOS are shared below.

### 6.1. Lesson plans and activities related to documentaries

*Documentary 1: Lesson Plan for Science & Life-Mendel Documentary*

*Course Name:* Science Course

*Subject Area:* Creatures and Life

*Unit:* DNA & Genetic Code

*Grade:* 8<sup>th</sup> Grade

*Documentary:* Science & Life-Mendel

*Scientists Mentioned in the Documentary:* Gregor Mendel, H. De Vries, Correns, E. Von Tschermak

*The Purpose of the Documentary:* Comprehending the importance of Mendel's works in heredity.

*Duration:* 10 minutes

*Concepts in the Documentary:* Heredity, Gene, DNA, Genetic Diseases

*Tenets of NOS in the Documentary:*

1. Scientific knowledge includes logical, mathematical, and experimental inferences.
2. Imagination and creativity play an essential role in acquiring scientific knowledge.

*Summary of the Documentary (1):*

Austrian botanist and priest Johann Gregor MENDEL (1822-1884) is considered the father of genetics, today's popular science. From 1856 he began collecting various pea seeds, growing them in the monastery garden, and studying their differences. **Mendel did not use plants in food but in experiments.**

In the 18<sup>th</sup> and 19<sup>th</sup> centuries, scientists did not try to explain how the characteristics of living things are passed from generation to generation. Mendel did this without realizing it. Mendel observed that some physical characteristics of some plants resemble their parents or even their ancestors. So he engaged in a series of experiments on peas that lasted for years. Mendel chose peas because it is possible to obtain easily distinguishable non-sterile hybrids, cross-fertilization is easily prevented, and peas are cultivated in the garden and greenhouse. Mendel conducted thousands of different experiments focusing on seven different characteristics, including the height of the plant, the color of the flower, the position of the flower, the color and shape of the seed, and the color and shape of the pod. He has grown around 24,000 plants. At the end of his studies, he reached a conclusion that no scientist had reached. As it is understood from here,

the experiment is vital in science. **Scientific knowledge is based on data collected from the observation of nature and experiments. The data obtained from the observations and experiments are interpreted in a way that is partially affected by the scientist's creativity and imagination.** Creativity and imagination affected Mendel's selection of the pea plant in his studies. Scientists may not be successful in many natural phenomena through direct observation. At such times, they use experiments to collect scientific information. The emergence of scientific knowledge sometimes occurs quickly, like Archimedes' accidental discovery of the lifting force in the bath. Sometimes it may require a lengthy process like the work of Gregor Mendel. This process includes evaluating the data collected from numerous observations and experiments, creating new hypotheses, and testing them.

Mendel published the results of his years of research in his article "Experiments on plant hybrids" in the journal of the natural sciences society published in Brünn. Moreover, he sent it to 40 scientists and organizations with his private effort. His efforts show that the generation of scientific knowledge is not sufficient alone and that scientific knowledge should be accepted by society as well. **Moreover, society's cultural values and expectations decide how and in what way science will be accepted.**

Mendel's studies and discoveries did not arouse any interest during his lifetime, and no one noticed their importance. Sixteen years after his death, three biologists, H. De Vries in the Netherlands, Correns in Germany, and E. Von Tschermak in Austria, demonstrated the validity of Mendelian laws in the research they conducted, unaware of each other on various plants. They combined all results under the name of Mendel's laws. **Here, it is seen that people from all cultures participate in doing science because scientific knowledge requires collaborative work.**

*Measurement Tools:* VNOS-E questionnaire (Question 1-2-7), Interview

*Activity Name (1):* Evaluation of the tenets of NOS in Science & Life-Mendel Documentary

*Directions:* The entire documentary should be watched to realize this activity. Before watching the documentary, the teacher should inform students about the tenets of NOS in the documentary. Then the students are told to watch the film by paying attention to these tenets. After the documentary, students are given a worksheet consisting of questions on which they can evaluate the tenets of NOS in the film. Ununderstood parts of the worksheet are explained. Finally, student responses are evaluated by the class.

*An Example of Activity Worksheet (1)*

1. What questions came to your mind while watching the documentary?
2. Who are the scientists mentioned in the documentary?
3. What is the role of observations in acquiring scientific knowledge?
4. What are your thoughts on the function of imagination and creativity in acquiring scientific knowledge?

5. Does cooperation play a role in the acquisition of scientific knowledge? Please tell us the parts of the documentary you watched that might be related to this subject?

*Documentary 2: Lesson Plan for Science & Life-DNA Documentary*

*Course Name:* Science Course

*Subject Area:* Creatures and Life

*Unit:* DNA & Genetic Code

*Grade:* 8<sup>th</sup> Grade

*Documentary:* Science & Life-DNA

*Scientists Mentioned in the Documentary:* Rudolph Virchow, Louis Pasteur, Oswald Avery, Friedrich Miescher, James Watson-Francis Crick, Maurie Wilkins

*The Purpose of the Documentary:* Comprehending the impact of DNA discovery on human history.

*Duration:* 10 minutes

*Concepts in the Documentary:* DNA, Nucleotide, Gene, Chromosome, Genetic Engineering

*Tenets of NOS in the Documentary:*

1. Scientific knowledge includes logical, mathematical, and experimental inferences.
2. Scientific knowledge is tentative.
3. Imagination and creativity play an essential role in acquiring scientific knowledge.

*Summary of the Documentary (2):*

After years of work, Mendel reached a conclusion that no scientist did before; he discovered the transfer mechanism of physical characteristics from one lineage to another. The physical characteristics of species were transferred from parents to offspring through certain particles. About 35 years after Mendel put his theory forward, his approach that inheritance is transferred through particles was accepted worldwide. However, there were new and vital questions to be answered. For example, what are these particles? Where are they located in the body? The answer to the second question came from the German biologist Walther Flemming in 1879. Flemming observed that during cell division, the cell nucleus is divided first. **Scientific knowledge is generated by investigating and observing the causes of events occurring in nature and the interpretation of these observations by the scientist. It is based on data collected from the observation of nature and experiments.** However, it is not always possible to conduct experiments. For example, the structure of the atom has not been directly observed until now. Nevertheless, by interpreting the data obtained in the laboratory environment and observed activities, reliable information about the structure of the atom has been reached, and atomic models have been developed in light of this information. **As it is understood from here, experimenting is essential in science. Science contains experimental implications, but it is not always possible to perform experiments. On the other hand, predictions and assumptions are also crucial in science. Scientists often deal**



**with events that cannot be directly traced; therefore, they try to support their claims with evidence obtained indirectly. For this reason, estimation and theoretical assumptions are crucial in science. The best examples are gravity, the structure of the atom, and the theory of evolution.**

The first thing dividing in the cell nucleus was a set of threadlike particles. Flemming named these filamentous fragments "chromatin," which means "color" in Greek. Over time, they were called chromosomes. **Imagination and creativity are essential in the generation of scientific knowledge. Besides the observation of nature, the creativity and imagination of the scientist are also a part of the generation and development of scientific knowledge. Since science is a human activity, the explanations, inventions, and theoretical subjects included in science are generated as a result of scientists' creativity and imagination.**

Oswald Avery et al. found that DNA carries the knowledge of life rather than the protein, as it seems. James Watson, Francis Crick, and Maurice Wilkins started working on DNA with this method at Kings College, London. In 1953, this trio realized the second breakthrough in biology. Watson, Crick, and Wilkins found that DNA has a double helix structure, resembling a spiral staircase. They won the Nobel Prize in 1962 for this important discovery. DNA analysis is one of the most important scientific events of the 20<sup>th</sup> century with all its biological consequences. **Scientist is curious; they think and evaluate the work of other scientists. For this reason, people from all cultures participate in science because scientific knowledge requires collaborative work.**

*Measurement Tools:* VNOS-E questionnaire (Question 1-2-3-7), Interview

*Activity Name (2):* Evaluation Activity of the Tenets of NOS in Science & Life-DNA Documentary

*Directions:* The entire documentary should be watched to realize this activity. Before watching the documentary, the teacher should inform students about the tenets of NOS in the documentary. Then the students are told to watch the film by paying attention to these tenets. After the documentary, students are given a worksheet consisting of questions on which they can evaluate the tenets of NOS in the film. Ununderstood parts of the worksheet are explained. Finally, student responses are evaluated by the class.

*An Example of Activity Worksheet (2)*

1. What questions came to your mind while watching the documentary?
2. Who are the scientists mentioned in the documentary?
3. Are experiments and observations always done to acquire scientific knowledge? What do you think about this topic?
4. How do you think scientists explain an event they can observe but are unaware of the details? How would you explain it if it were you?
5. What are your thoughts on the function of imagination and creativity in acquiring scientific knowledge? Give examples by thinking about the documentary you watched



6. Regarding acquiring scientific knowledge, what parts set an example for cooperation?

*Documentary 3: Lesson Plan for Charles Darwin & Tree of Life Documentary*

*Course Name:* Science Course

*Subject Area:* Creatures and Life

*Unit:* DNA & Genetic Code

*Grade:* 8<sup>th</sup> Grade

*Documentary:* Charles Darwin & Tree of Life

*Scientists Mentioned in the Documentary:* Charles Darwin, Richard Owen, Marie Curie

*The Purpose of the Documentary:* Learning about the diversity of plants and animals living on earth through Darwin's research and recognizing that there are different views on evolution.

*Duration:* 14 minutes

*Concepts in the Documentary:* Adaptation, Biodiversity, Evolution

*Tenets of NOS in the Documentary:*

1. Scientific knowledge is tentative.
2. Scientific knowledge is subjective.
3. Imagination and creativity play an essential role in acquiring scientific knowledge.
4. Observation and inference are different things.

*Summary of the Documentary (3):*

Our Earth is the only planet known to host life. Furthermore, it is very rich in life. A man, who explained this astonishing diversity of life, was born 200 years ago. Thus, it has completely changed our view of the earth and our place on it. This man was Charles Darwin. Darwin was a fanatical insect collector in his childhood. He once discovered 69 different insect species in a small area in just one day. **Science is based on observations in the natural world and their interpretation. Mendel observed the plants he grew in the monastery's garden for eight years; Darwin had the opportunity to observe many species, from birds to seashells, during a five-year journey. Based on this information, we can say that scientists make observations for many years to reach scientific knowledge and base their data on solid foundations.**

Darwin, who studied botany and geology at Cambridge University, collected plant and animal samples. He made it a habit to write what he found in his diary. He sent most of the mammalian bones and fossils to Richard Owen, one of the most outstanding zoologists of the time. Owen was the first person to identify dinosaurs and the one who gave them that name. He later founded the Natural History Museum in London. Many of the samples collected by Darwin are still preserved and exhibited in this museum, established by Owen, along with 17 million other samples. **Scientific knowledge is affected by the social and cultural environment at the development stage. Science is inevitably open to the influence of that culture and society's**

**value judgments, as well as political, economic, and similar formations. At the same time, scientific knowledge is subjective. In other words, scientists' origins, previous experiences, knowledge, and prejudices affect their observations and conclusions.**

Darwin also pondered what he had seen on the Galapagos island and other parts of the world. Perhaps the species were not fixed. Every day he walked to this little grove in the corner of his garden. It was where he came to ponder nature's history, including the question of how species mutated into another, which was the biggest mystery. He realized that most animals produced far more offspring than needed to replace those who died. For example, this female blue tit can produce a dozen eggs yearly and 50 in her lifetime. The survival and reproduction of two offspring are enough to sustain the blue tit population. These surviving babies are, of course, the healthiest ones, best adapted to their environment. These characteristics are passed on to the next generation. Thus, the species may change after many generations if environmental changes occur. Only the strongest survive. That was the trick. Darwin called this process "natural selection." It also explained the differences between the finches he had brought from the Galapagos. They were very similar to each other except for their beaks. Some of these birds had a thin and delicate beak that allowed them to catch insects, while others had a strong beak suitable for cracking nuts. So these changes may lead to radical changes over perfectly lengthy geologic time if species conquer new environments.

Darwin sketched out his idea in one of his notebooks. He showed how a single ancestor could give rise to many species. He wrote "I suppose" on it. Now, he had to prove his theory. Furthermore, he spent years collecting convincing and sufficient evidence. He was an outstanding letter writer. He wrote a dozen or so letters every day and sent them to naturalists and scientists worldwide. **New knowledge should be reported clearly and precisely because the generation of scientific knowledge alone is not enough. Its socialization is just as crucial as its generation. For new knowledge to be accepted by society, it should be reported and shared with others.** Owen did not deny that all these different species had arisen. But, he believed that each was separate and created by God. Darwin's theory needed connections. Not only among similar species but also in large groups of animals. If fish, reptiles, birds, and mammals have evolved from one another, there must have been intermediate life forms between these large groups. However, they were lost.

Then, two years after *The Origin of Species* was published, Richard Owen bought the most remarkable fossil for his museum. The fossil was found in a lime quarry in Bavaria, where stones are divided into flat and smooth layers. They have been used as roof tiles since Roman times, and most of them are empty. However, from time to time, a crayfish or a fish appear when you break them. It is nearly impossible to stop without breaking off every edge you see. Then you open it almost like a book, check the pages, and see if it contains a new fossil. However, this fossil was unprecedented. It is still one of the most valuable treasures in the Natural History Museum. That was it. Its name is *Archeopteryx*. It obviously has (bird) feathers on its wings. Therefore, Owen had no hesitation in characterizing it as a bird. However, this was not like any known bird species. Because it had claws on the front of its wings and, as was later discovered, it did not have a beak but a jaw with teeth and a set of bones supporting its

tail. In other words, it was half reptile-half bird. It was the link between the two large groups of animals. The link was not lost anymore. **Estimates and assumptions are critical in science. Scientists' creativity and imagination are essential at all stages, from shaping a scientific problem to designing research and interpreting its results. Therefore, imagination and creativity are essential in the generation of scientific knowledge. Scientists not only use their imagination and creativity in scientific studies but also make analogies.** For example, Walther Flemming observed that several filamentous particles were the first thing divided in the cell nucleus. He named these filamentous fragments "chromatin," which means "color" in Greek. Over time, they were called chromosomes. Here, Flemming likened chromosomes to a set of filamentous particles.

Scientists believed that the age of the Earth could be measured in millions. However, no one could say the exact number of million years. Then, less than 50 years after Darwin's theory was announced, a significant breakthrough was made in a field that seemed completely unrelated. This invention would finally provide a solution to this problem. A Polish woman working in Paris, Marie Curie, discovered that some rocks contain an element called uranium. It was an element that decomposed at a constant rate in a process called radiation. Today, a century after this vital discovery, the methods of calculating age by measuring the change in radioactivity have been greatly improved. **Scientists are curious; they think about and evaluate other scientists' works. For this reason, people from all cultures participate in scientific work here because scientific knowledge requires collaborative work.**

*Measurement Tools:* VNOS-E questionnaire (Question 1-4-5-7), Interview

*Activity Name (3):* Evaluation Activity of the Tenets of NOS in Charles Darwin & Tree of Life Documentary

*Directions:* The entire documentary should be watched to realize this activity. Before watching the documentary, the teacher should inform students about the tenets of NOS in the documentary. Then the students are told to watch the film by paying attention to these tenets. After the documentary, students are given a worksheet consisting of questions on which they can evaluate the tenets of NOS in the film. Ununderstood parts of the worksheet are explained. Finally, student responses are evaluated by the class.

*An Example of Activity Worksheet (3)*

1. What questions came to your mind while watching the documentary?
2. Who are the scientists mentioned in the documentary?
3. What is the role of experimental processes in the acquisition of scientific knowledge? Do you think experimental processes are sufficient alone? Think about the movie you watched and give examples.
4. How do we know dinosaurs existed when we have never seen them?
5. In the documentary, it is seen that Darwin wrote down his observations in his diary. What do you think about it?

6. Is scientific knowledge subjective or objective? What are the reasons for the different explanations of Richard Owen and Charles Darwin on the same phenomenon? What draws your attention on this subject in the Documentary?
7. What role do you think imagination and creativity play in acquiring scientific knowledge? Give examples considering the documentary you watched.
8. What do you think about people from different cultures working together to acquire scientific knowledge?

#### **7. Acknowledgements or Notes**

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**IMPACTS OF COVID-19 IN THE WORLD COUNTRIES****Prof. Dr. Cavide DEMİRCİ**

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**1. Introduction**

COVID-19 emerged in late December 2019 in Wuhan, China. This disease has been defined by the World Health Organization (WHO) as a new type of coronavirus (Wang, Wang, Chen and Qin, COVID 2020). The virus, which showed a high contagiousness, spread all over the world, especially in Europe, in a short time (World Health Organization [WHO], 2020). The pandemic, with symptoms such as cough, fever and severe acute respiratory tract infection, had fatal consequences and threatened the world. According to research, 80% of cases have survived the disease without requiring serious medical attention. However, in severe cases, the disease can turn into pneumonia and artificial respiration methods may be needed. However, in serious cases, it has shown that the disease can turn into pneumonia and artificial respiratory methods may be needed. It has been observed that one out of every five people in contact with the disease has a severe illness. It has been determined that individuals with chronic diseases such as diabetes, high blood pressure, lung and heart diseases and elderly people are in the risky group. Apart from the elderly, children and young people are also likely to get the infection and spread it to their environment. There have been cases where people in this age group also had a severe illness (Johns Hopkins, 2020). The negative effects of the global epidemic have been seen in many areas such as economy, sociology, psychology, education, starting from the field of health. The extent of this negative effect has increased day by day and has given concern. The rate of transmission and spread of the infection caused by the 2019-nCoV virus is much faster than other viral infections seen in the history of the world (Ergül, Altın Yavuz, Gündoğan Aşık & Kalay, 2020).

Governments had to take radical measures such as social distancing (social isolation), quarantine practices, martial law, travel and education restrictions to control the spread of the epidemic (Bourouiba, 2020).

## 2. Education During the Pandemic in the World Countries

The USA has announced that they have canceled compulsory central exams held in 50 states. Similarly, all written exams for senior secondary students and high school students in Norway have canceled and it has been announced in Netherlands that they decided not to apply the high school and university entrance exams.

In Scotland and England, all exams have been canceled and teachers have been asked to identify and give possible grades students may get. Ireland has announced that all students should be given full marks by canceling the exams. While Slovakia has announced that the written part of the national exam has been completely canceled this year, India has announced the cancellation of all exams for students in grades 1-8, which will enable them to move up to the next year. Indonesia has canceled exams held at the end of secondary school. In Japan, first-line exams were held for universities, the second-line exams, which applied by universities, were canceled and it was decided to make admission decisions according to the results of the national exams.

- Some countries have decided to postpone the exams. China has announced that Gaokao university entrance exam, which has ten million entrants, has been postponed for one month. Austria, Australia and Hong Kong are other countries that have decided to postpone the entrance exams.
- In addition to postponement and cancellation decisions, there were also countries that used the option to continue the practice by changing the format of the exams to be held. It has been decided to apply the Advanced Placement (AP) exam, which is used to enter prestigious universities in the USA, online. England and China are the other countries that enable their students not to stay away from the exams with online exam applications. Egypt has announced that it will conduct student assessments through research projects. Ecuador and Vietnam are also the countries that has planned to reduce the number and content of the exams. In Turkey, the content of university entrance exam (YKS) and high school entrance exam (LGS) have been narrowed down and LGS, which is planned to be held on June 7, postponed the date of June 20; YKS, which will be held on 20-21 June, was first postponed to 25-26 July, then it was changed again to 27-28 June.

### 2.1. China

It is one of the first countries that switch to distance education due to the Covid-19 pandemic first appeared in China. Due to the Covid-19 pandemic in China, 270 million primary, secondary, high school and university students have switched to online education. Many schools have provided online live lessons, online on-demand teaching, and video teaching on TV. In addition, a student-centered education model has been established (Durak, Çankaya, İzmirli, 2020). Within this period, the "Rain Classroom Teaching Platform", which is known as the most effective and advanced online learning platform in China, which started to be used in

2016, has been used effectively. During the epidemic, some students had problems in using this system because they did not like the distance education model and due to the difficulties in working from home (such as the lack of a quiet environment at home, the negative effects of the physical conditions at home on the learning process) (Lau, Yang, & Dasgupta, 2020). In China, teachers were given the opportunity to enable their students to create their own self-learning environments at home by sending them home study plans and sharing teachers' course materials from various platforms (Xie & Yang, 2020).

## **2.2. Spain**

In Spain, the Ministry of Education, launched the EduClan platform, which includes videos, games and e-materials that students aged 3-10 can download according to their age, by cooperating with broadcasters (Tanhan&Özok, 2020). Also, for children aged 6-10 in the Basque region, while education continues on national TV channels, the students can access the videos broadcast here on Youtube and on the website.

## **2.3. Belgium**

Bart Somers, Minister of Internal Affairs, called on companies providing internet access to provide free internet access to the children of the families with insufficient financial means in order to ensure equal opportunities in education. Thereupon, companies such as Telenet and Proximus tried to support the children of poor families to participate in distance education activities by creating access codes (Sözen, 2020).

## **2.4. Holland**

Like the other countries, all schools at different levels were suspended due to covid 19 in the Netherlands. The Ministry of Education stated that a budget of 2.5 million euros has been allocated in order to solve the problem of children who do not have a laptop and / or tablet, and therefore cannot participate in the distance education process. In order to enable the students, who live in socioeconomically disadvantaged areas, to be included in distance education, laptops were provided to 6,800 students (bbc.com, 2020).

## **2.5. Singapore**

The first case of COVID-19 in Singapore was confirmed on January 23. The Ministry of Education (MOE) has since stated that schools and educators have been working to ensure that students can continue to learn meaningfully and to provide more support to those who are unable to learn. The Ministry of Education (MOE) has changed the June holidays to May 5, 2020. Schools have planned and implemented the Home Based Learning (HBL) plan that best suits students' needs and the nature of the subject. Teachers were able to monitor students' learning progress and assignment presentations through a system called SLS (Singapore Student Learning Space). In addition, some of their lectures were conducted using video conferencing platforms (Sözen, 2020).

## **2.6. Australia**

As of April 13, the 2nd term started and the trainings were given through online programs. teachers explained the lessons to their students in empty classrooms by conference method through programs such as Zoom, Webex, Microsoft Teams. In addition, in order to encourage all students at different levels to learn online, students are provided with easy-to-use platforms that are easily accessible (like Google Drive/ Microsoft Teams) (OECD, 2020).

## **2.7. Mongolia**

In Mongolia, online courses began with the closure of the schools. In addition to the education in different languages such as Mongolian, Kazakh and Tuvan, 16 different television channels continued to broadcasts about education in order to ensure that the trainings reach the public. Also, a system with more than 3020 tele-courses and 206 e-textbooks has been put into use for the students of Econtent - K12 education.

## **2.8. Chile**

Through Aprendo en Linea education platform, it has been started online education for the students from Primary School to Secondary School senior level. With the agreement reached with GSM operators, educational materials continued to be downloaded free of charge and still, these materials continued to be delivered in print to students who did not have this opportunity. The country has also agreed with Google for applications such as G suite and Google Classroom to be used by teachers for content editing and doing homework.

## **2.9. Portugal**

Portugal has announced that they developed a support network which provides guidance on the preparation of online classes, offering a wide variety of free open content resources. It has been a problem to reach the students who has low socio-economic opportunities. To solve this problem, they announced that they have established a common network by cooperating with institutions in order to communicate with families with low socio-economic status.

## **2.10. Romania**

Lessons and courses have been continued by establishing partnerships with various providers (Google, Microsoft etc.). It has been announced that they have signed a partnership with the national television channel for a Teleschool program and are trying to reschedule school activities so that the school year ends normally.

## **2.11. Italy**

Since the British variant was found in 54% of the daily number of Covid-19 cases in Italy on February 18, 2021, schools were closed in high-risk areas and distance education was resumed (Demirci, 2021). Until the beginning of 2021, mostly face-to-face education has been suspended. The Italian government has announced the transition to distance education for all students, paying particular attention to vulnerable groups (students with disabilities and youth at risk). With the transition to online education, the Italian government informed students and their families about hygiene and safety measures, made agreements for many online resources,

provided financial resources to schools for the allocation of tablets and laptop computers with interest-free loans, and abolished the requirement for face-to-face final exams (Cedefop, 2020). The Italian Ministry of Education has published informative measures on how to combat a possible coronavirus epidemic in schools on its website. In addition, an information portal on the distance learning process was opened and webinars on distance education were organized (Kottasová & Isaac, 2020; Togoh, 2020; Benu, 2020). Italian Prime Minister Giuseppe Conte announced that all schools across the country will be closed until the summer vacation and that it has been decided to start education after the summer vacation. In Italy, Ministry of Education has created video sessions, online web pages and virtual support areas; has developed new learning environments to facilitate the use of digital content and new models of didactic organization by offering electronic learning platforms and has provided all teachers with up-to-date distance learning materials free of charge (Sözen, 2020). Parents protested the closure of schools, saying they did not have the appropriate technology and did not have time to support their children with distance education (Unicef, 2021; Reuters, 2021). As half of Italy has become a “red zone” from March 15, 2021, the government has announced that the highest level of Covid-19 restrictions will be reinstated (bbc.com, 2021). So, they continued education online.

### **2.12. France**

It was thought that regular contact should be ensured for pedagogical continuity between students and teachers. For this purpose, teachers especially benefited from existing networks (particularly digital workspaces, e-mail), enabling students to access course materials and do homework. In addition, the biggest assistant of teachers in this process has been a free pedagogical platform called Cned: My Class is at Home. Thanks to this application, students were allowed to maintain their emotional connections between their classmates and teachers through online lessons (OECD, 2020a).

### **2.13. Estonia**

The Ministry provided daily support and guidance for all educational institutions, including youth social work (hobby schools, open youth centres). In addition, support, information and guidance services on distance education issues were provided with the online institutions with which agreements were made. In Estonia, all learning materials continued both on paper and alternatively online. Therefore, it was explained that many schools already use the digital version in the past and do not need additional support or guidance. In order to provide full service to all schools, teachers, students and parents here, the systems of Information and Communication Technologies have been tried to be supported. Also, an open webinar was organized to provide guidelines for parents to support students in distance learning activities (Yılmaz, Mutlu & Doğanay, 2020).

### **2.14. Finland**

The Finnish National Education Agency has guided schools in planning and preparing different flexible learning arrangements under the extraordinary circumstances and they expected the

schools to take the necessary measures to make the best possible arrangements regarding educational services (OECD, 2020a).

### **2.15. South Korea**

The courses were taught online via the Internet. The Ministry of Education worked on the simultaneous school opening and sequential school opening system. In the sequential school system, one day school and one day online course were planned. The Korean Education Broadcast System was used to continue education in South Korea. The Korean Education Broadcast System is a Korean public broadcasting organization that does not aim to inform, educate and enlighten students of all age groups, from pre-school to basic education and secondary education, as well as adults by involving them in the process (World Bank, 2020). Teachers stated that they were concerned about the possibility that they might be recorded and responsible for a speech they made during distance education lessons. The fact that the students could not connect to the lessons on time and the problems that could be experienced with the devices made the teachers worried (Sözen, 2020).

### **2.16. England**

The UK government initially stated that school closures would be “unnecessary” to implement a free herd immunity policy. However, since the epidemic spread rapidly, quarantine and martial law measures were adopted, distance education was considered as a priority solution. Schools at different levels in the UK have offered online education to their education stakeholders. Most of the schools have implemented distance learning through online courses and worksheets. On the other hand, it has been announced that exams in all schools at different levels have been cancelled. While private schools continued their lessons via video conference, public schools could not teach for a month. During this period, BBC television produced 14-week course content in accordance with the curriculum (bbc.com, 2020). After each national closure decision in England, schools were reopened, and a decrease was observed in the number of students returning to school each time. Some families reported that they would not send their children back to school despite the government's announcement of absentee students' grade retention and fines, because they learned that school food support would not be provided. In the researches, it has been determined that during the closures, students spend an average of 5 hours at home for education, and K12 students spend their time outside of education with online actions (Telli & Altun, 2021).

### **2.17. The USA**

Before the Covid-19 pandemic, 96% of universities and colleges in the US offered online courses to their students, and more than 3 million students took at least one online course (Allen & Seaman, 2006). In the USA, everything that increases the anxiety level of children has been removed, including exams. It has even been ensured that computer games that cause stress are identified and their access is blocked. In addition, it was stated that very intelligent children are more affected by this process because their antennae are very open, and qualified guidance and information studies were carried out. There have been strong online education systems for many years in the United States, which canceled face-to-face class classes and made these classes



online due to the epidemic (MIT, 2020; Stanford, 2020; Harvard, 2020; Caltech, 2020). US universities, which rank first in the world in terms of the number of international students they host, aimed to compensate for the economic loss caused by the travel restrictions imposed due to the pandemic by quickly making their programs online. For this purpose, the online programs of world-renowned schools have been reduced to 30-40% of the face-to-face program costs (Telli & Altun, 2021). As in many other countries, the Covid-19 pandemic process has forced living conditions for students who have limited access to education due to infrastructure, economic situation and parental education level in the USA (Steel, 2020; Giannini, Jenkins, & Saavedra, 2020). It has been observed that many schools lack the technological infrastructure or resources to enable all their students to learn online (Lieberman, 2020).

### **2.18. India**

In countries where there is a digital divide such as India, the gap has increased with the closing of schools due to the Covid-19 outbreak. Smartphones used to reduce the digital divide have not been successful in spatial and infrastructural dimensions at this time of crisis. A student's unsuccessful attempts and multiple concerns to attend online classes can also affect their mental health. Therefore, in this process where individuals are affected psychologically, it is possible that the digital divide will increase (Mishra, 2020).

### **3. Economy During The Pandemic in the World Countries**

With the Covid-19 epidemic, almost all countries in the world, whether developed or developing, had to take a series of protective measures. These strict measures, from the ban on travels, the closure of workplaces, social isolation to curfews, brought most sectors of the economy to a standstill, and even caused some to come to a standstill. All sectors, mainly domestic and international flights, transportation services, railway services, sports, education, trade and service organizations, were affected negatively by the COVID-19 pandemic. The economies of most economically strong countries faced the threat of high inflation and rising unemployment due to excessive spending on the treatment and rehabilitation of COVID-19 patients and their families, as well as support for struggling businesses. This pandemic in the world caused a recession that negatively affects many interconnected sectors such as agriculture, trade, industry, transportation, finance and banking, health, airlines and energy markets (Duran & Acar, 2020: p. 57). It was seen that there was a serious recession process in the world economy and a serious economic recession in many countries.

#### **3.1. Europe**

The rapid spread of the Covid-19 virus has caused countries to implement protective measures. The EU, which has a supranational structure, could not act as quickly as nation states in the first stage of the crisis, and as the crisis deepened in Europe, its economically destructive effects were greater in parallel with the late measures taken. The EU countries, which were caught unprepared for the economic crisis caused by the epidemic, could not take a decision as a union and many sectors in the economic chain were affected badly (Öztürk Günar & Günar, 2020, p.154-155). With the European debt crisis, the Covid19 pandemic, which emerged at a stage where the economy was deeply damaged and had just begun to recover, caught the EU at its

weakest and most unprepared moment. The Covid-19 pandemic has transformed into a health-related economic and political crisis that threatens the existence of the EU in a short time (Öztürk & Günar, 2020: p. 154). Europe's leading countries in terms of economic power and population; EU countries such as Germany, France, Italy and Spain have announced measures and incentive packages (Koç & Yardımcıoğlu, 2020: p. 147).

### **3.2. China**

After the corona virus, serious lockdowns have emerged in the Chinese economy, which has led to a decrease in production and consumption. In general, the functioning of global supply chains has been disrupted, and all companies in the world have been affected adversely by this situation. Millions of people are in a position to lose their jobs in the future. (Cinel, 2020: p. 126). It has been observed that the global impact analysis of the Covid-19 crisis mostly focuses on China and developed economies. There are several reasons for this. First, these countries have been more affected by the pandemic. Secondly, three quarters of world production is realized in these countries (Pakdemirli et al., 2020: p. 19).

### **3.3. The USA**

According to the data of the US Labor Department, the number of applicants for unemployment funds in the USA, which has the highest number of cases and deaths in the world, reached 30 million 307 thousand in the last 6 weeks, as the Covid-19 epidemic affected the labor market. This was the highest number of applications in history in terms of the number of applications filed on a weekly or monthly basis throughout the history of unemployment insurance (DOL, 2020). Trump announced the largest financial package of \$ 6 billion in US history in order to eliminate the economic damage of the epidemic, and stated that with this package, the American people could see the light at the end of the tunnel (Euronews, 2020). However, despite the fact that 20 million Americans lost their jobs in April, Trump stated that there was no urgency in increasing financial aid, and the unemployment rate in America increased further in May (Miller & Masaro, 2020).

### **3.4. Italy**

In addition to the medical struggle against Covid-19 at the beginning of the epidemic, Italy could not respond at the same level economically, and later, with the economic support from the European Union, it got ahead of the UK. Ranking second among selected European countries in terms of economic package size, Italy ranked third among five countries with these figures. Considering the similarities with England in terms of the high number of cases and deaths, it is seen that the package sizes they announced are similar, too. The subject of the package announced by Italy is to support the country's domestic market and exports (Yorulmaz, Kırac & Aydoğdu, 2021: p. 170).

### **3.5. England**

The UK has announced a package amount of more than 1.5 times the public health expenditures in GDP. With these numbers, England, along with Germany and Italy, became the third country to spend much more than the budget allocated for health expenditures in its GDP for the

pandemic. The most basic subject of the announced package is the measures taken to struggle Covid-19. (Yorulmaz, Kırac & Aydoğdu, 2021: p. 169).

### **3.6. Gulf Countries**

It has been determined that the coronavirus epidemic is most effective on social and economic life. The measures taken in the fight against coronavirus can be evaluated in terms of two areas. First of all, when the measures taken within the scope of health measures are examined; It has been observed that various studies have been carried out in the Gulf countries to facilitate the detection of possible cases. For example, the UAE has launched a mobile drive-in test center, where individuals can be tested by staying in their cars, thus minimizing contact with other potential cases (Arab News, May 2021: p 30). Additionally, Abu Dhabi Health Services has reserved Al Ain Hospital for coronavirus patients. It is stated that the most felt issue, especially in terms of economy, is experienced on petroleum and petro-chemical raw materials. During the epidemic, the Organization of Petroleum Exporting Countries (OPEC) reduced production due to compulsory reasons and the need for these substances increased demand due to the epidemic. With the onset of the epidemic from the GCC countries, as in other regions, the decrease in domestic and international oil and gas demand, decrease in trade, interruption in oil production, decrease in consumer confidence and especially the tightening of global financial conditions created additional difficulties. However, the impact of this epidemic has not been uniform and workers and workers in certain sectors have been affected more than others. This effect has emerged most clearly in the economies that generate their income from oil, mainly due to tourism, hotel management and the decrease in global demand for these resources (Ozcan, 2021: p. 49). Governments also had to re-evaluate their economic policies to mitigate the impact of the crisis.

### **3.7. New Zealand**

The government has prepared a financial package of 52 million dollars to cover the damages caused by the closure (Analytica, 2020). In addition to when the epidemic will end, the uncertainty of the economic consequences of the early closure has make the government feel uneasy (Baker et al, 2020: p 11). However, in the following process, this uneasiness gave way to relief with the statistics announced.

## **4. Tourism During The Pandemic in the World Countries**

The tourism sector, which is one of the most important items of the service sector and called the smokeless industry, has been one of the areas most affected by the pandemic. The uncertainty caused by Covid-19, the cancellation of touristic travel plans and reservations, the flight restrictions imposed by countries have seriously affected many tourism-related sectors such as travel agencies, tour organizations, hotel management, entertainment venues, restaurants, souvenirs. The losses in the tourism sector have been great, as countries such as France, Spain, America, China and Italy, which are among the countries most affected by the epidemic, are also among the countries that host the most international tourists according to the data of the International Tourism Organization. (UNWTO, 2020).

### 5. Health Service During The Pandemic in the World Countries

The COVID-19 epidemic, which has affected the whole world and is expected to be felt for a while, has forced the health systems of countries. The rapid increase in the number of patients exceeded the current bed and health worker capacity, and this had a negative impact on the spread of the epidemic. In this context, the inadequacy of masks, disinfectants and protective clothing and materials used to protect against the epidemic was another accelerating factor (Yılmaz et al., 2021: p. 961).

In the first year of the COVID-19 epidemic, it was observed that quarantine measures were limited in countries that adopted populist policies, especially in the USA and Brazil. So, the highest number of deaths occurred in these countries. The non-implementation of quarantine brought a heavy burden on health systems, and caused disruptions in equal access to the right to health. In Italy, in March and April of 2020, it was observed that healthcare professionals were forced to choose patients because hospitals are insufficient (Monella, 2020).

China, South Korea and New Zealand stood out among the countries that focused on quarantine measures and preferred intense filtration (contact tracing) and intense testing and social restrictions. It has been observed that these countries prefer isolation methods based on the scientific approach according to the rate of disease transmission regarding the sustainability and accessibility of their health systems with quarantine measures. (Tabish, 2020: p. 21).

Italy, which was once the center of the epidemic in Europe; While it made a name for itself with its strong industry, infrastructure and disciplined stance, Germany drew attention with its stance against the epidemic and the 'Herd Immunity' policy it implemented when the epidemic broke out. While England is frequently mentioned with the private health system, where the most tests are applied in the world, the most cases and death rates are seen; the USA has been mentioned frequently during the Covid-19 pandemic, especially in terms of low-income group and black citizens encountering great drama and dangers (Yorulmaz, Kıraç & Aydoğdu, 2021: p. 165-166).

As it is known, we can briefly summarize the introduction of Covid-19 into our lives, whose history is very new, but the rate of spread is very fast.

- On 31 December 2019, China alerted the World Health Organization about pneumonia-like cases in Wuhan.
- Seafood and animal markets believed to be at the center of the outbreak were closed on 1 January 2020.
- On January 9, 2020, the World Health Organization stated that the infection was caused by a new type of coronavirus.
- On January 10, China shared the genetic code of the new virus.
- On January 11, scientists started working on a vaccine and at the same time the first death occurred.
- On January 13, the virus spread abroad for the first time with a case in Thailand (Mazumdar, January 30, 2020 p.213).

- As of April 4, 2020, according to the World Health Organization, there are countries or regions with 1,009,625 confirmed cases, 51,737 confirmed deaths and 208 cases due to Covid-19 in the world (WHO, April 4, 2020, p.214).

Approximately three months after being declared a pandemic by the World Health Organization on February 12, 2020, confirmed cases were detected at least in Latvia (784) and the most in the USA (889,391) among OECD countries (Selamzade & Özdemir, 2020: p.989).

The USA has been the leading country in determining the actual number of cases with the number of tests it has applied. It has been observed that the USA has a rate below the world average in the case/death rates calculated by taking the number of detected cases and the number of deaths (Yorulmaz, Kırac & Aydoğdu, 2021: p. 168).

### **5.1. Germany**

Germany is the most successful country in the number of cases, number of deaths and case/death ratio among the 3 selected European countries. Case/death rates were slightly above the world average, however, it was the most successful among the selected countries in the number of cases per 1 million people. Keeping the measures tight since the beginning of the epidemic, Germany has become the leading country in epidemic management, as in other issues within the European Union countries (Yorulmaz, Kırac & Aydoğdu, 2021: p. 168). Since March 2020, when the virus was first seen and especially accelerated, Germany has been able to provide the necessary treatment and care to all its patients who need treatment. This has increased the number of beds, intensive care units and ventilators and testing capacity in hospitals during the pandemic (Robert Koch Institut, Die Bundesregierung, 2020).

### **5.2. China**

The city of Wuhan, known as "Chinese Chicago", was thought to be one of the numerous viruses that emerged with the same symptoms when faced with the new type of coronavirus. However, when the epidemic spread to other provinces and countries, the Chinese government was alarmed and a series of measures were implemented on the first day of 2020, starting with a meat trade ban. Thanks to China's developing health policies, the COVID-19 pandemic was more prepared than the SARS epidemic. It is understood that, in the effective fight against the pandemic, especially health insurances are a guarantee for the purpose of making the whole public benefit from health services, and in cases where the insurances do not cover the hospital expenses, the state undertakes the payments. Thus, the faster spread of the virus was prevented, and the increase in the number of daily cases and deaths was brought under control (Sarıyıldız, Paşaoğlu & Yılmaz, 2021).

## **6. Conclusion and Discussion**

The Covid-19 pandemic, which emerged in the first months of 2020 and was declared a pandemic by the World Health Organization, adversely affected many areas of life such as health, education, transportation, trade and tourism, especially the economy. In order to prevent the spread of Covid-19, countries have implemented various measures such as travel bans, lockdown, quarantine, closure of shopping malls and some workplaces or limitation of working

hours. These measures brought social and economic life to a standstill. In this process, individuals went bankrupt, lost their jobs, and lost income due to practices such as short work and unpaid leave. The measures taken with the pandemic affect the economy of individuals negatively and the incomes of individuals did not meet their basic needs. This situation has led to an increase in the working poor (Özkan, 2021). Due to the consequences of the high-speed spread of the epidemic, social distance rules have been introduced in all countries of the world, quarantine processes and lockdowns have been implemented. These measures taken against the spread of the epidemic brought along economic problems and created an environment of uncertainty that would cause global economic recession and then economic contractions. IMF, World Bank and European Central Bank (ECB) have announced their loan packages for the countries whose economy has deteriorated due to the epidemic (Küçüköğlü, 2021).

With the epidemic, countries have closed inward, economies have shrunk, the capitalist system does not consider citizens, left them in trouble, and it has been proof of how serious the win-win logic has caused. It has been observed that the understanding of the social state is out of order since everything is privatized in capitalist systems from the services that everyone should benefit equally from. All these negativities have affected the poor regardless of the development level of the countries. With the epidemic, the economic crisis broke out in all countries and most of the small and medium enterprises were closed. Accordingly, unemployment figures have reached the peak in our country and in the world. There were big businesses that profited from this, and small businesses were on the verge of disappearing completely because the epidemic lasted for a long time. The economies, support policies and budgets of underdeveloped and developing countries could not easily overcome this. Therefore, as unemployment increased and per capita income decreased, people had to be more thrifty and abandon some consumption habits. Demand for goods other than compulsory consumption goods decreased. People had to review their spending and meet their priority needs. This situation has caused stagnation in the production of certain products and in the markets. In addition to compulsory consumption products, the products whose demand has increased during the pandemic process have been hygiene products, technological products such as computers, game consoles and similar products that will make it fun to spend time at home. Solving the problems caused by the pandemic on people's psychology and economic income can be both costly and take a long time (Kayabaşı, 2020).

Tourism is an important part of many national economies. It directly contributes to an average of 4.4% of GDP and 6.9% of employment on average in OECD countries. According to UNWTO, it accounts for 10% of world GDP and 10.1% of employment. One out of every 10 people in the world is employed in tourism. This situation will turn into important macroeconomic effects especially in countries, cities and regions dependent on the tourism sector. Many governments are taking tourism-specific measures to eliminate this negative situation on the sector and facilitate recovery.

It is no longer possible for the global economic and political system not to change. Perspectives have completely changed for both the producer and the consumer. Cleaning, hygiene, digitalization and the digital (virtual) economy have been the new trends. In short, it is



necessary to develop new products and markets in order to obtain high export income. Revising business models, organizational management and innovation methods has gained importance in terms of making the current situation advantageous, which seems to be disadvantageous (Bahar&İlal, 2020).

The consequences of the coronavirus pandemic were felt more severely than other pandemics. The world economy has been greatly affected, both locally and globally. A 1% to 5% reduction in GDP is expected worldwide. Economists have talked about the benefits of the global economy and foreign trade until now, but the current coronavirus pandemic has pointed out that there may be changes in the economic literature (Tekin, 2021).

While the crisis affected some sectors negatively on a global scale, it also offered the opportunity to bring some sectors into the forefront. At the beginning of the sectors where the effects of the crisis were felt the most, the industrial sector, especially the sub-sectors such as automotive, machinery and equipment, comes first. In addition, the crisis made itself felt in sectors such as transportation and logistics. The strategic importance of the agricultural sector was once again understood with the epidemic (Pakdemirli, Bayraktar, Ünalmiş & Takmaz, 2020).

The unexpected emergence of the COVID-19 epidemic has caused many countries to be caught unprepared for the epidemic process. In addition to the existence of economic measures and supports, the inadequacy of the health sector in many countries and the difficulty in responding to the demands made it more difficult to dress the wounds of this process.

The characteristics of the countries and the different practices they exhibited against the COVID-19 epidemic have caused each country to experience the process differently and face different results. In many countries, the health system was clogged, the infrastructures of health service provision were insufficient, risk groups couldn't be protected, mortality rates were higher than expected, and health professionals were faced with ethical dilemmas in providing treatment and service (Tekin, 2020).

In the context of COVID-19 outbreak indicators, the countries with the lowest number of cases and deaths were Australia, Greece, Hungary, Poland, Brazil, China, India, Indonesia and S. Africa. However, the countries with the highest test average per million inhabitants are Austria, Denmark, Estonia, Germany, Portugal, Russia, Belgium and Spain. Turkey is one of the countries with the lowest death rate per million people. Turkey is also one of the countries with the highest rate of cured patients. The countries with the highest rate of cured patients are Australia, China, Luxembourg, Germany and Austria.

Covid-19 epidemic, flood, earthquakes, tsunamis, erosions, tornadoes or fires and infectious disease outbreaks (epidemic) etc. experienced by all countries of the world. In the face of all these shocking events, countries have shown us that distance education should be included in the scope of the "Emergency Action Plan" as a priority. While it is seen that developed countries have easily completed the transition to the distance education process in the epidemic; it has been seen that developing countries have difficulties and problems in accessing education have emerged (Oyedotun, 2020). On the other hand, the transition of schools to the online education



process by taking a break from face-to-face education has also provided important opportunities for countries to explore and understand the possibilities of distance education.

The concepts of distance education and remote work may continue to exist for a while in the future. Some companies have announced that some of their employees will continue to work remotely after the pandemic; Educational institutions, on the other hand, found the "distance education" gains obtained with the pandemic useful in terms of offering different education opportunities in the future. Both students and instructors; It has been seen that it is necessary to create distance education/work guides for companies and employees, and to create a culture in the society in this direction (Hotay, Omay, Bayrak, Karaüzüm, Belgin&Ünal,2020).

## 7. Suggestions

In global pandemic situations, dealing with epidemics can become much more complex and difficult. Decision makers at all levels of each country can be affected by the policies of other countries and can develop various solutions to the pandemic (Türkoğlu & Yılmaz, 2021).

On the other hand, due to the increasing mobility in the world with the development of technology, Many negative situations like epidemics etc. have the power to spread and affect all countries of the world in a short time. Therefore, it is possible that we will encounter similar problems in the coming years. For this reason, there can be some suggestions made to be prepared for such a situation.

### 7.1. Education

In general, the following recommendations can be made to cope with COVID-19 and similar epidemics (Cullinane and Montacute, 2020):

- While schools are closed, governments should help all children have at least minimal resources (a laptop or other suitable device and a stable internet connection) to access online learning.
- Disadvantaged students should be given access to additional one-on-one or small group classes to reduce the impact of school closures.
- It is vital to ensure that all students have access to high-quality content. Therefore, teachers should be trained to enable them to provide online content to students. Guidance and training for teachers online can help make provisioning more consistent across schools.
- Infrastructure and superstructure works can be carried out to provide broadband internet required by online services and applications in all geographical regions.
- Parents can be guided about the process and their burden can be reduced by supporting them in their duties in the process (Avcı & Akdeniz, 2021).

### 7.2. Health

- Health workers should be provided with access to adequate protective equipment and this should be made regular.
- Everyone entering health institutions should be screened for signs of COVID-19, face protection equipment should be strengthened for risky individuals and healthcare workers.
- Hygiene measures should be maximized in health institutions.

- Barrier measures should be applied to ensure social distance.
- Adequate sleep and nutrition needs of health workers should be met.

### **7.3. Agriculture**

- In times of crisis, agricultural and food policies, which should be planned comprehensively and holistically, can encourage domestic and local production.
- Purchase guarantees can be given to farmers for certain products.
- Farmer debts can be postponed or some of the debts recorded during the pandemic period can be written off.
- Family farming can be strengthened and supported to ensure its sustainability.
- Socio-cultural and socio-economic measures can be taken to encourage young people to participate in agricultural production.
- A sufficient number of agricultural engineers and veterinarians can be provided to work in public extension activities in agricultural production areas.
- Measures to improve the mobility and working conditions of agricultural workers can be taken and placed on a legal basis.

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**1. Introduction**

Analytics of data in financial Econometrics employs statistical techniques to comprehend financial issues. The discipline of financial data analytics blends econometrics with the technology components of data analysis. Financial data analytics utilizes machine learning, predictive analytics, and prescriptive analytics to provide robust opportunities for interpreting financial data and resolving related difficulties. The field of financial data analytics has exploded in the past decade. As financial data analytics are applied to financial time series, academics and financial analysts have been increasingly interested in modelling and forecasting the volatility of the time series, a field of behavioural decision study that is becoming increasingly fruitful. Numerous economic and financial applications, such as portfolio optimization, risk and return analysis, and asset pricing, find it highly important. The digitization of the finance industry has enabled technologies such as advanced analytics, machine learning, artificial intelligence, big data, and the cloud to permeate and transform the competitive landscape of financial institutions. Consequently, huge businesses are adopting these technologies to enhance digital transformation, satisfy consumer demand, and increase profitability. Most firms are storing valuable data, but they are not sure how to maximize its potential since the data is unstructured or not captured. The financial sector was not born into the digital age, so it has had to undergo a long process of conversion that has required behavioural and technological changes. In recent years, big data in finance has enabled significant technological innovations that have enabled convenient, personalized, and secure solutions for the industry. Consequently, big data analytics has transformed not only individual business processes but also the entire financial services sector. The use of machine learning is changing trade and investment. Big data can now take into account political and social trends that may affect the stock market instead of just analysing stock prices. Algorithmic trading relies on big data to execute financial trades much faster than humans. Mathematical models are used to determine the parameters and instructions that determine the timing, price, and quantity of trades. Using machine learning, analysts can compile and evaluate data in real-time



to make smarter decisions. Machine learning, fuelled by big data, plays a significant role in fraud detection and prevention. With analytics that interpret buying patterns, the security risks once posed by credit cards have been mitigated. With the advent of secure and valuable credit card information being stolen, banks can instantly block the card and transaction, and notify the customer about the security threat. Accounting and finance professionals can provide better services to their business clients by leveraging advances in data analytics. We provide an overview of the main financial applications of computational and data analytics approaches in this chapter, emphasizing the most recent trends and developments.

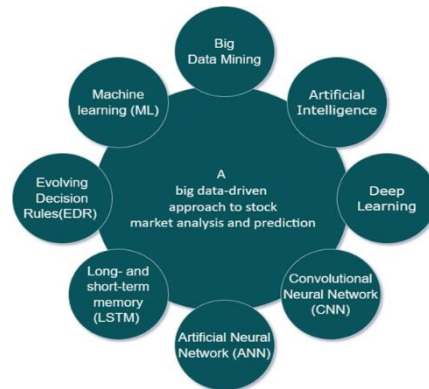
The foundations, fundamentals, and applications of advanced data analytics in finance are identified in Section 2 i.e., background of the study. Section 3 presents an overview of sentiment analysis using Deep Learning for Investors. The topic in Section 4 focuses on Python's application in financial data and fin-tech. In Section 5, the analysis of financial data via data mining is examined. In Section 6, Trends in the financial data industry are discussed. Section 7 provides an analysis of Predictive Analytics. Section 8 has an explanation of Algorithms. Section 9 concludes the chapter.

## **2. Background of the Study**

This section provides a brief recap of prior research on the predictive ability of internet data for financial markets and demonstrates how results have improved over time. During the previous decade, the adoption of artificial intelligence (AI) in the economy accelerated significantly (Agrawal et al., 2019; Furman and Seamans, 2019; Brynjolfsson et al., 2021). As a general-purpose technology, AI is said to have a significant direct and indirect impact on numerous industries (Taddy, 2019). The banking sector is one of the industries in which AI has been utilised most extensively (Bredt, 2019; Biallas and O'Neill, 2020). Since the eighties and nineties of the previous century, documents and academic publications have examined and reported on the varied effects of AI on finance and financial markets (e.g., Pau, 1986, Shap, 1987, Pau and Tan, 1996). Recent articles on this topic have elucidated numerous potentials, problems, and consequences. (Baesens et al., 2015) present a comprehensive analysis of a number of learning algorithms and approaches utilizing diverse credit risk assessment data sets. Similar techniques have also been applied in sectors such as profit and behavioural scoring (J. N. Crook, Edelman, & Thomas, 2007; Thomas, 2009) and bankruptcy prediction (Alaka et al., 2018). The complexity of analytical models for credit risk analysis is a key cause for worry, particularly from a supervisory standpoint. Combining comprehensible systems with powerful modelling algorithms has been proposed (Baesens, Setiono, Mues, and Vanthienen, 2003; Florez-Lopez and Ramon-Jeronimo, 2015; Martens, Baesens, Gestel, and Vanthienen, 2007). Artificial intelligence approaches employ automated decision-making processes (Zopounidis, Doumpos, & Niklis, 2018), while decision analysis techniques rely on the domain knowledge and skills of financial decision-makers. The addition of relevant information to financial models improves their clarity and realism. A purely data-driven strategy may be incapable of addressing this issue. Combining this with additional analytical tools (based on optimization or artificial intelligence) (Christodoulakis & Satchell, 2008) can reduce model risk. Most decision analysis methodologies have a constructive stance, which enhances the learning process and provides

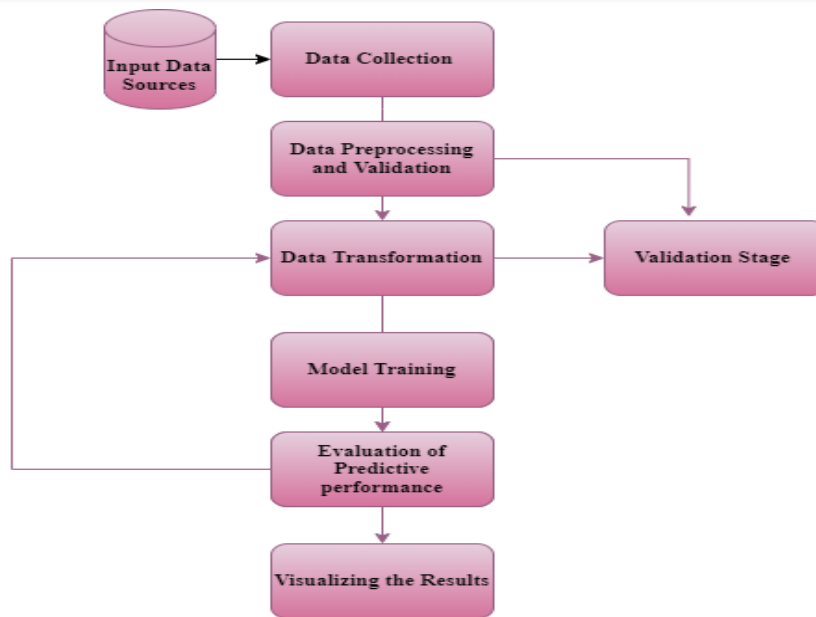
insight into various facets of financial choice problems and the preferences of the people involved (e.g., managers, investors, policy makers, etc.). They are frequently a component of decision support systems that include data management, analytics, visualizations, and reporting instruments. Classification models, regression models, and clustering models are the three forms of predictive analytics models. Classification models predict which values belong to a particular class, while regression models predict a number. Some of the popular techniques are used in developing the predictive models. In an artificial neural network, a network of artificial neurons is used to simulate the functions of the nervous system, processing input signals and producing outputs. Modelling such complex relationships is extremely challenging, but this model is capable of doing it. Artificial neural networks come in various models, each with a different algorithm. Back propagation is a popular algorithm used for many supervised learning problems. Artificial neural networks are also used for unsupervised problem solving. In unsupervised learning, clustering is used along with artificial neural networks. Nonlinear relationships can be handled by them. Recent studies have examined the cointegration relationship of the stock market amid crisis. Several authors have recognized the comprehensive analysis by applying the Generalized Autoregressive Conditional Heteroskedasticity (GARCH(1, 1) Model developed by Bollerslev (1986). Analysis of time series data in the field of behavioural finance has revealed the volatility clustering of the Indian stock market. GARCH models can be used to model and predict asset return volatility over time (Engle & Patton, 2001). Using a volatility forecasting model, (Maloney & Mulherin, 2003) predicted the irrational behaviour of investors. (Fehr & Tyran, 2005) observed that a small group of irrational investors affect the aggregate outcome of the market during crashes a small amount of individual irrationality can lead to large deviations from the aggregate predictions of rational models. It has been found that a small amount of individual irrationality can lead to large deviations from the aggregate predictions of rational models during crashes. (Fehr & Tyran, 2005). Past research on the predictive value of online communication for stock price changes include Bollen, Mao, and Zeng (2010), Zhang and Swanson (2010), Sprenger and Welpé (2010), Oh and Sheng (2011), and Xu et al. (2012). Oh, and Sheng (2011) analysed 72,000 microblog posts from Stocktwits.com over the course of three months to forecast stock price fluctuations. Using sentiment analysis, they discovered that microblog posts foretell future stock price movements. In addition, they briefly analysed the possible return on investments and discovered that basic (as opposed to market-adjusted) returns yield superior outcomes. In 2000, Charalambous et al. developed a financial crisis warning model using a sample of American companies from 1983 to 1994 and explained corporate bankruptcy. Model results indicated that the main option incentive variables (such as corporate performance volatility) play an important role in predicting defaults in the first, second, and third years of bankruptcy. The SVM algorithm was used by Ptak-Chmielewska to develop a bankruptcy prediction model. In comparing three typical corporate distress models with this model, a study found that traditional neural network algorithms are effective at predicting corporate distress based on financial statements. Zhou et al. examined the effectiveness and limitations of the SVM approach with respect to the corporate bankruptcy prediction problem, and concluded that the SVM approach performs better than the BPN neural network approach. The SVM algorithm

exhibits higher accuracy and generalization than the BPN algorithm with fewer training sets. Zelenikov et al. presented a two-step classification method (TSCM) in a related enterprise crisis warning model. Some companies were tested using financial ratio indicators, and several indicator trainings models, including economic indicators and microeconomic indicators, achieved an ideal accuracy rate.



**Figure 1.** Techniques of Predictive analytics using big data

Research on predictive analytics for big data has gained importance due to its applicability in a variety of fields and sectors. It has penetrated every industry, including healthcare, communications, education, marketing, and business, among others. Frequently, predictive analytics refers to forecasting the result of a given occurrence. Prediction is using statistical approaches to specific input data in order to forecast the result of an event. The word 'predictive analytics' is identical with terms such as 'machine learning,' 'data mining,' 'deep learning,' AI, CNN, ANN, LSTM, EDR (Figure1) and, more recently, 'data science,' which is currently in widespread usage. There is a fine distinction in their contexts of use, despite the fact that they appear equivalent.



**Figure 2.** Flowchart for stock market forecasting using Big data analytics

Stock market forecasting and analysis are among the most difficult tasks to do. There are several reasons for this, including market volatility and a range of other dependent and independent variables that impact the value of a certain stock in the market. These variables make it incredibly difficult for any stock market expert to predict the market's rise and fall with great precision. However, with the emergence of big data analytics and its powerful algorithms, contemporary market research and Stock Market Prediction improvements have begun to include such methodologies (figure 2) in evaluating stock market data.

### 3. Deep Learning for Investors Sentiment Analysis

It has been discovered that Deep Learning algorithms boost classification outcomes in some Big Data domains, such as computer vision and speech recognition. However, Deep Learning sentiment analysis has not been extensively investigated. Alexandrescu et al. presented a model in 2006 in which each word is represented by a vector of features. All of these features utilise a single embedding matrix. Using recursive neural networks (RNNs), Luong et al. (2013) modelled the morphological structures of words and learned morphologically-aware embeddings. Compositional distributional semantic models were utilised by Lazaridou et al. (2013) for phrase learning. Chupala (2013) employed a simple recurrent network (SRN) to discover continuous vector representations of character sequences. In 2011, Socher et al. suggested a semi-supervised technique for Deep Learning employing recursive auto encoders to generate a meaningful search space. Socher et al. (2012) proposed a model of semantic compositionality that is capable of learning vector compositions of arbitrary length. They describe a phrase using word vectors and parsing trees and compute vectors for higher nodes using tensor-based composition methods.

#### 4. Application of Python in Finance and Fin-Tech

In the financial industry, python is used for both quantitative and qualitative analysis. In addition to analysing stock markets, predictions, and machine learning in relation to stocks, financial analysts also use this technology. Python has many libraries for analysing the financial market, such as Pandas, NumPy, spicy, etc. The reason why analysts prefer this language is its ease of coding and ease of creating Python scripts. Python is also capable of integrating with other languages such as Ruby. Consequently, Python for finance is becoming increasingly popular. Now that we have a general understanding of Python, it makes sense to step back a bit and consider briefly the role of technology in finance. In this way, we will be better able to assess the role Python currently plays and, even more importantly, how it will likely play in the financial industry of the future. Most people who make their first steps with Python in a finance context will tackle an algorithmic problem. Scientists might use this technique, for example, when solving differential equations, evaluating integrals, or simply visualizing data. A formal development process, testing, documentation, and deployment are generally not considered at this stage. Nevertheless, this is the stage when people really fall in love with Python. Possibly one of the major reasons is that Python syntax is quite similar to the mathematical syntax used to describe scientific problems or financial algorithms. The role of technology in finance can be summarized in the following ways:

- Technology costs in the finance industry.
- Using technology to enable new business models.
- Access to technology and talent in the finance industry.
- Growing speed, frequency, and data volume.
- Increasing use of real-time analytics.

#### 5. Analysing Financial Data Using Data Mining

Data Mining is a field which executes advanced examination of data and it utilizes mechanisms and methods from statistics and machine learning. Advanced analytics and business intelligence applications make use of the information that is generated by them through the analysis of verified data. A financial analysis of data is crucial when determining whether a business is stable and profitable enough to make a capital investment. Financial analysts analyse balance sheets, cash flow statements, and income statements. There are several ways in which data mining in finance can be useful.

- Money laundering is the conversion of black money into white money. Today, data mining approaches have been developed in such a way that they include appropriate techniques for identifying money laundering. In the methodology of data mining, bank clients can identify or verify the anti-money laundering effect.
- Every bank is in the business of distributing loans. It also tests data pertaining to the size of features used in the loan prediction system. The data mining process helps in managing all the vital data and their large databases with the help of its models.

- Marketing and data mining work together to target specific markets; both support and decide market decisions. Using data mining, it helps retain profits, margins, etc., and determine which products are best for different kinds of customers.

## **6. Trends in the Financial Data Industry**

Following are a few trends that the financial data industry is following to improve customer service.

### **6.1. Implementing AI, ML, and Data Analytics**

AI, machine learning, IoT, and analytics are being used by financial institutions to understand customer needs and create business strategies accordingly. ML and AI provide risk assessment models that synthesize large volumes of data, identify critical market and consumer patterns, and predict impending risks. AI can reduce underwriting costs and delays, allowing lenders to increase profits per loan. In the future, AI and ML-based technologies will continue to serve the financial data industry and offer unprecedented opportunities.

A time series is a collection of data, in this case the price of a stock that is indexed over time. Hourly, daily, monthly, or even by the minute, this period of time could be divided. By accumulating price data using machine learning and/or deep learning models, a time series model is created. The data must be analysed and then fitted to the model. Using this method, future stock prices can be predicted over a set period of time. In machine learning and data science, a classification model is a type of modelling. These models are provided with data points, and then they attempt to classify or predict what is represented in the data.

Using financial data, such as the P/E ratio, total debt, volume, etc., a machine learning model can analyse the stock market or stocks in general and determine if they are a good investment. Models can be used to determine whether now is the right time to sell, hold, or buy a stock based on the financial information we provide.

### **6.2. Digital Finance**

In digital finance, credit products, payments, and other financial services are readily available to customers and companies. New users who are interested in digital financial services have been attracted to the online platforms as a result of affordable smart phones and easy access to the internet. The API-based ecosystem has led to organizations completing KYC procedures digitally. Banking cards, USSD, AEPS, and other digital payment systems are attracting more customers to digital financial services. The financial data industry is increasingly embracing digital services to meet the needs of customers.

### **6.3. Cyber Security**

Cyber-attacks have significantly increased due to the increasing use of online technology and cloud computing. Protecting the huge amount of data gathered by companies requires strict online security protocols. The use of artificial intelligence and modern technology can play an important role in securing that data and reducing cyber threats by monitoring and regulating different types of cyber-attacks.



#### 6.4. Personalized Services

In banking and other financial services, personalization engages several benefits such as improving conversion and engagement rates, improving customer loyalty and retention, and enhancing the customer experience.

#### 7. Predictive Analytics

The process of using computer models to predict future events is known as predictive analytics. Using statistics, historical data, and computer modeling, predictive analytics attempts to predict an outcome. Predictive analytics is especially useful for banks and financial institutions in forecasting market movements and assessing risk. Artificial intelligence, data mining, and machine learning are used by sophisticated programs to analyze enormous amounts of information. A model tries to predict what is likely to happen next, given current conditions, through the use of those resources. In either case, institutions rely on a wide variety of data sources and machine learning. They may also pull demographic data and other details from external databases in addition to your transaction history. Data analytics can assist customers with managing their accounts and completing banking tasks more efficiently in an online banking environment.

##### 7.1 Reporting

The Basic version of our analytics solution focuses on storing and reporting simple univariate and bivariate data. Banking examples include suspicious activity reporting and account verification.

##### 7.2 Descriptive Analytics

Developing actionable insights based on complex and multi-variate data.

In the banking industry, examples include customer segmentation and profitability, campaign analytics, and parametric Value at Risk calculations.

##### 7.3 Predictive Analytics

**Predictive analytics** is to predict the likely future outcome of events using structured and unstructured data from different sources. Banks typically use pattern recognition and machine learning to predict fraud, generate risk alerts at the customer/product/geographical level, design personalized and next-best offers, and conduct trigger-based cross-selling campaigns.

##### 7.4 Prescriptive Analytics

Big data from a variety of sources and simulations in various business scenarios are used to prescribe action items for addressing future events. For example, behavioural PD1, LGD2, and EAD3 modelling, channel mix modelling, real-time offer models, next-best-offer models, and stress testing for mandated and custom scenarios are typical banking examples.

Banks also benefit from reducing risk and reducing costs using data analytics. You're probably familiar with predictive analytics, which utilizes data to predict your creditworthiness. FICO credit scores, for instance, use statistical analysis to predict your behaviour, including whether



you are likely to miss payments. A portion of your score is based on how borrowers similar to you have performed in the past. Additionally, there is a critical field in which predictive analytics is indispensable for the financial sector: risk analysis. Credit scoring and determining the suitability of clients are often determined by models generated by predictive analytics. Analyzing key data points and comparing similarities among policyholders help in the decision-making process.

### **8. Algorithms**

In data science, algorithms are extensively used. The essence of an algorithm is a set of rules used to perform a certain task. Most of us are familiar with algorithms that can be used to purchase or sell stocks. An algorithm sets rules for things like when to buy a stock or when to sell a stock.

As an example, an algorithm could be set up to purchase a stock once it drops by 8% over the course of the day or to sell the stock if it loses 10% of its value compared to when it was first bought. Algorithms work without human interference. These programs are sometimes called bots. Their decisions are based on logic and are devoid of emotion.

### **9. Conclusion**

AI and predictive analytics are not only integral parts of the banking sector, but also of the financial industry as a whole. The knowledge about technology and what it has made possible has increased customer expectations. Any serious contender in the financial world today is unlikely to survive without a well-designed AI and predictive analytics strategy in place. In order to acquire new customers, banks can use these features to automatically group leads based on their interests. Artificial intelligence-enhanced systems can develop personalized and targeted marketing campaigns that have high success rates using analytical tools like response modelling. If you believe the numbers, technology is growing exponentially, and today we are processing vast amounts of data. According to a recent report, global data will grow by 61% by 2025 to 175 zettabytes. These are staggering numbers! Data Analytics and Machine Learning are helping traders become more efficient today. As a result, they complement each other and act as catalysts for identifying opportunities and reducing trading costs. The use of Financial Data Analytics enhances banks' marketing capabilities. Analytics are extremely valuable to functional areas like Risk, Compliance, Fraud, NPA monitoring, and Calculating Value at Risk to ensure optimal performance and make timely decisions.

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## EXCELLENCE IN BUSINESS, EXCELLENCE IN EDUCATION: THE FLAGSHIP UNIVERSITY THEORY

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### 1. Introduction

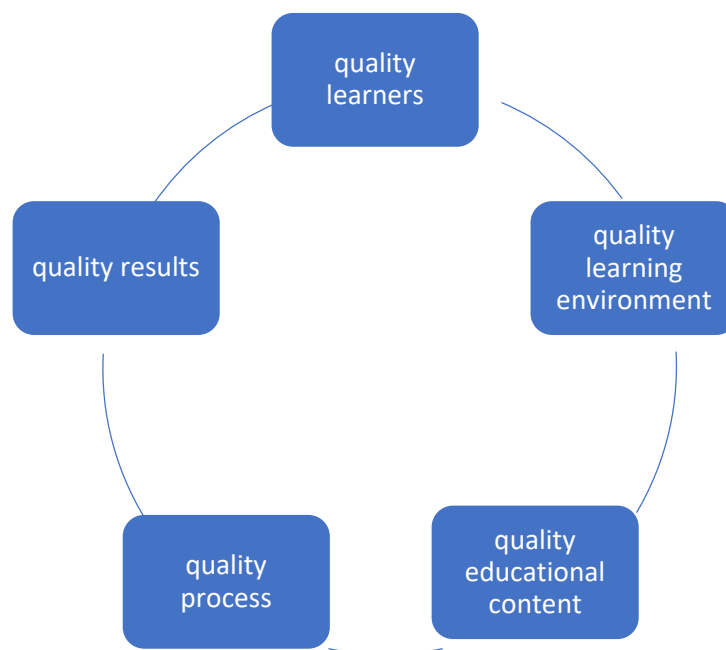
Our first and most important task is to summarize what we really mean by quality. Quality is a very complex concept. Given the many subjective elements that go into the definition of quality, we cannot define it precisely. What is clear is that quality can be considered in several places and in several domains. It can be said that quality can be defined as the level of satisfaction perceived by the customer, the client, the customer's customer. However, quality can also mean much more than this. In addition to satisfaction, it can also mean the excellent environment in which we work. Quality can also mean the process of creating a product or service that meets all your needs. So, the meaning of quality is an interesting question from the point of view of where we want to measure it or where we see the essence of our value creation.

It can be agreed that quality also means conformity, wherever we want to express it. This already implies the requirement of what expectations and requirements we want to meet. Quality therefore requires us to have objectives, expected results, targets or expressible parameters that help us to interpret quality itself. This is supported by one of the best-known methods, the so-called quality polygon. A polygon is a single graph showing the difference between expected values and actual values. Quality is achieved when the expected values on each arm of the polygon are equal to or exceed the actual values. The science of project management says the same thing. By quality we mean if we manage to meet or exceed the customer's expectations. It is quite clear that to interpret and establish quality, you really need to have the expectations that can form the basis of measurement.



Quality can be measured in many places. On the one hand, you can measure the result. You can also measure how you got to the result. Finally, we can also look at the environment in which the product or service itself is delivered. The latter is very important for understanding quality. Indeed, most models talk about the fact that it is not enough to measure quality in terms of the result. Rather, quality is determined by the environment in which the product or service itself is created. In other words, it is the extent to which the environment can create value, what it does to enhance this value creation and how the environment's commitment to quality can be improved. These ideas are also reflected in the EFQM model, which is increasingly being applied by higher education institutions. We need to understand quality in the same way in higher education.

We can say that the aim is to develop an education system that is able to offer much more to all stakeholders in its environment. The fundamental aim is to create an education system that can incorporate five essential elements. In the case where we are trying to improve the quality of the education system, we should not only think strictly of the students in education. The fundamental aim is therefore to develop an education system that emphasizes the importance of focusing on the five essential elements. These five elements include, on the one hand, quality learners, they include quality learning opportunities, that is, a quality learning environment, we must also address the provision of quality content in education, and they also include quality processes and quality outcomes. As can be seen, the concept of quality can indeed be applied to higher education, but it is a complex and complex process for those who wish to address the issue of quality in higher education. Improving the quality of education is a key issue because today's most competitive economies compete in international markets with real knowledge and expertise.



**Figure 1.** Understanding the quality of education



## 2. Literature Review

### 2.1. Why knowledge is the key?

Knowledge has become much more valuable in the 21st century. This is because knowledge is a unique resource that is neither depreciating nor ever depleting compared to other material resources. Knowledge can be seen as a resource and an asset in the national economy that can be constantly renewed and that enables economic actors to continuously create new value by making good use of knowledge. Without knowledge and expertise, there can be no real increase in competitiveness. It can be pointed out that without knowledge and appropriate skills or expertise, there is no chance of achieving significant economic success in the future.

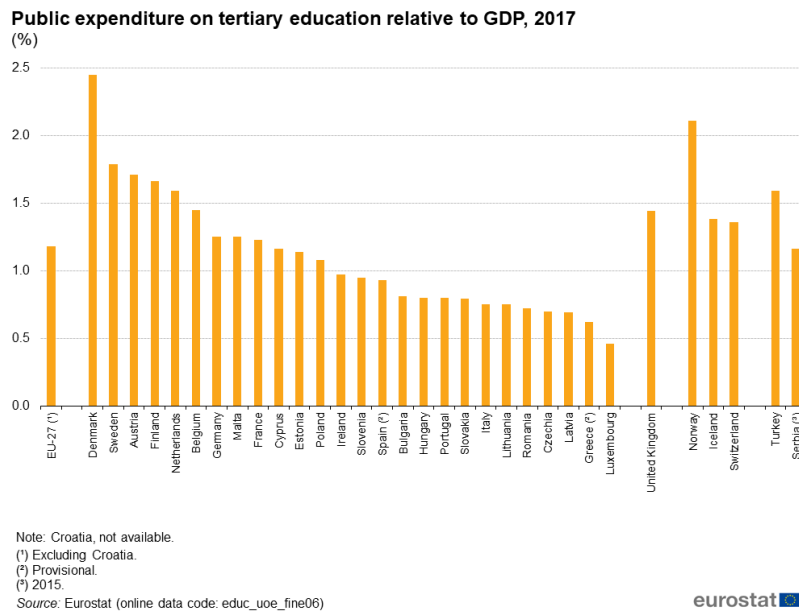
In the 21st century, a new resource will become dominant, slowly displacing traditional resources, and emerging as the new world currency. It is information, knowledge, imagination, intuition, and many other human-related resources that companies are competing for (Gerken, 1993). Competence is an inalienable factor of production. Key competences are the key to gaining a competitive advantage (Hoványi, 2002). Core competence is interpreted as the competence that is the main determinant of competitiveness. It directly determines what the organization can offer to the consumer and indirectly, through what system of activities it carries out its demand fulfilment function (Chikán, 2002). The importance of knowledge must be stressed to such an extent that we can now talk of knowledge-based economies. The most advanced and developed countries can now be considered as truly knowledge-based economies, with a very high level of innovation. It is not difficult to see, and perhaps does not need to be demonstrated, that innovation is indeed a knowledge and skills-intensive activity. A country that wants to build a more innovative economy must start by improving education. Today, education can be seen as a factor of competitiveness as well and must therefore be considered an important economic policy priority.

Knowledge-based economies were already important in the 1970s. The following competences are particularly advantageous in knowledge economies: creativity, problem-solving, knowledge transfer, enthusiasm, and confidence to succeed, and receptiveness to the new. In the nineteenth century, it is the individual and his or her knowledge and creativity that constitute the differentiating competences that create competitive advantage (Drucker, 2000). A more interesting approach is taken by Ridderstrale and his co-author (2003), who argue that when land was a profitable resource, nations fought over it; today, they fight to acquire talented people. Whether we like it or not, the success of every region and every organization depends on its ability to attract people who can bring about change. According to Gerken (1993) mentioned earlier, the next generations and generations will no longer focus on money, but on knowledge and information. These will emerge as the new world currencies and the economy will be based on information and innovative intelligence. These cannot be produced and developed without a proper education system. Again, it is not difficult to see that this is an attribute that is inseparable from man.

The human brain and mind can be capable of the continuous renewal and innovation that can lead us to knowledge-based economies. Many famous economists, including Solow, mention

the role of knowledge. Solow's famous economic growth model emphasizes technological innovation and the importance of education. Today, economists are talking about a new revolution: the knowledge and information revolution. Traditional resources such as capital, assets and land are becoming less important. In the "knowledge age", the most important resources will be knowledge and intelligence. New theories of growth are emerging, according to which economic growth depends fundamentally on the scale and efficiency of investment in knowledge: education and R&D. Companies with huge money and assets grow more slowly and can claim much lower returns than smaller, knowledge-based firms. The latter, however, are not created out of thin air. Creative, smart and problem-solving people help make the world a more innovative place every day, but it is also important to recognize that expertise alone is not enough. Knowledge does not develop by itself, nor does the environment that can best support its use.

So where this competitive knowledge comes from is also a very important question. We can clearly say that economic actors involved in knowledge transfer, knowledge transfer or, simply put, education, will have a major role to play here. The most important task of these actors is to train and release into the economy highly skilled, excellent professionals. However, it should also be borne in mind that these actors are now also highly competitive. The study focuses exclusively on higher education institutions and seeks to answer the question of whether higher education institutions can be considered as quality institutions or as business models that can best help them to compete in the competitive environment in which they operate. Yes, it must be said that higher education institutions themselves are not at the same level. Differences are also emerging between them, and it is a very important question in all cases how a higher education institution can survive and maintain its competitiveness in an increasingly competitive environment. One of the answers to this is the right business model. The question is whether the institution has a business model at all, and the other question may relate mainly to whether the business model includes the pursuit of quality. These are issues that are clearly areas to be examined in the context of the current situation and competition in the higher education sector.



**Figure 2.** Public expenditure on tertiary education relative to GDP, 2017

Source: EuroStat (2018)<sup>1</sup>

## 2.2. The business model for education

very business organization has a business model in principle. A business model describes the way organizations create value. For some actors, it is a well-defined, well-organized, and structured model, while for others it can be described as a spontaneously developed, routine organizational characteristic. The refinement of the business model is largely responsible for the extent to which it has succeeded in creating high value for its stakeholders. The business model is fundamentally different from the strategy. Strategy describes in concrete terms the objectives and the pathways to those objectives. Strategy is where we define our vision and mission. Of course, this does not mean that strategy excludes the existence of a business model. But the fundamental difference is that the strategy defines precise paths and goals, whereas the business model describes the way in which value is created, i.e., the process of value creation itself. The question of the extent to which actors who want to operate at a higher quality level can define both their strategy and their business model is therefore very important.

In essence, those actors that are involved in business planning or strategy formulation are not far from formulating a business model. It would be even better if they could include qualitative aspects in the strategy or business model. It has been shown above that quality can be considered from several angles and in several areas. The same can be said for quality in higher education. If we look at higher education institutions, they operate in a very similar way to businesses. Most higher education institutions have a shorter or longer-term strategy. Higher education

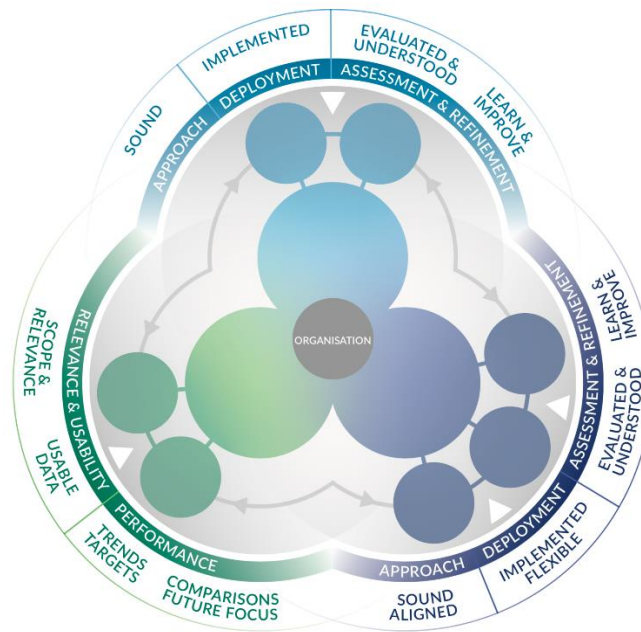
<sup>1</sup>

[https://ec.europa.eu/eurostat/statistics-explained/index.php?title=File:Public\\_expenditure\\_on\\_tertiary\\_education\\_relative\\_to\\_GDP,\\_2017\\_\(%25\)\\_ET2020.png&oldid=500714](https://ec.europa.eu/eurostat/statistics-explained/index.php?title=File:Public_expenditure_on_tertiary_education_relative_to_GDP,_2017_(%25)_ET2020.png&oldid=500714)

institutions also set shorter or longer-term objectives. It is equally true that they have functional strategic elements. Almost all HEIs have, for example, a human resources strategy or a financial strategy.

As competition in the 21st century intensifies, more and more institutions need to develop a marketing plan or carry out marketing campaigns to attract more students. It is therefore clear that higher education institutions are also increasingly having to adopt strategic elements to remain competitive. However, in the 21st century it is no longer enough to simply implement strategies. Indeed, a higher education institution must also define the way in which it wants to create value for its stakeholders. Stakeholder should be seen in a much broader sense, as has been stated earlier in the paper. Stakeholders do not only mean students in higher education, but also many other stakeholders need to be considered in this perspective.

The EFQM model mentions this and points out that true quality must be achieved by an institution through several pillars. It is not enough to have a strategy, although the EFQM model also considers this to be an important condition. The EFQM model is a specific framework that aims to enhance quality in economic operators. The EFQM model is a globally recognized framework to help operators manage change and improve performance. Over the years it has undergone several cycles of development, as a result of which it has retained its validity and continues to provide guidance for any organization that envisages a long-term and sustainable future. At the heart of the EFQM model's logic is a system that refers to the relationship between the organization's purpose and its strategy, and how this helps the organization to create sustainable value and deliver outstanding results for its key stakeholders. The focus here is again on stakeholders and the environment. This also shows that the understanding of quality cannot be only on the output side, but that we need to analyze quality at many points. Here we need to go back to the five points we made earlier about the quality of education.



**Figure 3.** The new EFQM model

Source: Institute for Total Quality Management (2018)<sup>2</sup>

### 2.3. The flagship university theory – is it a true story?

Higher education institutions themselves can design the strategy and business model that will best enable them to extend value creation at all levels. In addition to the five elements above, it is perhaps worth highlighting the excellent colleagues without whom knowledge transfer could hardly function well. Flagship universities is an existing term used to describe the most outstanding universities. The starting point should be that there is also competition between institutions and that the place or concrete manifestation of this competition can be seen in the rankings of higher education. These rankings make a clear distinction between institutions, so that we can indeed see better and less well performing institutions. But these rankings are not only dependent on the number of students. Each ranking looks at different evaluation criteria. An institution wishing to move up in a ranking should take into account the assessment criteria of that ranking. The EFQM model described above has defined just such evaluation criteria. For example, according to the model, striving for excellence means that an institution has appropriate strategic objectives and sub-objectives, can analyze its environment, is continuously self-diagnostic and is able to reach out to the widest possible range of stakeholders. Quality should not be understood merely in terms of student satisfaction, which is only an output-side approach. Processes and teaching methodology are as important an area of analysis as, for example, the measurement of student satisfaction. The higher education institution should be seen as a system. It has been mentioned earlier that these institutions should be treated in a similar way to enterprises and that several management solutions can be

<sup>2</sup> <https://www.itqm.ch/en/efqm-diagnostic-tool-radar>

applied to them that were not previously possible. Why not apply the same quality approach to higher education institutions? The flagship university theory is an excellent example of this.

It has been shown above that a higher education institution that is truly committed to quality is also able to define an appropriate strategy and, in addition, to develop a business model for all stakeholders to create value. The focus of this study is to examine whether we can find a business model among HEIs that can really create value for stakeholders. The answer can be found in the international literature.

The flagship model is also considered a highly controversial model in the international context. What is clear is that flagship universities are indeed the most successful institutions. One of the most striking features of flagship universities is that they are very supportive of an institutional culture in which those involved are given the right support and background for development. It should be highlighted that quality models have also emphasized the existence of an appropriate culture.

The harmony between an appropriate organizational culture and leadership is crucial for enhancing quality. It should be stressed that organizational culture is the set of values, customs, norms, traditions that characterize a particular group of employees or groups of employees at a particular time and the way they behave towards each other within the organization. There can be little question that the right behavior within an organization can influence its quality development. TQM itself emphasizes that quality is in fact the way in which the members and stakeholders of an organization think about quality or the way in which they actively act every day to achieve better results. It could be argued that this approach could become prevalent in higher education institutions and that a great deal could be done to ensure that the stakeholders themselves are committed to quality. This includes the heads of the institutions, the students who study there, the administrative staff and, not least, the staff and teachers who teach there. If everyone were interested in improving quality and had the right motivation and commitment, the desired behavior could go a long way towards achieving better results. In sum, quality occurs when there is a meaningful improvement or enhancement in the parameters we measure, while the sacrifices and efforts made to achieve it have not in any way degraded any cultural feature of the organization. The term 'institutional culture' is used hereafter instead of 'organizational culture'.

The management of the institution complements the effectiveness of the institutional culture. As in the case of higher education institutions, their management style can have a profound impact on the cultural values that characterize the institution. It has been mentioned above that, to achieve the right quality, it is necessary to provide the people concerned with support and a background for their individual development. It is not only financial recognition that will be important here, although it should be stressed that there are also significant differences in financial remuneration between European universities (Douglass, 2016).



Annual gross statutory starting salaries (EUR) for full-time, fully qualified teachers in public schools, 2019/20

	BE fr	BE de	BE nl	BG	CZ	DK	DE	EE	IE	EL	ES	FR	HR
ISCED 02	32 010	34 746	33 061	6 657	12 792	47 040	:	:	:	13 104	30 550	26 537	:
ISCED 1	32 010	34 746	33 061	6 657	13 608	54 228	51 695	15 520	36 953	13 104	30 550	26 537	14 376
ISCED 24	32 010	34 746	33 061	6 657	13 608	54 504	57 311	15 520	36 953	13 104	34 121	29 065	14 376
ISCED 34	39 817	43 537	41 246	6 657	13 608	51 277	59 935	15 520	36 953	13 104	34 121	29 065	14 376
	IT	CY	LV	LT	LU	HU	MT	NL	AT	PL	PT	RO	SI
ISCED 02	24 297	:	9 000	10 476	67 391	7 195	19 615	39 504	:	8 076	22 351	8 969	19 529
ISCED 1	24 297	:	9 000	14 573	67 391	7 195	23 927	39 504	38 414	8 076	22 351	8 969	19 529
ISCED 24	26 114	:	9 000	14 573	76 376	7 195	23 927	39 806	38 224	8 076	22 351	8 969	19 529
ISCED 34	26 114	:	9 000	14 573	76 376	7 195	23 927	39 806	38 325	8 076	22 351	8 969	19 529
	SK	FI	SE	AL	BA	CH	IS	LI	ME	MK	NO	RS	TR
ISCED 02	8 592	29 201	36 798	4 189	6 120	69 967	39 955	75 835	9 715	6 624	38 236	6 330	7 926
ISCED 1	10 646	33 140	37 209	4 938	6 528	75 012	39 657	78 779	9 715	6 811	45 669	7 396	7 926
ISCED 24	10 646	35 792	38 398	5 132	6 936	83 606	39 657	93 042	9 715	6 811	45 669	7 396	8 242
ISCED 34	10 646	37 954	39 388	5 423	8 160	94 162	38 487	93 042	9 715	7 111	49 586	7 396	8 242

Source: Eurydice.

Figure 4. The starting salary of teachers (2019/2020)

Source: Publications Office of the European Union (2021)<sup>3</sup>

So, competition is fierce not only in the university rankings, but also in other areas. The graph above clearly shows the differences in the salaries of academics across countries. The flagship universities will also try to provide adequate conditions for their staff in this respect, so adequate financial conditions will be a very important feature of the flagship universities. However, money alone is not enough to improve quality, because here too the saying is true that only money well spent will bring real results. It must be invested in the right place and, first and foremost, more needs to be spent on staff recognition and development. Flagship universities are doing very well in this. If we assume that people are working on research projects and that the production of new knowledge also requires a strong human brain, it is not difficult to see that it is worth investing in human capital and in the human brain. At the same time, the quality of management in flagship universities must be right.

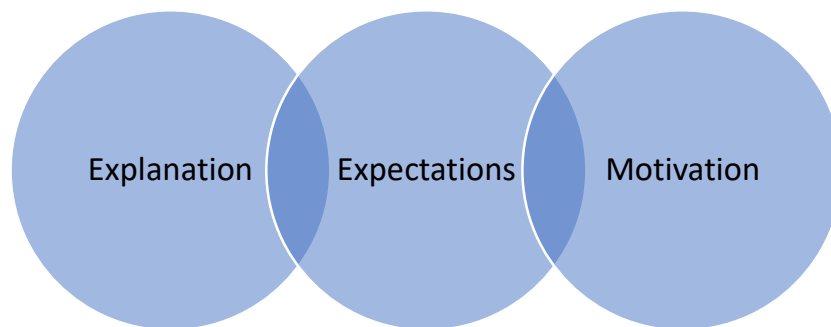
Leadership can and usually does have an impact on the institution. For institutions striving for quality and excellence, leadership is not a position to be filled, but rather a behavior that results in attitudes at all levels and units of the organization. Leadership therefore acts as a kind of influence on the behavior of staff and all those involved, not in a negative sense, but in a positive and stimulating sense. A style of leadership is needed that promotes the delivery of results in the institution. Leadership inspires and empowers others and, where necessary, permeates and transforms values and norms, as well as helping and shaping the institutional culture. The leadership of the higher education institution plays a primary role in shaping these values in the

<sup>3</sup> <https://op.europa.eu/en/publication-detail/-/publication/ea38b809-3dea-11ec-89db-01aa75ed71a1/language-en/format-PDF/source-search>



right way. Values must be nurtured and cared for on an ongoing basis. It is like an uncut diamond that can be transformed into a magnificent gem with the right tools.

In shaping the institutional culture, it is necessary to consider the need to manage the culture and nurture its values. It is necessary to create the conditions in the higher education institution that are most conducive to change and able to support development. Creativity in the institution must be strengthened. It is also necessary to engage stakeholders because quality only develops to a high degree in an environment where stakeholders are sufficiently committed to it. And commitment must be fostered by management tools such as explanation, clarification of expectations and motivational tools (Douglass, 2016).



**Figure 5.** Strengthening engagement

Source: own editing

A key feature of flagship universities is that they strive to be at the forefront of new knowledge creation. In addition, these institutions establish significant international collaborations to ensure that knowledge is shared at the highest possible level. Several forms of international cooperation can be identified. One only has to look at international mobility programs, which can offer considerable potential. However, flagship universities are not only at the forefront of small-scale or short-term mobility programs. Larger-scale research and other collaborations or links with businesses will also be important.

A very important feature of these institutions is that their strategic thinking is constantly reflecting a fundamental question: what is the pathway to becoming a flagship? And when the path emerges, it is immediately apparent why it is necessary and important for the institutions to have a strategy. There must be a vision and a path along which the institution can achieve the desired state of becoming a flagship. The most outstanding and successful universities in the world almost always have similar characteristics. One of the most important of these characteristics is that they are characterized by a very high quality and high level of research activity. They do not just carry out R&D in isolation. They are also characterized by international cooperation in this field and extensive use of external expertise at all stages of R&D.

Flagship universities also express their strategic thinking in a completely different vertical. They use their mission and scientific culture, as well as their organizational characteristics, to enhance their relevance in life and in different societal communities. Flagship universities no

longer aim to be merely educational institutions. They aim to become useful actors in society, to create value for a wider audience and to engage with the economy in more ways than just training and education. All this requires a transformation of our strategic thinking, as mentioned earlier. An institution of higher education must already turn in directions such as social responsibility and, in this sense, it must also seek to prioritize CSR activities.

The flagship universities also provide many examples of the importance of good publication results. The fact that they also have publications, patents, and licenses, and in more than a few cases are very active in the business world and thus in some cases are themselves entrepreneurs, contributes greatly to their high ranking. The concept of the entrepreneurial university is not far removed from these institutions, which are able to test and disseminate their knowledge in everyday life, even in business markets. The flagship university concept originated in the US. It sought to promote social and economic mobility and economic development through the targeted development of education and research. Already in the mid-1800s, a network of universities emerged that were able to do more to promote development. The state supported the development of these institutions with targeted investments, investments that would still be important today. As already discussed in the context of knowledge-based economies, building competitiveness at the national level requires higher investment in education. In the second half of the 1800s, it became prevalent in the US that only an educated citizen could be able to promote democracy. The institutions that have grown into flagship universities along the way have become very important in shaping and training these educated citizens. The promotion of science and learning has been the primary means of becoming an educated citizen, a function which these institutions around the world continue to perform to a high degree today (Douglass, 2016).

Flagship universities are indeed a network, as can be seen in Figure 6. They include those institutions that have a real impact on their environment. Behind all this is the fact that these institutions have formulated a strategic goal in the past: we want to become a flagship! And in addition to setting this goal, they have made qualitative changes that have helped them to move up the ladder. These included the culture change and leadership support mentioned earlier. Of course, we cannot continue to ignore the financial issues, as the flagship universities have also received adequate public funding, which has been allocated to strategically important areas.



**Figure 6.** Flagship Universities in the US

Source: insidehighered.com<sup>4</sup>

The flagship universities are committed to educating the best students, providing the highest quality professional education, and engaging in civic engagement and economic development. Such universities have an excellent research record. They have full freedom of research, so there are no constraints that would hinder these institutions in any meaningful way. They are also committed to combining academic and vocational education, so they can innovate in their profile and provide a diverse educational palette for those who wish to learn. It is also crucial to stress the importance for such institutions of continuous feedback and evaluation of the usefulness of research results. They want their research to be of real benefit to society, so they want to filter out activities that do not add significant added value. It is a perfectly logical concept to think that it is pointless to support research that does not add anything to what we already know.

### 3. Summary and Conclusions

The aim of our study was to present the concept of the so-called flagship university, which could play a really important role in the economy. Its name suggests that such a university can play a central role in shaping a society or community, and more and more universities today should take on this role. The mission of universities needs to be rethought. Today, it is no longer enough for universities to be concerned only with education and training, but they must also reach out into ever more diverse areas of life. Universities can become entrepreneurs, they can implement CSR programs, they can do more for sustainability, but perhaps most importantly, they need to become more visible and important actors at the societal level. There is a lot of valuable knowledge accumulated by these actors that could be used in the economy. Many models or methods are being created that exist only on paper, when they could provide solutions

<sup>4</sup> <https://www.insidehighered.com/blogs/world-view/flagship-universities-vs-world-class-universities>

for many economic players. The flagship university is also significantly different from other so-called traditional universities in its strategic thinking and its commitment to quality. Higher education institutions could be managed like businesses. A few management solutions could be applied to universities, for example the use of the EFQM methodology. However, the human factor is the most important factor. It is the attitude and behavior of people that most determines the character of an institution. In the context of a university, it is not only the management but also the teaching staff, the administrative staff and the students who determine the commitment to quality. The responsibility of management must also be stressed here, as they can do the most to ensure that culture change is achieved. The paper has a separate chapter on the role of institutional culture in this process, and a specific section on why stakeholders really need to be engaged to become a truly flagship university. Strategic commitment, receptiveness to change and a willingness to act are also needed for a university that aims to become a flagship. Although the American concept dates to the 1800s, it still raises relevant and important issues today. Higher education is also in a state of flux, so institutions may from time to time ask themselves how they can become more successful and competitive in a world where the pace of change is only intensifying. Higher education stakeholders cannot ignore these changes either, so when making strategic decisions, they could really reflect on the question of what the path is to become a flagship. Hopefully, more and more institutions will find this path, because it will then point towards a much more competitive and modern education system.

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## **BENEFITS AND ADVANTAGES OF STUDYING AND LIVING IN CANADA FOR INTERNATIONAL STUDENTS**

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### **1. Introduction**

Canada is one of the largest countries of the North America. Well structured political economy principles performing by the politics of this country, made Canada one of the leading countries of the world. Clear strategic policy formulation, efficiency of implementation of right formulated strategic policy, justice position on major legislative issues and formulated stable foundation for future policy guides and effective policy maintenance by leaders of the country, made this country well-known and Canada attracted and attracts a huge number of immigrants to country.

Well-executed international student policy of the government of Canada and perfect education system has created all the conditions for obtaining secondary education and high education recognized in almost all leading countries of the world.

### **2. Study and Live in Canada**

Canada is a federation of 10 provinces and three territories. Under the Canadian constitution, provincial governments have exclusive responsibility for all levels of education. There is no ministry or department of education at the federal level; instead, premiers are responsible for education in the provinces and territories respectively.

Education in Canada is generally divided into primary education, followed by secondary education and post-secondary. Within the provinces under the ministry of education, there are district school boards administering the educational programs. The Council of Ministers of Education Canada (CMEC) founded in 1967 by the ministers of education serves as:

- a forum to discuss policy issues related to education
- a mechanism through which to conceive educational activities, projects, and initiatives in areas of mutual interest
- a means by which to consult and cooperate with national education organizations and the federal government
- an instrument to represent the education interests of the provinces and territories on an international level (CMEC, n.d.).

While all provinces and territories carry out education-related international activities individually, CMEC speaks and acts on behalf of the country on the world stage. CMEC coordinates and supports provincial and territorial efforts to further the education sector at key multilateral organizations, such as the Organization for Economic Co-operation and Development (OECD) and the United Nations Educational, Scientific and Cultural Organization (UNESCO) and at major international education events such as the International Summit on the Teaching Profession (ISTP). Other organizations with which CMEC has a working relationship include: The Organization of American States (OAS), the Asia Pacific Economic Cooperation (APEC), the Commonwealth, the G7, and the G20.

In the face of ongoing global developments, the government of Canada has taken initiative to invest in innovative technologies and ideas which, in turn, will improve the economic growth of the country and make Canada more globally competitive. Government leaders have been acting to further develop and see through recommendations made in the 2018 Fall Economic Statement of Canada (Government of Canada, 2018). The main goal of the proposal is to breed a more globally connected country.

In this Fall Economic Statement, the Government proposes to:

- Support business investment through new tax incentives
- Diversify Canada's trade with Europe and the Asia-Pacific region
- This helps businesses take full advantage of trade agreements, while offering continued support for Canada's innovators.
- Remove the barriers to trade within Canada
- Modernize business regulations

Such economic goals cannot be successfully achieved without a community of educated individuals. Funding education is a vital part of investing in a country's overall welfare.

Education also enriches our understanding of ourselves and the world around us. Among other benefits, it leads to broader social benefits to individuals and society. Investing in education increases individual productivity and creativity, while also promoting entrepreneurship and technological advances.

In 1989, Tilak, Jandhyala B. G. wrote that education transforms individuals into productive human capital - this is done by instilling skills required by both the traditional sector and the modern sector of the economy. As a result, individuals become more productive not only in the marketplace, but also in the household. Both technical training and general education contributes to economic growth, which leads to increase in individuals' earnings as well. This article represents the positive impact of general education on the industrial and social performance of a country (Tilak, 1989).

Being one of the most highly developed countries of the world, Canada constantly ranks as the top country for quality of life. The government of Canada has created a reasonable balance



between the growth of the education and economic sector alike. According to the OCED, Canada is the country with the 5th largest share of its GDP in education.

**Table 1.** Canada and similar countries' GDP comparison

Norway	6.7%
New Zealand	6.2%
United Kingdom	6.1%
United States	6.0%
Canada	5.8%
France	5.2%
Spain	4.3%
Germany	4.3%
Italy	4.1%
Japan	4.0%
Russia	3.4%

This table represents the percentage of each country's contribution to the education sector according to their respective federal budget.

Canada employs two major tactics to educate their residents.

### 3. Opening More Schools

The government of Canada is opening elementary and secondary schools to accommodate the current population of the country which is 38.23 million. There are currently 10,100 elementary schools and approximately 3,419 secondary schools.

#### 4. Practicing International Student Policy

Secondly, Canada is practicing international student policy in the country; government opens a huge opportunity for the undergraduate international students and graduate international students to come for study in Canada. Table 2 has proven statistic data of study permit holders in Canada.

**Table 2.** Top ten origin countries of study permit holders with a valid permit in Canada in 2020.

India	180 275
Republic of China	116 935
Vietnam	18 910
France	18 295
Republic of Korea	18 170
Iran	14045
United States of America	12 740
Brazil	11 050
Nigeria	10 635
Bangladesh	7 785

When asked the question, why they chose to study in Canada, international students answered:

- 1) the positive reputation of the country
- 2) safety purposes
- 3) high education standards
- 4) multiculturalism
- 5) Canadian values

**Table 3.** Total number of international students in Canada, by province and territory, 2015 and 2016 (GoC, 2017).

	2015 Long Term Students	2015 Short Term Students	2015 All Students	2016 Long Term Students	2016 Short Term Students	2016 All Students
Newfoundland and Labrador	2,638	0	2,638	3,227	0	3,227
Prince Edward Island	1,424	291	1,715	1,969	301	2,270
Nova Scotia	10,347	2,191	12,537	11,799	2,264	14,063
New Brunswick	4,173	663	4,837	4,493	686	5,178
Quebec	49,689	12,191	61,880	54,934	12,600	67,534
Ontario	149,435	46,275	195,710	185,398	47,828	233,226
Manitoba	9,918	1,358	11,276	12,894	1,404	14,298
Saskatchewan	5,736	1,078	6,814	6,949	1,114	8,063
Alberta	18,472	7,591	26,063	22,496	7,846	30,342
British Columbia	93,927	40,397	134,324	103,938	41,753	145,691
Yukon	25	0	25	60	0	60
Northwest Territories	9	0	9	19	0	19
Nunavut	0	0	0	0	0	0
Canada[11]	345,793	112,036	457,828	408,176	115,796	523,971

### **5. Economic Impact of the International Students on the Economy of Canada.**

As we see from the above table, British Columbia, Ontario, and Alberta have demonstrated the highest performance among all provinces in terms of the education services to the international students.

The number of international students studying in Canada continues to grow steadily. In fact, the increase between 2015 and 2016 was substantial, from approximately 457,800 to 524,000, an increase of 14.4%. As of December 31st, 2021, Canada is hosting nearly 622,000 international students (Government of Canada, 2017).

There is an undeniable correlation between the number of the international students and economic growth within each region of Canada. A 2017 study on the effect of international students on the Canadian economy demonstrates this (El-Assal, 2022).

This report emphasized three major economic impacts:

1. Direct impact measures the increase in industrial output and the increase in an industry's labor force resulting from the inflow of international students and their spending on a yearly basis.
2. Indirect impact measures the change in industrial output and employment demand in sectors that supply goods and services to sectors of the economy that are directly impacted.
3. Induced impact measures the changes in output and employment demand over all sectors of the economy as a result of an income increase in households impacted both directly and indirectly (Government of Canada, 2017).

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**Table 4.** Total annual expenditures of international students in Canada, by province and territory, 2015 and 2016 (CAD \$ millions) (GoC, 2017).

	2015 Long Term Students	2015 Short Term Students	2015 All Students	2016 Long Term Students	2016 Short Term Students	2016 All Students
Newfoundland and Labrador	\$58.4	\$0.0	\$58.4	\$72.6	\$0.0	\$72.6
Prince Edward Island	\$47.3	\$1.4	\$48.6	\$66.9	\$1.4	\$68.3
Nova Scotia	\$328.2	\$24.5	\$352.8	\$388.1	\$25.3	\$413.4
New Brunswick	\$119.3	\$4.7	\$124.0	\$131.5	\$4.9	\$136.4
Quebec	\$1,596.2	\$96.3	\$1,692.5	\$1,787.7	\$99.5	\$1,887.2
Ontario	\$5,748.1	\$413.2	\$6,161.4	\$7,379.7	\$427.1	\$7,806.8
Manitoba	\$275.0	\$12.8	\$287.8	\$361.6	\$13.2	\$374.8
Saskatchewan	\$168.2	\$12.8	\$181.0	\$209.4	\$13.2	\$222.6
Alberta	\$590.8	\$78.1	\$668.9	\$742.8	\$80.7	\$823.6
British Columbia	\$2,901.8	\$335.1	\$3,236.8	\$3,380.3	\$346.3	\$3,726.6
Yukon	\$0.6	\$0.0	\$0.6	\$1.4	\$0.0	\$1.4
Northwest Territories	\$0.2	\$0.0	\$0.2	\$0.4	\$0.0	\$0.4
Nunavut	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0
Canada	\$11,834.1	\$979	\$12,812.9	\$14,522.3	\$1,012	\$15,533.9

## 6. Study in British Columbia (Bc), Canada And Features of Curriculum Development

As it was mentioned above, the province of British Columbia (BC) is one of the attractive and popular provinces for the international students. British Columbia is located in the West part of Canada, with a population of an estimated 5.20 million. The province is protected by mountains and warmed by the current of the Pacific Ocean, making BC one of the warmest cities in Canada.

There are three factors which attract international students to study in BC, Canada:

- 1.Beautiful nature and moderate climate
- 2.Educational programs that meet all the demands of the modern economy of the world
- 3.Safe and engaging learning conditions which are created and sustained in educational institutions

The top organization for coordinating and operating programs for international students in BC is called the British Columbia Council for International Education (BCCIE). The BCCIE is a provincial Crown corporation, that supports the internationalization efforts of British Columbia's public and independent K-12 schools, public and private colleges and universities and language schools. It promotes international education in and for BC, to enhance BC's international reputation for quality education, and to support the international education activities of the provincial government.

Worldwide recognized educational system of Canada is proven fact that program and curriculums of Canadian educational institutions are unique, accurate and comply with modern economic model of the world.

In order to demonstrate how world-class educational programs have been implemented in BC, we can further examine Alexander Academy and Langara College, two leading post-secondary schools in the province.

### 6.1. Alexander Academy

Alexander Academy is a private school located in Downtown, Vancouver BC, Canada. Alexander Academy offers a graduation program and a university transfer program for local and international students. There is an internationally diverse student community at Alexander Academy, which represents students from over 30 countries. Here are the names of unique programs of this school:

- The BC Dogwood Graduation Program is designed for students willing to complete high school programs from grade 9 to 12
- The University Transfer Program is designed to provide students with opportunities to begin University transfer studies in sister school Alexander College while in high school.
- The English Language Development Program is designed for all non-native English speakers of all ages.

•The summer school program includes courses that are aimed to help students improve their marks to prepare for the next grade and graduate in time to apply to college or university

## **6.2. Langara College**

Langara College is a public degree-granting college in Vancouver, BC which serves approximately 22,000 students through its various programs.

- Art programs: Digital and Print Publishing, Professional Photography, Web and Mobile Design and Development
- Business programs: Financial Management, Marketing Management, Nutrition and Food Services Management
- Science and Technology programs: Applied for Science Engineering, Data Analysis, Computer Science, Internet and Web Technology
- Humanities and Social Science programs: Women Studies, Peace and Conflict Studies, Environmental Studies
- Health programs: Kinesiology, Nursing Practice in Canada, Food and Nutrition.

The curriculum development process can be categorized into five basic steps:

- 1) needs assessment,
- 2) the planning session,
- 3) content development,
- 4) pilot delivery and revision,
- 5) the completed curriculum package (Miles, 2016).

That is a fact, program and curriculum developer of educational institutions of Canada, make an accurate research and analysis to provide a right orientations and directions through education programs and job place training programs based on the requirements of the modern economy. Right after “needs assessment” they acknowledge and identify specific skills and specialist requirements for the workplace of province or country, then process curriculum development to educate the students. In the Journal of Teacher Education, a group of education scientific researchers made the following decision in regards to correct determination of “needs assessment”:

To compete in a global arena, a nation needs its workforce to develop new ideas and solve problems successfully, collaborate and communicate with other people effectively, and adapt and function flexibly in different contexts and environments. Central to this mission is the need to develop certain types of specialized knowledge, skills, and values within its workforce. These include science, mathematics, and technological literacy, multilingual oral reading, and communication competence, willingness, and ability to understand different cultures and use such understandings to work with different individuals. From this perspective,



one of the primary responsibilities of teachers is to equip a nation's future workforce with these qualities."(Wang et al., 2011).

## **7. Conclusion**

It is clear from the presented above information and data enrolment of the international students to the educational institutions of the Canada became a part of the domestic and foreign policy of Canada. The government of Canada regulates this strategic policy a very successfully and sharing the results of the benefits and advantages of this policy with international students.

Our analysis on study and live in Canada for of international students indicate, that relationship between international students and government of Canada has been built on win-to -win bases: both sides are getting benefits from this partnership relationship: right after admission international students get opportunity to receive scholarships from the government of Canada and after 2 years of the full-time study international student can apply for work permit. Graduated international student gets high paid job in Canada or if he/she goes back to the country of origin, international student represents well-known in the world Canada's educational institutions.

The Honorable James Gordon Carr Minister of International Trade Diversification of Canada from 2018-2019, on his message to the public has been recognized and noted all aspects of the contributions of the international students in the economy of Canada:

“Students from abroad who study in Canada bring those same benefits to our shores. If they choose to immigrate to Canada, they contribute to Canada's economic success. Those who choose to return to their countries become life-long ambassadors for Canada and for Canadian values. Many Canadian education institutions export services such as curriculum licensing and technical and professional training, often with the help of the Canadian Trade Commissioner Service (TCS). In doing so, they export Canadian values and import new ideas, as well as generate economic returns for Canada. In 2018, international students in Canada contributed an estimated \$21.6 billion to Canada's GDP and in 2016 supported almost 170,000 jobs for Canada's middle class. This is a significant economic contribution— and one that is felt right across the country” (Government of Canada, 2019).

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**DEBATES ON CREATIVITY AND ITS REFLECTIONS IN  
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**1. Introduction**

Creativity is an ability that we have encountered and are still encountering in many different fields of life since ancient times. Creativity, which was thought to be a divine power in ancient times, was considered a reflection of God in man (Glaveanu & Kaufman, 2019). Man's creative actions were regarded as the manifestation of God. This divine perception has turned towards the individual over time. It is known that the Renaissance period affected the emergence of the idea that creativity is an individual phenomenon. Numerous valuable works in the Renaissance period have developed the idea that individuals produce creative products by performing creative actions. This ability, which has been reduced from divinity to the individual, has begun to come to the fore in different fields and to be given greater importance (Runco, 2004). Creativity has served as the foundation for many theories (see The Investment Theory in Creativity) and has emerged as a crucial factor in the selection of qualified personnel, particularly in entrepreneurship. However, it gained popularity in social sciences and psychology with a more specific event, when Guilford underlined the need to focus on creativity in his presidential speech at the American Psychological Association (APA) congress in 1950 (Kaufman, 2009). Before Guilford's speech, creativity was a phenomenon attributed to art and thought to manifest itself in visual works, while in much older history, a mystical perspective on creativity had existed. Over time, how creativity is perceived has moved away from mysticism and evolved towards being specific to the individual (Sternberg et al., 2008), and it has paved the way for a scientific approach to creativity.

There are various definitions of creativity in the literature. For this reason, although it is difficult to talk about a single basic definition of creativity, as a result of the review of more than 90 studies in the literature by Plucker et al. (2004), it was found that the majority of these definitions intersect at two common points, novelty, and usefulness (Plucker & Beghetto, 2004; Plucker et al., 2004). According to many researchers, being new and useful are essential components of creativity (Cropley, 1999; Csikszentmihalyi, 1996; Sternberg & Lubart, 1995). Based on these intersecting components in the definitions, creativity is a new and useful product/idea creation process (Plucker & Beghetto 2004; Plucker et al., 2004; Sak, 2014). Definitions such as generating ideas and strategies as an individual or as a community, being able to reason critically between them and producing reasonable explanations and strategies consistent with the available evidence (Stylianidou et al., 2018), being able to establish relationships between previously unestablished relationships, being able to come up with a new experience or product within the framework of a newly formed idea and creating an innovation suitable for the culture or the individual (Ataman, 2018).

There are many misconceptions in society about creativity. Among these well-known misconceptions, which are called myths, the following can be listed: everyone is creative, creativity is unknown, creativity cannot be learned, developed and is unconscious, creative people are crazy, creativity can develop with a group and listening to classical music like Mozart compositions (Chabris, 1999; Sak, 2014; Treffinger et al., 2006). These unrealistic beliefs stem from the lack of knowledge about creativity, and as studies on creativity increase, these ideas are proving to be urban legends.

When the creativity literature is reviewed, different opinions on many issues can be revealed. These opinions are supported by studies, but the discussions continue without clarification as there are different findings. In this section, different answers to the ongoing questions about creativity with the research in the literature and their reflections on mathematics education are compiled.

## **2. Is it Necessary to be Intelligent to be Creative?**

The view that there is a relationship between creativity and intelligence extends from the past to the present. There have been studies indicating that creativity is part of intelligence or intelligence is part of creativity or that there is no relationship between the two (Sak, 2014). Sternberg and O'Hara (2009) discussed the views on the relationships between intelligence and creativity under five headings. These are;

- Intelligence includes creativity.
- Creativity includes intelligence.
- Creativity and intelligence are identical sets; they are the same.
- Creativity and intelligence are equivalent sets; they overlap.
- There is no relationship between creativity and intelligence.

The most comprehensive of the studies that can be considered under these headings is Terman's classic work in the literature. In Terman's longitudinal study on 1500 participants with high IQ scores, known as Termites, individuals who were not included in the study because they were

below the IQ limit determined by Terman were later awarded the Nobel Prize for their original and creative contributions to the fields of science in their adulthood. Similarly, the threshold theory is a study that reveals a relationship between intelligence and creativity. The threshold theory argues that an individual must have at least an average level of intelligence to exhibit creative performance. According to the theory, the intelligence level of individuals does not increase in parallel with their creativity. More specifically, a significant relationship between creativity and intelligence up to 120 IQ scores was observed, but no statistically significant relationship above 120 IQ scores was found (see Sternberg, et al., 2011; Sternberg & O'Hara, 1999; Kim et al., 2010; Torrance, 1968).

Şahin (2014) found that the intelligence scores of average-mildly students (87-114 IQ) and moderately gifted (115-129 IQ) students had a significantly low-level positive correlation with creativity in a study he conducted with the participants classified according to their intelligence scores. It was also observed that the creative potential of individuals does not rise parallel to their intelligence, that there is a low correlation between the intelligence and creativity potential of individuals with an IQ in the range of 87-129 and that there is no significant correlation between the two for individuals with a 130 IQ and above. As a result of this study, Şahin (2014) reached findings to support the threshold theory. While there are studies that support the threshold theory, there are also studies that do not support it (Ogurlu, 2014; Yılmaz et al., 2020). Yılmaz et al. (2020) compared the correlation values of the lower and upper groups classified according to the threshold value of 120 IQ and reached findings that do not support the threshold hypothesis in the younger age groups. In addition, a piecewise regression analysis was performed to test whether there was a threshold value at other levels, and an inverse threshold effect at about 120 IQ was observed between creativity indices and general intelligence level. As a result, in the study, contrary to the threshold hypothesis, it was interpreted that the intelligence components possessed in young age groups bring an advantage to the creative imagination process as the IQ exceeds 120. Thus, even though the literature presents strong evidence for threshold theory, some of the studies still find it argumentative.

### **3. Can Creativity Be Scored?**

Another controversial issue about creativity is whether creativity can be measured or not. While the evaluation of creativity was an application that first started with the needs of the entrepreneurship sector, over time it also started to be considered in education. When the literature is examined, different approaches and measurement tools to evaluate creativity can be found. Until recently, the most common way of evaluating creativity in psychology and educational sciences has been the divergent thinking approach and tests (Said-Metwaly et al., 2021). For example, the Structure of Intelligence Divergent Thinking Test (Guilford, 1967), the Torrance Creative Thinking Test (Torrance, 1974), and the Divergent Thinking Test (Kogan, 1965) are among the measurement tools put forward to score the divergent thinking within the framework of the Structure of Intelligence theory proposed by Guilford. In these measurement tools, participants' responses are generally scored based on the following dimensions; fluency (number of correct answers), flexibility (number of answer categories), originality (newness of answers), and elaboration (richness of details in answers). Over time, with the strengthening of

the idea that it is not correct to evaluate creativity only from the perspective of divergent thinking (Runco & Acar 2012), different approaches and measurement tools have started to come to the fore. One of these measurement tools is the Remote Associates Test (RAT), which was created based on Mednick's (1962) theory of associations. In this test, the associations formed by the words given as triples are examined. One of the assessment approaches, which has been put forward on a basis different from that of divergent thinking is the Consensual-Based Assessment Technique (CAT), which was formed based on Amabile's (1982) componential theory. In this approach, it is emphasized that it is not correct to assess creativity objectively and that a team of experts should assess each output subjectively. However, although both divergent thinking tests and assessments based on expert opinion are used in scientific studies, the insufficient number of studies on creativity measurement in terms of predictive, discriminative, and construct validity is still a subject of criticism in the literature (Plucker et al., 2019).

#### **4. Can Creativity Be Developed?**

One of the controversial issues about creativity is whether creativity can be developed or not. Treffinger et al. (2006) stated that the idea that creativity cannot be improved is a mistake. Studies in the literature have also revealed that creativity can be developed.

Another debate in the literature can be included in the scope of this subject. This debate is about whether there is a fourth-grade slump in creativity. Studies have revealed that creativity is high in children, continues to increase until a certain age, but decreases after the middle age of childhood and forms a U-shaped graph (Beghetto & Kaufman, 2007; Gardner & Winner, 1982). Torrance (1968) defined the situation that changes the direction in this U chart as a fourth-grade slump. The fourth-grade slump is a term that describes when students enter fourth grade, there occur obvious declines in their creativity with certain environmental influences. It is stated that this decline may be caused by students' developing conformist behavior, getting used to thinking more realistically, acquiring a social environment, and the curriculum's becoming harder (Torrance, 1968; Sak, 2014). In the literature, some studies support this view (Besançon & Lubart, 2008; Long & Henderson, 1965), as well as studies that do not. Camp (1994) and Charles and Runco (2001) found that there is no increase or decrease in creativity in the fourth grade, while Hong and Milgram (2010), Lopez et al. (1993), and Sak and Maker (2006) found that there is an increase in divergent thinking in creativity. In addition to these findings, there have also been studies that have reached findings on the decline of divergent thinking in creativity in different periods. Kim et al. (2006) and Kim (2011) reported that divergent thinking in creativity falls in the sixth grade, Jastrzębska and Limont (2017), Lau and Cheung (2010), Said-Metwaly et al. (2021) and Sherwood and Strahan (1985), on the other hand, concluded that divergent thinking in creativity falls in the seventh grade.

Although creativity increases and decreases in different ages and situations, creativity should continue to be developed and supported throughout all ages and grade levels. Different models and strategies have been proposed for the development of creativity. The most prominent ones among them are having experiences in different fields (Cromptley & Urban, 2000), using



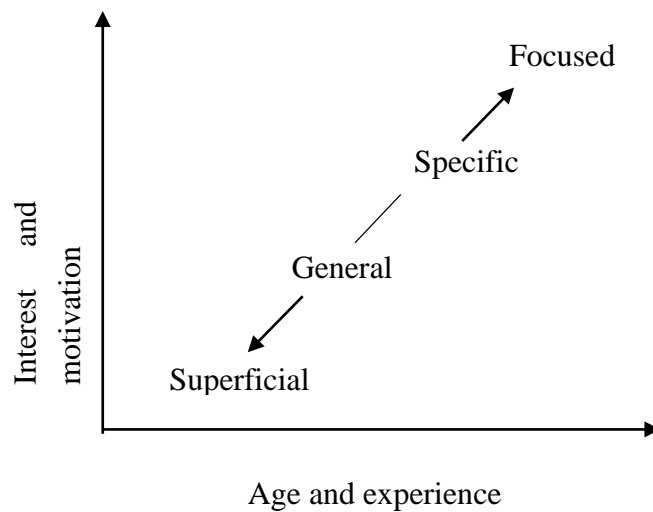
divergent thinking strategies in creative problem solving, using metaphors and analogies, brainstorming, using the SCAMPER technique, and morphological synthesis (Starko, 2017).

As a result of the conviction that creativity is found in all individuals as a potential, it is emphasized that creativity can be improved with such techniques and various pieces of training. The importance of education for the development of creativity is accepted by the majority. It should be mentioned that it is important to transfer creativity to the field so that teaching it in class can be more meaningful (Kanlı, 2019). Although general creativity skills are taught, this teaching will gain meaning by transferring it to the field in context. For this reason, it is important to carry out practices and activities that support creativity in the context of each lesson.

### **5. Can a Person Creative in Art Be Creative in Mathematics?**

In creativity, as in intelligence, the question of “whether it is general or domain-specific?” is discussed. Simon (1976), one of the researchers who defend the view that creativity is general, claims that a person who shows creative potential in one area has creative potential in other areas with the influence of Guilford’s Theory of Structure of Intellect (Guilford, 1967). The researchers who support this view place divergent thinking like Guilford to the essence of creative thinking (Kogan, 1994). The group, which is against the view that creativity is a general skill, criticizes Guilford’s theory for lack of empirical evidence and support (Runco & Nemiro, 1994), stating that divergent thinking alone cannot represent creativity (Csikszentmihalyi, 1990) and support the view that creativity can emerge in a field. Kanlı (2019) contributed to this discussion with an example that although Chekhov is a medical doctor, he is known for his contributions to literature, emphasizing that knowledge and expertise are important determinants in this discussion. Weisberg (2006) stated that it is not possible to be creative in every field and emphasized that the reason for this is the ten-year rule advocating that ten thousand hours must be spent to specialize in a field and that creativity can only develop with the development of knowledge and skills. According to Plucker and Beghetto (2004), creativity that starts with general skills necessarily progresses toward domain specificity with the progression of life. This progress is shown in Figure 1.





**Figure 1.** Conceptualization of general and domain-specific creativity (Plucker & Beghetto, 2004)

As seen in the model, Plucker and Beghetto (2004) stated that the focus points will become more domain-specific as the person gets older and gains experience in a particular domain or a particular task, and also as the individual's interest and motivation for a particular subject or problem increases. They explain this situation as follows; "as people become more interested in a subject or task, they will devote less time to working in other areas". From this perspective, creativity may seem domain-specific, but this is partly because people make choices in life that force them toward being domain-specific. It is emphasized that the optimal condition for creative production is a flexible position somewhere between general and domain-specific creativity (Plucker & Beghetto, 2004).

Mathematical creativity, which is a field of creativity that comes to mind about creativity specific to the field, should also be mentioned. In this section, mathematical creativity and reflections on creativity on mathematics education will be discussed.

Ervynck (1991) stated that mathematical creativity is one of the features of higher-order mathematical thinking, that the individual needs a context for creativity to take an important step forward with his/her prior experiences, that this kind of preparation takes place through previous activities and creates a suitable environment for creative development. Sriraman (2005) defined mathematical creativity at the Professional level as

*"-the ability to produce original work that significantly extends the body of knowledge, and/or - the ability to open avenues of new questions for other mathematicians."* (p.23)

Despite the confusion caused by the fact that many existing definitions of mathematical creativity are vague or incomprehensible (Sriraman, 2004), most of the efforts of educational researchers are generally directed at proposing frameworks for evaluating creativity, particularly demonstrating creativity through problem-posing and problem solving (Singer,

Voica, & Pelczer, 2017). There is a dominant view that problem-posing in mathematics is related to creativity (Singer & Voica, 2015, Singer et al., 2017, Bicer et al., 2020, Leiken 2009).

Torrance defined creative thinking “*as the process of sensing difficulties, problems, gaps in information, missing elements, something askew; making guesses and formulating hypotheses about these deficiencies; evaluating and testing these guesses and hypotheses; possibly revising and retesting them; and finally communicating the results*” (Torrance, 1988, p. 47). From this point of view, problem posing is among the creative strategies that should be used to facilitate teaching in mathematics education, improve problem-solving skills (Rosli et al., 2014), support conceptual learning and as a teaching approach and an assessment tool (English, 1997; Silver, 2013) and as a process of supporting students’ creativity.

Luria et al. (2017) suggested using creative strategies such as presenting open-ended problems, modeling activities, encouraging risk-taking, discussing mathematical concepts, concept-based learning, different thinking strategies and incorporating cultural elements into problem-solving activities to support mathematical creativity in the classroom.

Ataman (2018) defined a creative person as a person who gets rid of memorized and stereotyped thinking patterns, thinks multi-dimensionally in an interdisciplinary manner, and can produce new products. Based on this definition of the creative person, it becomes clear that problem-posing activities are among the classroom activities that can be used to support mathematical creativity. The use of problem-posing activities allows both the generation of new problems and the reformulation of given problems and the formation of mathematical problems from a situation (Silver, 1993; Silver, 1994). Problem posing is a very important mental activity for scientific discoveries (Silver & Cai, 2005). In addition, it improves the student’s creativity and accessibility to mathematical concepts (Ayllon & Gómez, 2014). Problem posing requires posing a personal and creative problem using acquired mathematical knowledge and related concepts. Problem-posing activities recommended to be used in the development of mathematical creativity are also used in the evaluation of mathematical creativity. Two examples of problem-posing activities taken from the activities in the book written by Yiğ and Ay (2021) are presented below.

*Example 1:*

*A dance show will be held as part of the school's end-of-year events. The zone where they will dance considered a coordinate system. Each unit of spacing on the horizontal and vertical axes is equivalent to 1 meter. Students Ayşe, Bilge, Can, and Deniz are located at points  $A(-2,4)$ ,  $B(2,4)$ ,  $C(2,-4)$ , and  $D(-2,-4)$  respectively.*

- a) What are the regions where students are located?*
- b) For demonstration purposes, students at positions A, B, C, and D must hold a colored stripe in their hands to form a perimeter of a rectangle. How many meters of tape are required?*
- c) Express what is given and requested in the problem in your own words.*
- d) Based on the above problem, pose a problem such that Ayşe, Bilge, Can and Deniz settle on the zone differently, but they hold the length of the colored stripe in their hands does not change.*

*Example 2:*

*Pose a solvable problem containing the coordinate system and rational numbers.*

*Take care that the problems are not like other problems you solve in the classroom.*

Although there is no consensus on the definition of mathematical creativity, many studies emphasize that creativity in mathematics education can be supported by problem solving and problem posing activities (like the examples above). It is recommended to use model eliciting activities in addition to problem solving and problem posing activities in mathematics lessons (Silver, 1994; Şengil-Akar, 2017; Yiğ & Ay, 2021). In this section, the mathematics education dimension of domain-specific creativity, which is one of the controversial issues in the literature, is discussed.

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**ALGEBRA AND ALGEBRAIC THINKING****Bilge PEKER**

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**1. Introduction**

Education has a very important place in today's society. Education is an effective tool for the development and progress of nations and for educating people in the best way possible. A nation's future cannot be shaped without education. Within the education system, mathematics education has an extremely important place in raising people who will work in industry, technology and other areas of daily life, and even academicians who will work in the field of mathematics. The need for mathematics in the field of education in a country and the universality of the language of mathematics are inevitable factors in the progress towards becoming an information society (Yıldız & Uyanık, 2004). Therefore, the importance of mathematics has been taken into account in every period.

Mathematics is one of the oldest sciences in human history. As a science that examines the properties of shapes, numbers, multiplicities and the relations between them, it is divided into many branches of science such as arithmetic, algebra, analysis and geometry. Algebra, as one of these branches of science, which we encounter in all areas of our lives, is a loyal guardian of mathematics (Schoenfeld, 2002). According to some experts, algebra is solving equations, while for others it is calculating. Algebra is a subject that uses a large number of symbols in it (Darojaturrofiah, 2017). Also, algebra provides ideas and symbols to express information about quantitative variables and relationships. In most countries, students use different arithmetic operators such as numbers, arithmetic operations, equal signs, arithmetic expressions and equations before starting to learn basic algebra (Zeller & Barzel, 2010). Because algebra uses symbols to generalize arithmetic (Samo, 2008). Students who begin to learn algebra enter the world of symbols rather than working with numbers. One of the most important steps in learning algebra is to understand the transition of the role of letters in mathematical expressions from unknowns to variables (Ely & Adams, 2012). In other words, it is a transition from concrete numbers to abstract variables. Thus, algebra is of great importance in teaching mathematics. Algebra emerges with many functions in every aspect of our lives. The importance of algebra in our lives is an undeniable fact. Williams (1997) stated that students who do not see learning

algebra as a requirement will not be able to understand advanced mathematics courses and that the doors of universities and career jobs will be closed to these students. Also, algebra is at the centre of mathematics learning and affects many areas of mathematics (Irwin & Britt, 2007; Kieran & Drijvers, 2006; Lacampagne, 1995). This importance of algebra in mathematics learning makes learning algebraic thinking a necessity (Usta & Özdemir, 2018). According to Van de Walle, Karp, and Bay-Williams (2014), algebraic thinking is one of the essential elements that dominate all mathematics and make mathematics useful in daily life. Algebraic thinking skills must be developed to be successful in mathematics (Bozkurt, Çırak-Kurt, & Tezcan, 2020). Although algebraic thinking is related to algebra, it has broader meanings than the concept of algebra (Çelik, 2007). Therefore, in this chapter, algebra, algebraic thinking, development levels of algebraic thinking, algebraic thinking styles, development of algebraic thinking and the importance of algebraic thinking will be emphasized.

## 2. Algebra

Algebra is one of the important learning areas of mathematics (Altun, 2014). Algebra is a branch of mathematics that examines the relationship using numbers and symbols or transforms these relationships into generalized equations (Akkaya, 2006). The foundations of algebra are based on Al-Khwarizmi's work *"El'Kitab'ül-Muhtasar fi Hisab'il Cebri ve'l-Mukabele"* (Summary Book on Algebra and Equation Calculation). Kieran (1992) stated that algebra is a tool that not only represents numbers and numerical data with letters, but also shows number relations and properties, and can also calculate with these symbols (Cited by Akkan et al., 2011). Lacampagne et al. (1995) claimed that only the complete learning of algebraic concepts can open the doors of advanced mathematics and defined algebra as the language of mathematics. Taylor Cox (2003) defined algebra as a more generalized version of arithmetic that contains variables and unknowns to solve the problem. Also, she stated that it enables to make calculations using these symbols. Algebra is based on finding the unknown values with the equations formed by symbolizing them with signs and letters or determining the relations between the unknowns (Argün, Arıkan, Bulut, & Halıcıoğlu, 2014). Dede and Argün (2003) stated that algebra takes on many different functions such as a language, a problem-solving tool, a tool for thought, and a school lesson. They stated that algebra is in every area of life in this respect and it is a necessity for people to learn it. Similarly, Williams and Molina (1997) state that the fact that algebra makes itself felt in all areas of life makes learning it compulsory. Although it is stated as a necessity to learn algebra, it is a lesson that students have difficulty in understanding (Carraher, Schliemann, Brizuela, & Earnest, 2006; Dede & Argün, 2003; Geller & Chart, 2011; Kaput, 1999; Kieran, 1992). This difficulty causes a decrease in students' success in mathematics (Ersoy & Erbaş, 2005). The structure of algebra, students' mental development, readiness levels and deficiencies in teaching algebra can be regarded as obstacles to students' understanding of algebra (Dede & Argün, 2003). Also, algebra is considered more abstract than arithmetic, since it is required to consider all numbers and number sets in algebra (Palabıyık, 2010). Kieran (1992) stated that the main difficulties in learning algebra are the perception of letters and changes in arithmetic and algebraic algorithm, and emphasized that it is necessary to understand what symbols and basic concepts mean to be successful in the field

of algebra learning. Gürbüz and Akkan (2008) stated that students had difficulties in transitioning from arithmetic to algebra. They said that the reason for this difficulty was the inadequacy of the student's knowledge of arithmetic operations, the inadequacy of symbolizing and modelling problems, and the inability to use the concept of variables in different situations. Also, they stated that the use of standardized problem types and standardized solution strategies in the learning environment led students to memorization and made the transition from arithmetic to algebra difficult. Akkaya (2006) determined the misconceptions of students about algebra in his study. These are:

- In mathematics, letters have no meaning. For students, letters are used in place of the unknown and have no function.
- Letters are not like numbers. For students,  $b=d$  can never be valid because each letter represents a number.
- For students, letters have a digit value and are only seen as numbers.
- Letters are used to abbreviate objects. For example, it is thought that the expression  $2e$  represents 2 eggs.
- Letters are valued according to their position in the alphabet. For example, since the letter  $d$  is fifth in the alphabet, its value is thought to be 5.
- The letters are sorted in alphabetical order. For example, if  $a=3$   $c=5$ , students think that  $b$  will be 4.
- The “=” sign always gives a result.
- The “+” and “-” signs always give a result.

Welder (2007) defined nine skills as prerequisites for understanding the concept of algebra. These are numerical operations, ratio and proportion, priority in operation, equality, patterns, algebraic symbols, algebraic equations, functions and graphics.

NCTM (2000) emphasized that every student should learn algebra starting from preschool education to the end of high school education. In the book published in the same year, the algebra standards that should be acquired by the students are stated as follows:

- Understanding patterns, relations and functions,
- Being able to analyze and examine mathematical structures using algebraic symbols,
- Understanding numerical relationships using mathematical models,
- Being able to analyze changes from various aspects.

### 3. Algebraic Thinking

Algebraic thinking, in its most general definition, is the use of variables according to quantitative situations and the capacity to make the relationship between these variables explicit (Driscoll, 1999). In the literature review, it is possible to see different definitions for algebraic thinking. Kieran and Chalouh (1993) put mathematical reasoning at the centre of algebraic thinking. According to them, the basis of algebraic thinking is to understand and use the meaning of mathematical symbols.

Hawker and Cowley (1997) defined this way of thinking as "involves an estimation that requires representation, structuring and generalized thinking of pattern and orders".

In Herbert and Brown's (1997) definition, algebraic thinking is the ability to analyze different situations using mathematical symbols and tools, to express and interpret mathematical information with figures, graphs, tables and equations. Also, algebraic thinking includes proportional reasoning, important ideas, representations, meaning of variables, inductive and deductive reasoning, patterns and functions (Greenes & Findell, 1998). In other words, it is a very comprehensive way of thinking.

Algebraic thinking is the engagement of students with regular roles generalized with mathematical relations and operations, and the establishment of assumptions, arguments and statements in increasingly formal ways through these generalizations (Kaput, 1999; Kaput & Blanton, 1999). In this respect, algebraic thinking skill is one of the high-level mathematical thinking skills.

NCTM (2000) described algebraic thinking as "requires understanding the functions, representing and analyzing mathematical situations and structures in different ways through algebraic symbols, representing and understanding quantitative relationships with mathematical models and analyzing the change in different situations encountered in daily life".

According to Lawrence and Hennessy (2002), algebraic thinking enables us to better interpret the world by translating situations into the mathematical language to explain and predict events in daily life. Also, algebraic thinking develops the ability to think abstractly.

Gülpek (2006) stated that the basic skills of algebraic thinking are generalization, formulation and symbolization. On the other hand, Bağdat (2013) stated that algebraic thinking consists of three basic skills; formulating generalizations, using multiple representations and using algebraic relations and symbols.

Kriegler (2007) stated that algebraic thinking consists of two main components as mathematical thinking tools and informal algebraic relations. Mathematical thinking tools are problem-solving skills (using problem-solving strategies and multiple approaches), representational skills (showing relationships symbolically, visually, numerically, verbally, and transforming different representations) and reasoning (inductive and deductive reasoning) skills. Informal algebraic relations are algebra as abstract arithmetic, algebra as the language of mathematics, and algebra as a tool for working with mathematical modelling and functions.

Çelik (2007) stated that algebraic thinking is not limited to the field of algebra, but is a special form of mathematical thinking. She stated that this thinking consists of three basic skills; using algebraic relations and symbols, using multiple representations (symbolic, graphic, table, etc.) and formulating generalizations. She also emphasized that for people to think algebraically, they should use the meanings of algebraic relations by creating them in their minds and make generalizations by establishing their relationship with real-life situations.

According to Kaya and Keşan (2014), algebraic thinking means establishing relationships between algebraic situations by assigning meanings to symbols as a reflection of mental activities, revealing thoughts through multiple representations and different presentations, describing concrete, semi-concrete and abstract concepts in algebraic relations and reaching conclusions through reasoning.

Algebraic thinking is at every grade level and consists of the following basic topics (Van de Walle, Karp, & Bay-Williams, 2014):

- 1) The use of patterns that lead to generalizations,
- 2) Studying the change,
- 3) Function concept.

The basic idea behind all these topics is that students have a deep understanding of the number system, operations and properties related to operations in achieving success in algebra (Seeley & Schielack, 2008, cited by Van de Walle, 2004). In light of all these explanations, algebraic thinking is among the basic mathematical skills. Some of the senses that affect algebraic thinking are operation sense, structure sense, number sense and symbol sense (Somasundram, 2018). Acar (2019) determined that there is a strong and significant positive correlation between secondary school students' number sense and algebraic thinking levels. NCTM (2000) stated that algebraic thinking skills should be acquired at an early age and that appropriate tools, materials and methods must be used for this. Therefore, the development of students' algebraic thinking skills should be one of the most important goals of mathematics teaching programs.

#### **4. Developmental Levels of Algebraic Thinking**

According to the results of the study conducted by Concepts in Secondary Mathematics and Science (CSMS) to determine the level of understanding of algebraic expressions of students aged 13 and 15 in England, students' understanding of algebraic expressions can be examined at four sequential levels (Hart et al., 1998).

Level 1: This level is where questions such as finding the value of a letter as a result of arithmetic operations, concluding a problem by taking letters as objects, or, even though letters are included, concluding an operation without assigning values to these letters, can be solved.

Level 2: This level is the same as the first level in terms of abstraction, but the difference is that the questions are more complex. Students at this level can solve more complex questions.

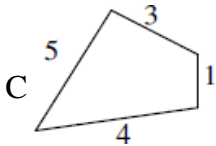
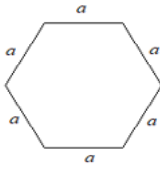


Level 3: This is the level where letters are perceived and used as unknowns. Since the letters represent an unknown at this level, the student who understands them as an object name cannot reach the correct result.

Level 4: At this level, students can attach meanings to similar but more complex expressions and conclude operations.

For a better understanding of these levels, sample questions about them are given in Table 1.

**Table 1.** Examples of Questions on Algebraic Thinking Levels (Altun, 2005)

Levels	Sample Questions	
Level 1		$3a + 2a = ?$
Level 2		$C = ?$ if $a = 3b + 2$ , $b = 1$ then $a = ?$
Level 3	if $e + f = 10$ then $d + e + f = ?$	$c + d = 16$ , if $c < d$ then $c = ?$
Level 4	Which is it greater; $2n$ or $n + 2$ ? Explain.	Is $a + b + c = a + b + d$ always true? Why?

It is clear that the correct understanding of the symbols used in algebra and the relations between the concepts by the students will contribute to their algebraic thinking. It can be said that it is important to determine the algebraic thinking levels of the students in this respect. Because algebraic thinking contributes to the development of mathematical thinking (Usta & Özdemir, 2018). Therefore, it would be appropriate for mathematics teachers to know the algebraic development levels of students and to provide education accordingly.

### 5. Algebraic Thinking Ways

Algebraic thinking starts with recognizing numbers and patterns in preschool (NCTM, 2006) and continues with issues related to generalizing and understanding patterns, examining their change, and the concept of function (Van de Walle, Karp & Mr-Williams, 2014). Therefore, algebraic thinking has many properties. Kaput's (1999) five interconnected ways of thinking include:

a) *Generalizing arithmetic to algebra:* Making generalizations from numbers and arithmetic starts from preschool and continues as long as students continue to learn numbers and operations. While arithmetic is concerned with the numerical value of doing calculations,

algebra is concerned with correctly applying mathematical laws and operations to find all solutions. Algebra generalizes arithmetic to find all solutions of equations. Making generalizations about the properties of operations includes noticing patterns that are fundamental to arithmetic and algebra (Russell, Schifter, & Bastable, 2011). In short, by generalizing arithmetic to algebra, it is meant to move the numbers to a higher point.

*b) Meaningful use of symbols:* Algebra has its own grammar and syntax that can formulate algebraic ideas clearly and effectively (Drijvers et al., 2011). It means that algebra has a language of its own. While students understand this algebraic language, they have difficulties in two subjects that can be considered the basis of algebra. These are the equal sign and the variable concept. Although the equal sign is one of the important symbols in arithmetic, algebra, and all mathematics in general, it is a difficult concept. This is because the equal sign is used to indicate the calculation operation in arithmetic, while in algebra, the equal sign represents the equivalence between two expressions (Carpenter et al., 2003; Molina et al., 2005). Difficulties can be eliminated by reinforcing that the equal sign means sameness in algebra. On the other hand, Mann (2004) suggested teaching the equal sign as a balance between the two sides of the equation. It can be said that teachers can benefit from the scale model while doing this.

Variables can be used as unknown values or varying quantities. Students cannot make sense of how to solve any algebraic equation without knowing the meaning of the variables (Van de Walle et al., 2014). In learning variables as unknown values, students should be familiar with forming mathematical sentences when equations have missing values and a symbol such as an empty square or star represents an unknown value. Also, they need to associate the missing values with the word "variable" (Van de Walle et al., 2014). Students can start learning about variables by using various symbols, letters and symbols to represent unknown quantities (Özden, 2019). In learning variables as changing quantities, the fact that the variables can represent more than one missing value is not understood enough by the students. When there are different variables in a single equation, each variable can represent more than one or even an infinite number (Özden, 2019). It is important to make students aware of this situation.

*c) Studying the structures in the number system:* Algebraic structure studies are an extension of the analysis of the structure of the number system (Greeno, 1991). Learning the number system requires knowing the properties of real numbers, and this structure can be extended to variables, hence algebra. Moreover, an important way to encourage algebraic thinking is to try to justify assumptions derived from the real number system (Van de Walle et al., 2014). Justifying assumptions at a basic level often requires using examples and adapting them to mathematical thinking to prove that the assumption is true in each example. For example, in an equation using the commutative property ( $a+b=b+a$ ), it is the main purpose of examining a structure to state that this is true for all numbers (Özden, 2019). The properties of number systems can be created while students work with true/false and open number sentences. However, here, questions such as "Is this true for all numbers?" or "Do you think this is always true? How can we understand?" should be asked to guide students. Students will have to provide reasons to explain their thoughts in this case (Özden, 2019). Therefore, this will lead them to think and interpret more.

*d) Examining patterns and functions:* Patterns are found in every field of mathematics. Learning how to find patterns, and transfer and extend them to another situation is an important part of algebraic thinking (Van de Walle et al., 2014). Herbert and Brown (1997) stated that the pattern generalization activities carried out by students at an early age are important in forming the basis of algebra and in the development of algebraic thinking. Similarly, Tanışlı and Özdaş (2009) stated that patterns are the building blocks in formulating generalizations, and generalizations are building blocks in algebraic thinking. The relationship learned with the pattern continues with the concept of function with the development of abstract thinking skills in students (Tanışlı & Kabael, 2010). The algebra of functions is mainly concerned with dependent relationships between variables (Drijvers et al., 2011). According to Van de Walle et al. (2014), knowing the function machine, input-output table, concrete, graphical, verbal and symbolic representations and making the transition between these representations easily will enable the development of functional thinking.

*e) Mathematical modelling process:* Mathematical modelling is defined as the process of starting with real facts and expressing them mathematically (Kaput, 1999). In the context of algebraic thinking, secondary school students should know how to use algebraic models to understand numerical relationships. Converting verbal problems to algebra often involves setting up equations and inequalities and finding the value of one or more variables. So learning how to solve equations and inequalities becomes an essential component of algebra. Mathematical modelling is learned by generalizing arithmetic according to algebra, using symbols in a meaningful way, examining the structure and examining patterns and functions (Özden, 2019). Therefore, it is an issue that needs attention.

## **6. The Development of Algebraic Thinking**

Algebraic thinking is a way of thinking that includes the basic skills necessary for mathematics. This way of thinking includes skills such as understanding variables, reasoning, using representations and explaining the meaning of symbolic representations, working with models, and transforming between representations (Kaf, 2007). Algebraic thinking, which is so important for mathematics, can be developed from an early age. Mathematics educators also emphasize that algebraic thinking should be started in early grades and at an early age (Kieran, 1992). Kieran (2004) listed the things to be considered in the development process of algebraic thinking as follows:

- Students should focus on relationships, not just finding an answer with numerical calculations.
- They should focus not only on the operations themselves and their results but on the reverse of the operations.
- They should focus on both the representation and solution of the problem, not just the solution.
- They should focus not only on numbers but also on what is written.

- They should focus enough on the meaning of the equation sign.

Since students cannot associate their arithmetic knowledge with new knowledge in algebra learning, meaningful learning cannot happen (Çağdaşer, 2008; Gülpek, 2006). Therefore, it was emphasized that arithmetic and algebra should be associated with each other to develop students' algebraic thinking at an early age (Girit & Akyüz, 2016). Lannin, Barker, and Townsend (2006) stated that it is important for students to comprehend the meanings of algebraic symbols and practices in order to enable them to move on to algebraic thinking. Expressing changes and generalizations with graphics, symbols, tables, diagrams or verbally is also seen as important for the development of algebraic thinking (Cañadas, Castro & Castro, 2011). Kieran (1992) emphasized that in order to be successful in learning algebra, it is necessary to understand what symbols and basic concepts mean. Radford (2012) supported the idea of developing algebraic thinking in students at an early age. He mentioned the importance of understanding patterns in early algebraic thinking and emphasized that for the development of algebraic thinking in younger students, key points in algebraic thinking such as equality, problem-solving and generalizing patterns should be understood.

Twohill (2013) stated that the development of algebraic thinking consists of five stages. These stages are pre-formal pattern, informal pattern, formal pattern, generalization and abstract generalization. In the pre-formal pattern stage, students do not identify and cannot recognise patterns. Students who complete this stage are expected to notice the expanding or repeating patterns and express the similarities of the repeating patterns in order to pass to the informal pattern stage. In the next stage, the formal pattern stage, students can explain the pattern verbally and reason about related terms. In the generalization stage, the student can express the rule of the pattern after finding the near term and the far term. In the next stage, abstract generalization, the student can now think algebraically.

### **7. The Importance of Algebraic Thinking**

Algebra allows students to think abstractly and make logical inferences (Stacey & MacGregor, 1997). Lacampagne (1995) said that “*Algebra is the language of mathematics. It opens doors for advanced mathematical subjects if fully learned. If not learned, it closes the doors of the university and technology-based careers...*” (cited by Dede & Argün, 2003). Algebra constitutes a small culture that encompasses a large culture of mathematics.

Although algebraic thinking is related to algebra, it cannot be limited to the subjects of algebra. Algebraic thinking, which helps individuals to solve the problems they face in daily life (Akkan, 2016), is a much wider and more comprehensive field and way of thinking. Algebraic thinking, which is a special form of mathematical thinking, is an initial step in the development of abstract thinking. Besides, algebraic thinking is associated with all areas of mathematics. This way of thinking has a wide and important place in the subject areas of mathematics, which consists of learning areas such as numbers and operations, algebra, geometry and measurement, data processing and probability (MONE, 2013). Algebraic thinking is also used in many fields in other disciplines. Individuals with advanced algebraic thinking are likely to become successful mathematicians, scientists, businesspeople and successful economists (Ahuja, 1998). In other words, it can be said that algebraic thinking also has an effect on students' careers.

Algebraic thinking skills include mental activities to think about, comment on and find solutions to the difficulties that students face not only in mathematics lessons but also in their daily lives. For students to understand algebra and increase their level of algebraic thinking, they should be able to practise what they have learned, make transitions between concepts and demonstrate this with multiple representation values. Every student should learn the necessary levels of algebra from preschool to the end of high school education (NCTM, 2000). This can be achieved by teachers being aware of this situation.

As a result, algebra and algebraic thinking contribute both to the development of mathematical thinking and to understanding the world we live in. In this context, it is very important in terms of mathematics education that students develop their algebraic thinking skills and that teacher candidates and teachers who will put this into practice have the necessary knowledge and skills in this regard.

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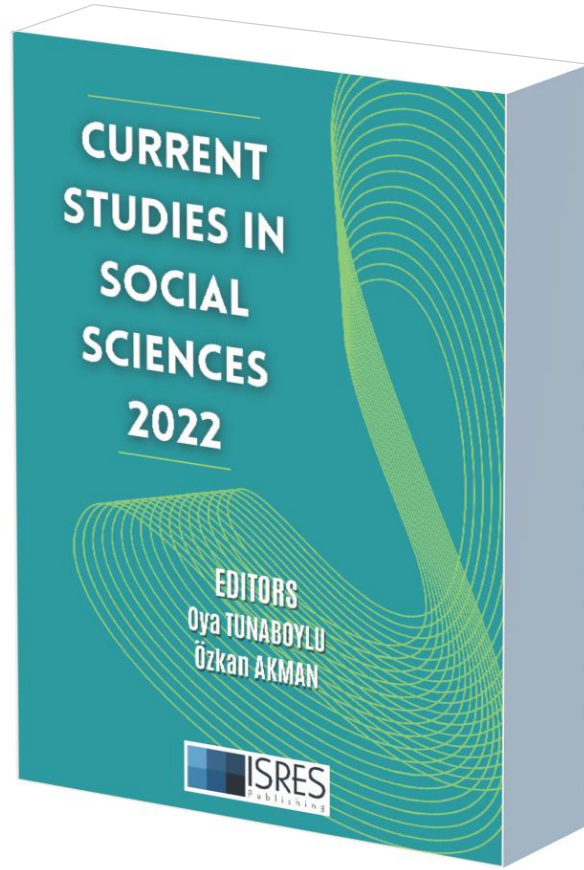
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