

# SEEJSD

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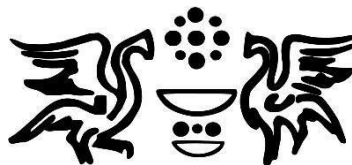
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# Curriculum Development for Education Towards Sustainable Development – A Real Example

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## ABSTRACT

This paper describes goals, process, and results in the effort to introduce new curricula at The Faculty of Technical Sciences of University Mother Theresa – Skopje fully devoted to teach students in the direction of sustainable development. The idea was born in the process of reaccreditation of the old curricula named “Mechanical Engineering and management” at The Faculty of Technical Sciences. The authors of this paper, and the idea for reconstruction were fully aware of the direction Mechanical Engineering needs to go to contribute to the sustainable development of the country and wider. Therefore, that idea led the developing process into new curricula titled: “Sustainable Design in Mechanical Engineering”. From total of 40 courses, 15-20 are fully related to sustainable development goals and the curricula includes also a number of projects and diploma work by which students will additionally have an opportunity to add to their understanding and knowledge of sustainable development tools. The new curricula successfully passed the process of accreditation and it is now a part of this University offer. Based on this curricula, a number of courses for lifelong learning will be developed. It is expected that this curricula will attract attention both of the new students, but also of the professionals at different companies, state and municipality institutions.

## KEYWORDS

Curriculum, design, sustainable, development, mechanical engineering

# 1 Introduction

The modern world faces many challenges. One of the biggest and most global challenges is how current generations can live better without compromising the ability of future generations to have a quality life, too. This challenge has been recognized by United Nations experts for decades and is called "sustainable development", and one of its missions is to create conditions for it in all parts and segments of life, [1], [2].

Figure 1 shows the three main pillars of sustainable development (Environment, Society and Economy) and the area of Comprehensive Sustainability [1].

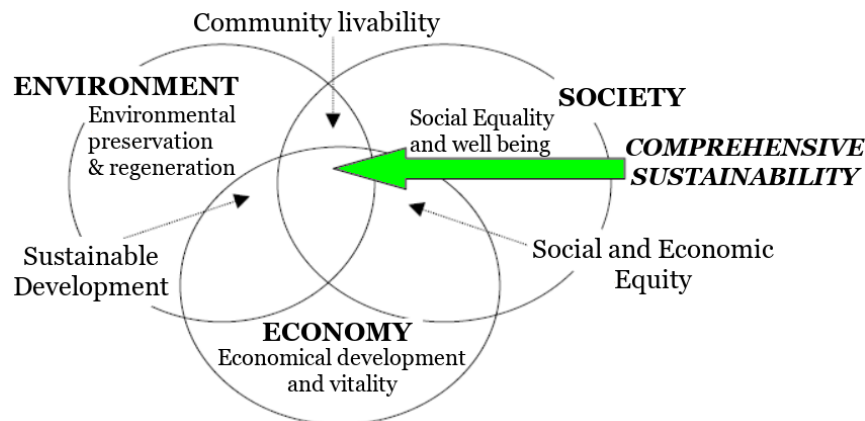


Figure 1. Pillars of Sustainable development and the area of Comprehensive Sustainability

Source: United Nations: Transforming our World: The 2030 Agenda for Sustainable Development; United Nations

Figure 2 UN Sustainable Development Goals divided into main pillars (Environment, Society and Economy), [1].



Figure 2. Sustainable development goals divided into main pillars

Source: United Nations: Transforming our World: The 2030 Agenda for Sustainable Development; United Nations

Professionals working in technology, technical science, and education have a historic responsibility to enhance the positive effects of technology and to eliminate, or minimize, its negative traces. Most of them have recognized it and have taken steps toward Global Sustainability Goals in their fields of activities. This is a case also with professionals showing pathways in science and education. This has resulted in number of respectful papers, books and events, [3], [4], [5], [7], [9], [10].



The design, development, production, use and release of used products take a large part in the process of sustainable development, globally, regionally, nationally, locally and even on personal level, [6], [8], [11], [12], [13], [14],

This situation is recognized by many higher education institutions in the world, especially in the developed world, and more and more research is being done and educational processes are being developed that should improve the acceptability of products in the context of sustainable development. This is recognized by the teaching staff and management of the University “Mother Teresa” who with a series of activities try to contribute to this process, [15], [16], [17], [18], [19], [20].

This paper describes goals, process, and results in the effort to introduce new curricula at The Faculty of Technical Sciences of University Mother Teresa – Skopje fully devoted to teach students in the direction of sustainable development.

The idea was born in the process of reaccreditation of the old curricula named “Mechanical Engineering and Management” at The Faculty of Technical Sciences. The authors of this paper, and the idea for reconstruction were fully aware of the direction Mechanical Engineering needs to go to contribute to the sustainable development of the country and wider. Therefore, that idea led the developing process into new curricula titled: “Sustainable design in Mechanical Engineering”.

## 2 Curricula development approach

One of the main goals of the Bologna Declaration is the creation of the European Higher Education Area (EHEA). Efforts in this direction are deep in their second decade and in terms of time they coincide with the initiatives of the United Nations to establish the process of sustainable development.

Institutions and individuals in charge of establishing the EHEA recognize the inescapable link between the two processes and in that direction a number of projects have been approved and developed and several coordination conferences have been held. Among the other fruits of such activity are the so-called "COPERNIKUS Guidelines for Sustainable Development in the European Higher Education Area.". This document sets out the objectives and ways to introduce the principles of sustainable development in the Bologna process.





Many universities in Europe already have some experience in this area. Therefore, in creating the study program Sustainable Design in Mechanical Engineering, the available information was used from numerous universities in Europe and beyond, which deal with design and production in mechanical engineering and especially those that have elements of sustainable development. There a number of authors and institutions contributing to that process on scientific level.

The author Mariano Ramirez Jr, in it’s worldwide survey of sustainability integration in industrial design integration clearly find that “Industrial design educators are informed, interested and even passionate about sustainable design”, [10].

Elisabeth Potter-Nelson and Sarah Meyers give contemporary (2022) research based “Introduction to Sustainability Education”, [7].

Kerstin Kremer and Deidre Bauer put light on “Teaching Sustainable Development Goals in Science Education”, [3].

Approaching to the curricula development started with identification of the goals of the Sustainable development towards which Technics and Mechanical Engineering has specific influence (Figure [3]).

<b>Economic Pillar</b>	2. ZERO HUNGER	3. GOOD HEALTH AND WELL-BEING	8. DECENT WORK AND ECONOMIC GROWTH	9. INDUSTRY, INNOVATION AND INFRASTRUCTURE
				











<b>Environmental Pillar</b>	6. CLEAN WATER AND SANITATION	7. AFFORDABLE AND CLEAN ENERGY	12. RESPONSIBLE CONSUMPTION AND PRODUCTION	13. CLIMATE ACTION
				
<b>Social Pillar</b>	4 QUALITY EDUCATION	10 REDUCED INEQUALITIES	11 SUSTAINABLE CITIES AND COMMUNITIES	17 PARTNERSHIPS FOR THE GOALS
				

Figure 3. Sustainable development goals on which technics has influence

Source: Self research

### 3 Curricula development methodology

The methodology of development the new curricula starts with analysis what will be the main task of the graduates from the new study program, and it will be designing of sustainable products.

Those products should be innovative, economical, attractive and affordable, as well as uncompromisingly safe.

Therefore, the engineers who are the bearers of all stages of these processes should be educated in a way to deal with such challenges, [12], [11]. Between the rest, the graduate engineers should:

- have traditional engineering competences an skills;
- bearawareness of the goals of sustainable development and have ability to design the new products in alignment with those goals;
- know the safety regulations of the products and understand the necessity and methodologies for checking their quality. This takes place in an EU quality system environment. In addition, the students at the end of the studies need to be able to understand and apply other global product quality systems as well;
- recognize needs and opportunities for innovative product development;
- be able to see and evaluate products in the context of economic, social and environmental parameters in the context of general sustainable development.

Bearing the described combination of competencies and skills, the graduate mechanical engineers of the study program "Sustainable design in mechanical engineering" will be an attractive profile for potential employers in the market. This will apply to both large and small businesses, but some of the graduates of this study program are expected to make a decision to start their own businesses.

The methodology for development the new course included wide and deep review of the literature dealing with this issue.

There is a number of literature sources which help the process of developing a curricula which accomplish core aspects of sustainable design of technical products. Some literature sources offer general knowledge and experiences, and the others more specific case studies regarding courses in the curricula, [13], [14], [15], [16], [17], [18], [9], [10], [11], [12], [19], [21]. They cover all phases of product life cycle and helped curriculum designers to find appropriate balance between proposed courses in the process.

As an example, the specific aspects analyses Tania Humphires-Smith in the paper “Sustainable design and design curriculum”, [6]. She specifically notes that eco-design and meeting the regulations are priorities when developing a new curricula. Also, other courses should be moved towards sustainability aspects.

Since the new curricula had to be realistically planned and later implemented, all institutional, personal and other capacity aspects have been considered and taken into account.

National, and regional specifics, both on academic and business level have been analyzed, as well.

Legislation aspects, specifically national, and EU have been used into consideration, having in mind their dynamic nature and direction of further development.

## 4. Result

Curricula developing process has involved most of the teaching staff from The Faculty of Technical Sciences and Mother Theresa University in Skopje. All of them have been motivated to contribute in conceptual design of the curricula, and specifically have done their best in proposing courses addressing goals of sustainable development. This process was run by preservation of good and positive practices in the area of Mechanical Engineering, and experiences in transfer of knowledge to the students.

The proposed study program is created primarily on such experiences and is based on the available prior knowledge of prospective students. At the same time, the necessary adjustments have been made to the real, economic, social and ecological environment in which University “Mother Teresa” operates. In this way, one of the key elements of the mission of the University is realized.

As a result, the curricula for Sustainable design in Mechanical Engineering has been developed.

Table 1. Curricula for the major Sustainable Design in Mechanical Engineering

Nr	Semester I	Semester II	Semester III	Semester IV	Semester V	Semester VI	Semester VII	Semester VIII
1	6 ECTS	6 ECTS	6 ECTS	6 ECTS	6 ECTS	6 ECTS	6 ECTS	6 ECTS
	Mathematics 1	Mathematics 2	Mathematics 3	Transport means	Principle and process of design	Production Technologies	Eco-Design	Metrology and measuring systems
2	6 ECTS	6 ECTS	6 ECTS	6 ECTS	6 ECTS	6 ECTS	6 ECTS	6 ECTS
	Engineering graphics	Basics of Electro-technics	Machine elements	Basics of construction design	Visualisation in design process in engineering	Human factors of safety	Quality management	Management of technology development and innovations
3	6 ECTS	6 ECTS	6 ECTS	6 ECTS	6 ECTS	6 ECTS	6 ECTS	6 ECTS
	Statics and strength of materials	Kinematics and Dynamics	Sustainable development in technics	Fluid mechanics and components	Structure of products	Prototyping	Technical requirements and testing of products	Products life cycle management
4	6 ECTS	6 ECTS	6 ECTS	6 ECTS	6 ECTS	6 ECTS	6 ECTS (Selectable)	4 ECTS
	Physics	Engineering materials	CAD Technics	Thermodynamics	Product ergonomics	Design for production and assembling	Principles of Marketing Accounting and sustainable business	Project
5	6 ECTS (Selectable)	6 ECTS (Selectable)	6 ECTS (Selectable)	6 ECTS	6 ECTS (Selectable)	6 ECTS (Selectable)	6 ECTS (Selectable)	8 ECTS
	Foreign language	Internet Technologies	Chemistry of materials	Automatic control systems	Life cycle of materials	Virtual models and procedures	Praxis	Diploma work
	Informatics	Basics of programming	Electrical machines		Green safe and			

		Matlab	Theory of electrical circuits		inclusive vehicles	Sustainability in traffic		
ECTS	30	30	30	30	30	30	30	30

The team developing the curricula, and teaching staff members in charge of writing each course syllabuses have agreed to built in the spirit of sustainability in the materials and way of presentation of the courses in front of the students.

Specific accent of sustainability has been given to the following courses (green boxes in Table 1.):

- The courses Engineering materials, Chemistry of materials, and Life cycle of materials will bring knowledge to the students related to the materials available for products production, their characteristics in terms of sustainability in each phase of products life cycle;
- Sustainable development in technics is foreseen as basic course which will bring definition of Sustainable development, policies, goals, etc. Specific emphasize will be put on the area of technics, and more specifically related to the scope of activities of Mechanical Engineering;
- The courses Basics of construction design, and Principles and process of design, besides of common aspects will put more attention to the possibilities to adopt the design process in such a way that sustainability of the products will be taken into account, very early, in their design phase. That will prevent negative consequences and reduce the costs in the product life cycle;
- The courses Structure of the products and Product ergonomics will allow the students to earn competences related to the structure of different products and their ergonomics in the context of their sustainability;
- Green safe and inclusive vehicles is a course covering one of very important areas of human life – transport. Vehicles are very complex products capable of making life more efficient and pleasant, but also dangerous for people and environment. Therefore this course will clarify those aspects and show the direction vehicles could improve their mission in contemporary life;
- The course Human factors in safety will address one very specific and important aspect of the sustainability – safety. Specific dangers which can be caused or mitigated by human factor will be clarified which will allow the student to be more critical to this sensitive area;
- Design for production and assembling is a course intended to help future engineers to reduce production and assembling costs and time. That means less energy consumption, lowered emission and improved economy;
- Sustainability in traffic is intended to bring basic knowledge and competences to the students on a ways traffic solutions can contribute to the sustainability (improved efficiency, reduced traffic jams; reduced emission, etc.)
- Eco Design is contemporary course aiming to teach students related specific competences in the area of ecology, and also help them earn skills to use modern design techniques;
- The courses Quality Management, Management of the Technology Development and Innovations, and Product Life Cycle Management will bring the very important management competences to the students, all in light of sustainable development;
- The course Technical Requirements and Product Testing will introduce the necessity of declaring product characteristics, and their testing in order to certify their compliance with the regulations. This system of quality is core for product safety, according to EU legislation (New Approach, Old Approach, and Specific Measures);
- Principles of Marketing is a course which will help the students understand the basics and how Market economy works. This is very important for engineers who will work in small and medium enterprises, where specific marketing expert are missing;
- Accounting and sustainable business course will also help engineers working in small and medium enterprises, but will specifically help those deciding to start their own business;
- Praxis and project work will help students feel the real world of dealing with business sector and facing personal tasks;
- Diploma work is a chance for the students to wrap-up their knowledge and skills and test themselves solving diploma tasks related to the sustainable development.

The process of development of the new curricula was successful, and finished with positive result of formal accreditation in front of National Board for Accreditation.

## 5. Conclusion

Sustainable development of the human society is a strategy which allows future generations to use earth resources and spend their life on human way.

That could be endangered if contemporary generation does not have determination and goals in that direction.

UN Sustainable Development Goals are global mains to avoid earth resources deteriorating.

Technics, and Mechanical Engineering, as part of that has one of the most important tasks.

The role of education, specifically Higher education is very important in meeting Sustainable development goals.

Faculty of Technical Sciences, at The University Mother Theresa in Skopje has taken it's responsibility in the process very seriously and has developed and formally accredited first cycle study program Sustainable Design in Mechanical Engineering.

With the realization of the planned study program, it is expected that the economy will be offered staff who are educated in the spirit of Higher Education, who will be promoters and practitioners of engineering activities that will support sustainable development in the environment in which they operate.

The success of accreditation will be followed by developing of a number of courses for lifelong learning. That will be done by care full research of the needs of professionals in the economy sector in the country and in the region.

It is expected that this curricula will attract attention both of the new students, but also of the professionals at different companies, state and municipality institutions.

## REFERENCES

- [1] United Nations: Transforming our World: The 2030 Agenda for Sustainable Development; United Nations
- [2] United Nations the Sustainable Development Goals Report 2016 ISBN: 978-92-1-101340-5 e-ISBN: 978-92-1-058259-9 ISSN: 2518-3958
- [3] Kerstin Kremer and Deidre Bauer: Teaching Sustainable Development Goals in Science Education. Journal Sustainability (ISSN 2071-1050) ISBN 978-3-0365-1558-8. 2021
- [4] Robert W. Kates: What kind of a science is sustainability science? PNAS (Proceedings of the National Academy of Sciences of the United States of America). December 6, 2011 108 (49) 19449-19450.
- [5] Department of Education and Early Childhood Development of New Brunswick: Science for Sustainable Societies. 2020.
- [6] Tania Humhries-Smith: Sustainable design and the design curriculum. J of Design Research January 2008, DOI: 10.1504/JDR.2008.024194
- [7] Elizabeth Potter-Nelson, Sarah Meyers: An Introduction to sustainability education. Massachusetts Institute of Technology. White paper series, August 2022.
- [8] Delft University of Technology: Design for Sustainability; A Practical Approach for Developing Economies.
- [9] The Journal of Sustainable Product Design: Issue 1: April 1997

- [10] Mariano Ramirez Jr. Sustainability integration in industrial design education: a worldwide survey, Connected 2007, International Conference of Design Education, University of New South Wales, Sidney, Australia.
- [11] Garrette Clark, Justin Kosoris, Long Nguyen Hong and Marcel Crul: Design for Sustainability: Current Trends in Sustainable Product Design and Development. *Sustainability* 2009, *1*, 409-424; doi:10.3390/su1030409
- [12] Mario Fargnoli, Fumihiko Kimura: Sustainable Design of Modern Industrial Products. Proceedings of LCE2006
- [13] Francisco J. Farias Stipo: A Standard Design Process for Sustainable Design.
- [14] Olaf Diegel, Sarat Singamneni, Stephen Reay, Andrew Withell: Tools for Sustainable Product Design: Additive Manufacturing. *Journal of Sustainable Development*, Vol. 3, No. 3; September 2010.
- [15] S.J. Skerlos, W.R. Morrow, J.J. Michalek: Chapter 23 Sustainable design engineering and science\_ Selected challenges and case studies. *Sustainability Science and Engineering*, Volume 1, 2006, Pages 467-515
- [16] Imre Horvath: Differences between research in design context and “design inclusive research” in the domain of industrial design engineering. *Journal of Design Research*, Vol. 7, No. 1, 2008
- [17] T. E. H Graedel, Braden R. Allenby: *Industrial Ecology and Sustainable Engineering: International Edition*. ISBN10: 0138140340. ISBN13: 9780138140342. 2010 Pearson Paper, 352 pp.
- [18] Salah M. El-Haggag: *Sustainable Industrial Design and Waste Management Cradle-to-Cradle for Sustainable Development*. Google Books
- [19] K. Josevski S. Decision-making and policy to introduce electric vehicles as contribution to regional sustainable development, PhD thesis, University “Ss Cyril and Methodius” in Skopje, Faculty of Mechanical Engineering – Skopje, 2018
- [20] Pierre Yohanes Lubis: *Sustainable Product Design*. Binus A So School of Engineering
- [21] Stevan K. Josevski, Atanas Kochov, Darko Danev, Aleksandar Kostikj, Sustainable Transport Indicators in the Context of Introducing of Electric Passenger Cars, *Tehnicki glasnik/Technical Journal* (Print: ISSN 1846-6168, Online: ISSN 1848-5588), Vol. 14/No. 3, September 2020,

# Analyses and Comparison Of The Turing Reduction And Mapping Reduction

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## ABSTRACT

The goal of the research study is to investigate and analyze the notion of reduction, with particular attention paid to two types of reduction: mapping reducibility and Turing reducibility, which we investigate and compare within the research study. The Turing reduction and mapping reduction are two important concepts in the field of computational theory and we are investigating by comparing and analyzing various models of computations. The primary goals are to investigate and analyze examples, along with examples developed implementation with programming codes to illustrate the approach and compare various forms of reducibility to find which is better suited for a particular case. The investigation is based on background research of previously published research, and a thorough review of several examples that are conducted. Based on the realized analyses heuristics reduction is more universal than mapping reduction, according to a comparison of the two. The results and insights are discussed and argued.

## KEYWORDS

Reduction, Mapping reducibility, Turing reducibility, concept of reduction

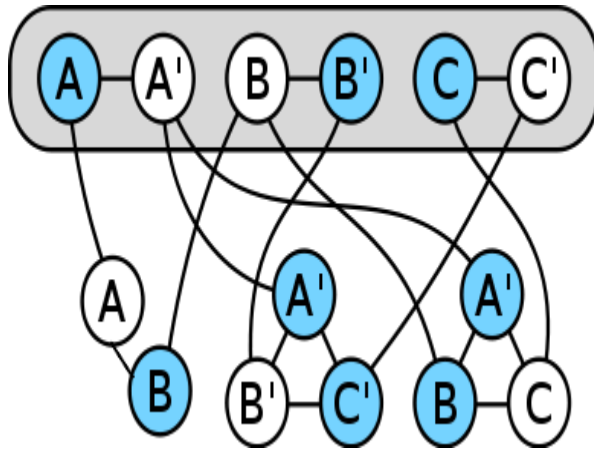
## 1 Introduction

Like in real life, reducing a previously solved problem to a new one is a common strategy in mathematics.

Often, a new problem instance is described entirely in terms of a previous problem instance, and the solution is then interpreted in terms of the current problem. Below is a description of many-one reducibility, a type of reduction. The work focuses on analyses and comparisons of mapping reducibility and Turing reducibility. In computational complexity theory and computability theory, a reduction is an algorithm that transforms one problem into another. It is possible to demonstrate that the second problem is at least as challenging as the first by demonstrating an efficient reduction from one problem to another.

If the problem B algorithm (if it exists) could be utilized successfully as a subroutine to solve problem A, then problem A can be reduced to problem B. If this is true, then solving A cannot be more complex than solving B. We write  $A \leq_m B$ , typically with a subscript on the  $\leq$ , to indicate the type of reduction being employed (m: mapping reduction, p: polynomial reduction). The word "mapping" is used in a variety of ways in certain articles and books.

It's called MANY- ONE. In articles and publications, the word many-one will be used in place of the word mapping. An illustration of a reduction to a vertex cover from the boolean satisfiability problem (A B) (A B C) (A B C)



.Figure 1. A reduction from the boolean satisfiability problem

The gray oval's gray vertices correspond to a satisfactory truth assignment for the original formula, and the blue vertices form a minimum vertex cover. The multi-one reduction and the Turing reduction are the two primary reductions used in computing complexity, as was described in the example above. Turing reductions determine the answer to one problem by mapping reducibility instances from one problem to instances from another, presuming the other problem is simple to solve.

As a conclusion, it demonstrates that Mapping reducibility is a more powerful type than Turing reducibility and is better at classifying issues into separate complexity levels. However, it is more challenging to locate them due to the tighter constraints on mapping reducibility.

## 2 Research Method and Objectives

The purpose of the research study is the analyses and assessment of the current state of the notion of reduction, with particular attention paid to two types of reduction: mapping reducibility and Turing reducibility, which we investigate and compare within the research study.

The research objective of the study is to investigate into several important focusing on two forms of reduction: mapping reducibility and Turing reducibility and we compare them. The main objective is to provide formal definitions examples, analyse and compare different types of reducibility. by providing answers and arguments.

## 3 Mapping reducibility

In computing theory and computational complexity theory, a reduction known as a mapping reducibility transforms instances of one decision problem into instances of another decision problem. As a result, Mapping Reducibility can be used to compare the difficulty of two computer issues. Mapping reducibility is defined as Assume that A and B are the formal alphabetical languages. A total computable function  $f: \Sigma^* \rightarrow \Sigma^*$  that has the property that each word  $w$  is in A if and only if  $f(w)$  is in B is a mapping reducibility from A to B. If such a function  $f$  exists, then we can claim that A is many-one reducible or m-reducible to B and write  $A \leq_m B$ . If there is a calculable function  $f$ , then we can write:  $A \leq_m B$ , where for every  $w$ ,



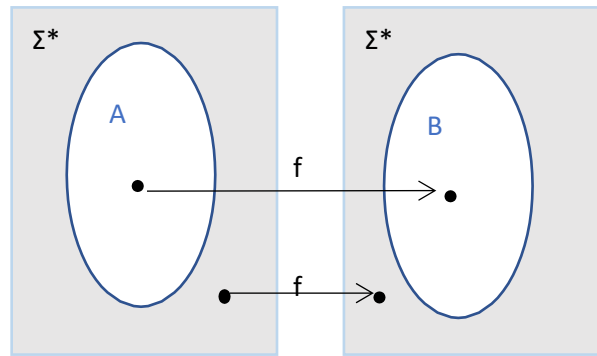


Figure 2. Redaction function

The function  $f$  is called the reduction from  $A$  to  $B$ .  $A$  is said to be reduced to  $B$  if  $B$  is more difficult to solve in terms of the layman than  $A$ . In other words, any  $B$ -solving algorithm can also be used as part of a (otherwise relatively simple)  $A$ -solving system. Mapping reducibility are a particular case and a stronger type of reductions in Turing. The oracle (i.e. our solution for  $B$ ) can only be invoked once at the end with mapping reducibility, and the answer can not be changed. It means that if we want to prove that problem  $A$  can be reduced to problem  $B$ , we can only use our solution for  $B$  once in our solution for  $A$ , unlike in the reduction of Turing, where we can use our solution for  $B$  as many times as we need to solve  $A$ .

This means mapping reducibility instances from one problem to instances from another, while Turing reductions calculate the solution to one problem, provided that the other problem is easy to solve. Mapping reducibility is more efficient in separating problems into distinct classes of complexity. The increased constraints on mapping reducibility, however, make it harder to locate them. A problem for a complexity class is complete if every problem in the class reduces to that problem, and it is in the class itself as well. In this sense, the problem represents the class, as any solution to it can be used to solve every problem in the class in combination with the reductions.

Theorem 1:

If  $A \leq_m B$  and  $B$  is decidable, then  $A$  is decidable.

Theorem 2 :

If  $A \leq_m B$  and  $B$  is recursively enumerable, then  $A$  is recursively enumerable.

Corollary 1:

If  $A \leq_m B$  and  $A$  is undecidable, then  $B$  is undecidable. Corollary 2:

If  $A \leq_m B$  and  $A$  is not in RE, then  $B$  is not in RE. Corollary 3:

If  $A \leq_m B$  and  $A$  is not in coRE, then  $B$  is not in coRE.

## 4 Analyses of Mapping Reductions Examples

Wide-ranging mathematical disciplines, including computing, can benefit from mapping reductions. For instance, take into account the subsequent two sets:

1. The collection of equations of the type  $Ax^2 + By + C$  with integer coefficients and a root made up of positive integers.
2. A group of knots that can be undone with no damage to the rope or breaks, leaving no more than 1 loops

These two sets are reducible to one another despite having quite different natures (by mapping reductions). Although we focus mostly on computing-related issues in this course, reductions are applicable in far broader contexts.

mapping reduction from the first set to the second set could be finding a one-to-one correspondence between the roots of the equations in the first set and the number of loops in the knots in the second set.

For example, suppose we have two equations:

- $2x^2 + 3x + 1 = 0$  with roots 1 and -1
- $3x^2 + 2x + 1 = 0$  with roots 2 and -1/2

We can associate the roots of the first equation with knots that have 1 loop and 2 loops, respectively. For the second equation, we can associate the roots with knots that have 2 loops and 1 loop, respectively.

Thus, we have established a mapping reduction that allows us to translate problems in the first set into problems in the second set, and vice versa. This reduction can be used to prove that problems in one set are at least as hard as problems in the other set, which can be useful in algorithms and computational complexity theory.

JavaScript code to implement the mapping reduction from the first set to the second set, as described above:

```
function mappingReduction(a, b, c) {
  let roots = [];
  let delta = b * b - 4 * a * c;
  if (delta < 0) {
    return null;
  }
  roots[0] = (-b + Math.sqrt(delta)) / (2 * a);
  roots[1] = (-b - Math.sqrt(delta)) / (2 * a);
  let loops = 0;
  for (let i = 0; i < roots.length; i++) {
    if (roots[i] > 0 && Number.isInteger(roots[i])) {
      loops += roots[i];
    }
  }
  return loops;
}
console.log(mappingReduction(2, 3, 1)); // Output: 3
console.log(mappingReduction(3, 2, 1)); // Output: 4
```

In the code above, the mappingReduction function takes three arguments a, b, and c, which are the coefficients of the equation  $Ax^2 + Bx + C$ . The function uses the quadratic formula to find the roots of the equation, and then iterates

over the roots to count the number of positive integer roots. The function returns the total number of loops, which is the result of the mapping reduction from the first set to the second set.

- An alternative and more efficient mapping reduction for this problem could be based on the properties of the coefficients of the equation, rather than finding the roots and counting positive integer roots.

One approach could be to use the parity of the coefficients  $a$ ,  $b$ , and  $c$  to determine the number of loops. For example, if the coefficients are all even, the number of positive integer roots is equal to the number of loops. If one of the coefficients is odd, the number of positive integer roots is equal to the number of loops plus one.

Here is a JavaScript code to implement this alternative mapping reduction:

```
function mappingReduction2(a, b, c) {
  let loops = 0;
  if (a % 2 === 0 && b % 2 === 0 && c % 2 === 0) {
    loops = a + b + c;
  } else if (a % 2 === 1 || b % 2 === 1 || c % 2 === 1) {
    loops = a + b + c + 1;
  }
  return loops;
}
console.log(mappingReduction2(2, 3, 1)); // Output: 3
console.log(mappingReduction2(3, 2, 1)); // Output: 4
```

In the code above, the `mappingReduction2` function takes three arguments  $a$ ,  $b$ , and  $c$ , which are the coefficients of the equation  $Ax^2 + Bx + C$ . The function uses the parity of the coefficients to determine the number of loops, and then returns the result of the mapping reduction. This approach is more efficient than the previous one, as it avoids the need to find the roots of the equation, which can be computationally expensive.

## 5 Findings

A concrete example of a mapping reduction for the population density map of North Macedonia could involve aggregating the data to show the overall population density of the country rather than by individual county. This reduction could involve calculating the average population density of the entire country or summarizing the population density data into fewer categories, such as rural, suburban, and urban areas. For example, the original map might show population density by county using a color scale, with darker colors indicating higher population densities. In the reduced map, the individual counties might be grouped into larger regions, and the population density for each region could be calculated and displayed using a single color or symbol. This mapping reduction can make it easier to quickly understand the overall population density patterns in North Macedonia, without having to interpret data for each individual county. Additionally, it can help to highlight regional trends and patterns in population density that might not be apparent when looking at data at a more detailed level.

In addition to the above methods, there are a few other strategies that can be used to improve mapping performance and reduce data size:

- 1) Use indexing: Indexing the data can improve the performance of map visualization by allowing for faster access to the data. Spatial indexing methods such as R-trees or quadtrees can be used to index geographical data and make it easier to query and display the data.

- 2) **Compression:** Compression can be used to reduce the size of the data, making it faster to load and visualize. There are many different compression techniques that can be used, including lossless compression techniques such as GZIP or lossy compression techniques such as JPEG.
- 3) **Use appropriate data formats:** Different data formats have different strengths and weaknesses, and choosing the right format for your data can have a big impact on performance. For example, vector data formats such as Shapefiles or GeoJSON are well suited for storing geographical data, while raster data formats such as GeoTIFF or JPEG 2000 are well suited for storing aerial or satellite imagery.
- 4) **Optimize the visualization:** Optimizing the visualization can also help improve performance. For example, using the appropriate symbology, labeling, and layout can help reduce the amount of data being displayed and improve the overall performance of the map.
- 5) **Use hardware acceleration:** Hardware acceleration can be used to improve the performance of mapping software. For example, graphics processing units (GPUs) can be used to accelerate the rendering of large maps, making it possible to display more data in real-time.

## 6 Conclusion and Recommendations

The study focuses on the concept of reduction, specifically mapping reducibility and Turing reducibility. It provides a comprehensive analysis of mapping and Turing reducibility. It includes a discussion of the formal definitions of these types of reducibility, along with examples with programming codes to illustrate the concepts. The comparison of mapping and Turing reducibility is a key aspect of the study, highlighting the similarities and differences between the two forms of reduction.

The two examples of mapping reduction from the first set to the second set are based on different approaches to finding a one-to-one correspondence between the roots of the equations in the first set and the number of loops in the knots in the second set.

The first example uses the quadratic formula to find the roots of the equation, and then counts the number of positive integer roots. This approach requires finding the roots of the equation, which can be computationally expensive, and then checking each root to see if it is a positive integer.

The second example uses the parity of the coefficients  $a$ ,  $b$ , and  $c$  of the equation to determine the number of loops. This approach avoids the need to find the roots of the equation and is more efficient, as it only requires checking the parity of the coefficients.

Both examples provide a mapping reduction that allows us to translate problems in the first set into problems in the second set, and vice versa. By establishing this correspondence, we can prove that problems in one set are at least as hard as problems in the other set, which can be useful in algorithms and computational complexity theory.

Here are some recommendations for mapping reduction:

- 1) **Use clustering algorithms:** Clustering algorithms such as k-means or hierarchical clustering can be used to group similar data points together, reducing the number of unique data points in the map.
- 2) **Simplify geometry:** Simplifying the geometry of features in the map can significantly reduce the number of vertices and improve performance. Techniques such as Douglas-Peucker or Visvalingam's algorithm can be used to simplify polygon shapes while preserving their overall shape.
- 3) **Use generalization:** Generalization involves reducing the level of detail in the map by aggregating or merging smaller features into larger ones. For example, merging small roads into larger roads or aggregating individual buildings into building clusters.
- 4) **Reduce attribute data:** Mapping data often contains many attributes that are not necessary for the analysis or visualization. Reducing the number of attributes can help reduce the size of the data and improve performance.
- 5) **Use appropriate map projections:** Using the correct map projection can have a significant impact on the size and performance of the map. For example, using a projection that is optimized for the region being mapped can reduce the amount of distortion in the map, resulting in fewer vertices and improved performance.

In conclusion, mapping reduction and performance optimization can be achieved by using a combination of the above methods. The specific approach will depend on the nature of the data, the purpose of the visualization, and the resources available.

## REFERENCES

- [1] "Splitting Theorems and Strong Redustions", Wang Shaoyi School Of Physical And Mathematical Sciences2019.
- [2] "The uniform Martin's conjecture for many-one degrees", Takayuki Kihara, September2018.
- [3] "Reductions between Types of Numberings", Ian Herbert , Sanjay Jain , Steffen Lempp ,Mustafa Manat and FrankStephan
- [4] "Parameterized Algorithms and Data Reduction for Safe Convoy Routing", René van Bevern  
DepartmentofMechanicsandMathematics,NovosibirskStateUniversityUlitsaPirogova2,630090 Novosibirsk, RussianFederation
- [5] "Corrigendum to "Counting Database Repairs that Satisfy Conjunctive Queries with Self-Joins", JefWijsen University of Mons,Belgium
- [6] "Complexity of Stability", Fabian Frei Department of Computer Science, ETH Zürich [Universitätstrasse 6, CH-8092 Zürich] fabian.frei@inf.ethz.ch  
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Informatik, Heinrich-Heine-Universität Düsseldorf [40225Düsseldorf].
- [7] On a generic Turing reducibility of computably enumerable sets-Alexander Rybalov Sobolev Institute of Mathematics, Pevtsova 13, Omsk  
644099,Russia.
- [8] On the degree structure of equivalence relations under computable reducibility, Keng Meng Ng and HongyuanYu.
- [9] On homeomorphisms of Cantor space that induce only the trivial Turing automorphism, BjørnKjos-  
Hanssen\* August 16, 2019
- [10] Analog Reducibility James Hanson November 18,2019.
- [11] Turing Reducibility, Robert I.Soare,2016
- [12] On a generic Turing reducibility of computably enumerable sets Alexander Rybalov Sobolev Institute of Mathematics, Pevtsova 13, Omsk 644099,Russia.
- [13] CoarseReducibilityAndAlgorithmicRandomnessDenisR.Hirschfeldt,CarlG.Jockusch,Jr.,Rutger Kuyper, And Paul E.Schupp.
- [14] A uniform reducibility in computably presented Polish spaces, Timothy H. McNicholl, Jason Rute,2016
- [15] Information and Computation,Volume 256, October2017
- [16] Bounded Turing Reductions and Data Processing Inequalities for Sequences \* Adam Case Department of Computer Science Iowa State  
University Ames, IA 50011USA.2016
- [17] Turing Degrees And Automorphism Groups Of Substructure Lattices Rumén Dimitrov, Valentina Harizanov, And AndreyMorozov,2016.

# How Recommendation Algorithms Know What You'll Like

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## ABSTRACT

One of the most used statistical techniques that include machine learning and data mining for predicting future outcomes with help of data that already exist is known as predictive algorithm. Predictive models are not stable, and they build assumption based on past and present actions. In the paper we are going to introduce Amazon online store and how algorithms know what we like, so they can recommend products to us by their own. One of the biggest innovations in online shopping - first introduced by Amazon - was automatic recommendation generation. The more accurate prediction algorithms are, the more online stores will sell their products. For that reason, prediction algorithms are of great significance for online stores.

## CCS CONCEPTS

• Education • Algorithms

## KEYWORDS

recommendation, algorithms, Amazon.

## 1 Introduction

One of the biggest innovations in online shopping - first introduced by Amazon - is automatic recommendation generation. Log in to the site and, right there on the home page, the site will give you suggestions for products you can buy. For example, if you are a JavaScript programmer, you will see recommendations for programming books that use that language, and if you are a mother of young children, you will see how the site mentions toys and children's books.

This homepage personalization is of great benefit to online stores compared to displaying only the top 10 listings or banner ads: page-through traffic and conversion rates are far higher. Customers are more likely to see and buy the products offered.

Prediction algorithms are of great importance to online stores - the more accurate they are, the more online stores will sell. In paper [5] are compared three well known approaches for solving the recommendation problem such as traditional collaborative filtering, cluster models, and search-based methods with their algorithm called item-to-item collaborative filtering. Online calculations based on their algorithm are measured independently of the number of clients and the number of items in the product catalog and produces recommendations in real time and with high quality. Amazon is recognized because his system for personalization and recommendations helps customers to found product that they might not find another way. In this update to their original paper, the authors discuss some of the

changes as Amazon has grown [6].

In recent years, Sentimental Analysis was used in all online product firms. Also, many users who are using websites, blogs, online shopping tends to review the products they used. Sentimental Analysis is defined as a concept of data analysis where the collections of reviews are taken into consideration, and those reviews are analyzed, processed, and recommended to the user. In this paper [7], the dataset was collected from the official product sites. First all the reviews had to be pre-processed. After pre-processing is completed, the trained dataset is classified using Naive Bayes and SVM algorithm. These existing algorithms provided the bad accuracy. An ensemble approach will be applied to improve the accuracy of the given scans. An ensemble is an approach to classification by combining two or more algorithms and calculating mode values based on voice references for each algorithm used. In this paper, Naive Bayes, SVM, and Ensemble algorithm were combined. Authors proposed an Ensemble method that helps in providing better accuracy than the current existing algorithm. Once the accuracy is calculated, based on the reviews, the product was recommended for the user.

The study [8] examines how vaccine-related books appear on Amazon. The authors collected vaccine-related books that appeared in the top 10 pages of Amazon search results for seven consecutive days. They also collected Amazon's recommendations for each vaccine book and mapped the recommendation network between these books. Using a network model, they found that books sharing similar views of vaccines were recommended together such that when a user views a vaccine-hesitant book, many other vaccine-hesitant books are further recommended for the user.

Problems that must be solved with such a recommendation algorithm are considered. A big online store like Amazon can have millions of users and millions of items in stock. New customers will have limited information about their preferences, while existing customers may have too much.

The data with which these algorithms work is constantly updated and modified. Customers search the site and prediction algorithms should consider recent item browsing, for example - it does not help if we are looking for a toy for our youngest granddaughter and all we get are jQuery suggestions. The biggest and most important criterion for these systems (apart from accuracy) is the speed. The recommendation algorithm must generate suggestions within a second or more. After all, the customer is in the process of displaying the homepage of the store where the recommendations will appear.

Traditionally, these referral algorithms work by finding similar clients in a database. In other words, they work by finding a set of customers who have purchased or rated the same items. They throw away the items you have already bought or commented on and recommend the rest. For example, if you have already purchased A and B, and a set of such customers also includes C purchases, then C will be recommended for you.

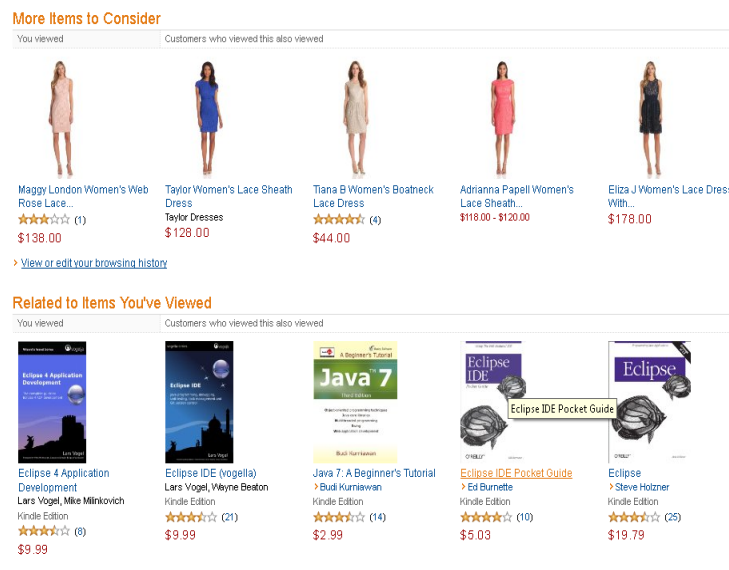


Figure 1 Recommendation process



## 2 Algorithms

### Collaboration

One of the earliest algorithms is known as collaborative filtering. Essentially, the algorithm represents each customer as a vector of all sales elements. Each entry in the vector is positive if the client buys or evaluates an item, negative if the client does not like the item, or empty if the client does not make his or her opinion known.

Most of the records are empty for most of the clients. Some variants of the factors for the popularity of the items may conflict with the importance of the items that are less popular or known. The algorithm then generates its own recommendations by calculating the value of similarity between the current client and everyone else.

The most acceptable way to do this is to calculate the angle between the vectors - the simplest method is to calculate the cosine using a point product divided by the product of the lengths of the vectors. The larger the cosine, the smaller the angle, and therefore more customer-like.

These processes are extremely expensive. There are usually many clients, and many calculations need to be done very quickly. There are techniques for reducing calculations (by taking the customer base or ignoring unpopular items, for example), but in general it is, and always will be, expensive to calculate recommendations this way.

### Client clusters

Another traditional algorithm for prediction involves the use of cluster models. Here the goal is to prepare the customer base by dividing them into clusters, and then assigning the current clients to one of the clusters, in theory is choosing the cluster with the most similarity. Since the cluster will be identified, recommendations will come from purchases and ratings from other clients in that cluster.

Although cluster selection works in much the same way as classification algorithm (assuming that we can calculate the characteristic vector that describes the cluster in the same way as the existence of a client vector), the real importance of the algorithm is in creating clusters.

In principle, grouping customer data is done through heuristics: we start with several empty clusters, assign randomly selected clients to each, and then assign other clients to the clusters according to similarity. From the original clusters that are essentially random, sub-algorithms must be used to merge or split the clusters.

The use of cluster models is with less calculations at the point where customer recommendations need to be made quickly. After all, there is less work to be done to find similar clusters than similar clients. Most of the work is done before the clusters themselves are created.

Unfortunately, this method tends to result in low quality referrals from purchases / ratings that are on average within the cluster. A certain customer is no longer the same as most similar customers, but with the average of a large group of customers. Of course, the number of clusters can be increased to adjust the matches, but then there will be opportunities to increase the computation time.

### Simple browsing

The next traditional algorithm is a simple search algorithm. For example, if I buy the book *Pride and Prejudice* by Jane Austen, the search algorithm will search for items in the database for other Jane Austen books, books with same content by other authors, DVDs made by Austen books, and so on. You can see targeted referrals like these in banner ads when you surf the web.

### Contents-to-contents

What Amazon did to improve its recommendations was to include collaborative filtering. Instead of trying to find similar customers, he finds the same content. This version is called content-to-content collaborative filtering.

This algorithm matches each of the current buyers who bought an item and ranks the items by similarity, and then builds a list of those same items. A table of similar items must first be built on the website by analyzing the items that

customers tend to buy.

Here's how it works: For each item X in the catalogue, we find all the C customers who bought X. For each of these customers, we find all the Y items purchased by C and record that the customer bought both X and Y. Then, for all pairs X and Y, we calculate the similarity between X and Y in the same way as for the collaborative filtering algorithms.

Although this calculation is quite expensive, it can be done in advance. Once the similarity between each pair of items is established, the list of recommendations is easy to obtain.

## **BELLKOR**

Back in 2006, the movie rental company announced a \$ 1 million competition to see if anyone could improve on the recommendations made by CineMatch. The goal was to improve the CineMatch score by 10 percent by testing subgroups of the vast Netflix database.

The winner, after almost three years, was a group that called itself BellKor. Competitors who accepted the challenge were given large databases of 100 million ratings, with each rating (between one and five stars) containing the rating date, title, and year of release of the film, and an anonymous user ID. Qualification database were also provided from the selection of 2.8 million ratings with the same information, but without a real rating.

The goal was to develop an algorithm from a large database, apply it to qualifying databases to guess the rating, and then Netflix would check how close the supposed rating was to the actual rating.

It is fascinating to see the strategies that BellKor uses to incorporate its algorithm. It must be emphasized that the BellKor solution is not a single algorithm by itself but can be seen as a series of algorithmic pieces that can be rotated to produce the best response.

## **Predictions**

The first strategy was to create a group of predictors. This describes the average user rating. Suppose the average rating of all movies is 3.5. As an example of a specific movie, Star Wars could have a complete rating of 4, which would be 0.5 better than the average movie.

Our hypothetical user though tends to rate movies below average: we see that his average above all movies is 3.2. Since his average is 0.3 lower than the average, our initial assumption about how he might rate Star Wars would be  $4 - 0.3$ , or 3.7.

The second strategy used was the realization that time plays a big role in people's ratings. First, the popularity of a movie will change over time. For example, a movie may have a big start and then be forgotten, while another may start with a small start and then become a cult movie. Popularity is also affected by the star or director when they publish a better (or worse) film additionally, and with their appearance, good or bad, in the media.

## **Time**

The overall rating of the user tends to change over time. This could be because the "user" is, in fact, the whole household, also the person making the rating may change, or it could be due to the psychological effect of the user breaking through to a good rating, their next rating may be lower than what would normally be justified (or vice versa: after a series of bad movies, the next good movie may be rated lower than expected).

The following strategy can also be described as part-time: the user can enter a rating for a set of recently viewed movies in one day. The user would like to make ratings unknowingly affect each other (if most movies were good, bad movies would tend to be better than expected ratings, or vice versa), instead of thinking about them all on their own. This strategy is known as frequency.

The development team at BellKor basically describes these strategies mathematically and statistically to provide parameters of the model that can be modified. Taking a large subset of data constantly executes the model, changing the parameters little by little, until they have predicted the ratings of the other smaller subgroups. In this regard, it was

possible for them to submit their guesses to the qualifying subgroup.

From all this, we can see that the prediction algorithms are not exactly accurate. Although they provide fast and usually accurate, it does not matter. For Amazon, the prediction engine is a distinguishing factor, and for Netflix it's the main reason for keeping customers in their memberships - after all, once a user has seen Star Wars and his / her collection of extensions, it happens that he / she wants suggestions for others works or will give up searching here.

### 3 The secret of Amazon recommendation

We wonder what Facebook, Google and Apple know to their users. It is true that Amazon may know more. And massive retailers prove it every day.

"To whom Amazon recommends a product on its website, it will be clear to many that this is not a coincidence."

Basically, the retail giant's recommendation system is based on many simple elements: what the user bought in the past, what items the user has in their virtual carts, the items they rated and liked, and what other clients watched it and bought it. Amazon (AMZN) calls this proprietary mathematical algorithm "content-to-content collaborative filtering," and it's used to greatly customize the browsing experience for returning customers.

The company announced a 29% increase in sales to 12.83 billion dollars during the second fiscal quarter, for a difference of 9.9 billion dollars in the same period last year. Much of that growth probably has to do with the way Amazon has integrated recommendations into virtually every part of the buying process from product discovery to checkout. One can go on Amazon.com and will find multiple panels with product suggestions, then will see areas titled "Most Purchased Together" or other items that customers have also purchased. The company doesn't talk much about how effective recommendations are.

Amazon also assigns recommendations to users via email. Although the website's referral process is more automated, the company provides some employees with numerous software tools to target customers based on shopping and browsing. Actual routing is done by employees, not machines. If an employee oversees promoting a movie for purchase such as Captain America, he should come up with similar movie titles and make sure that customers who have seen other comic book like action movies will get an email encouraging them to watch it Captain America in the future.

Amazon incorporates pretty much all the email marketing standards as any company - but less well known is the fact that the company has a survival-of-the-fittest type of income. This means that if a customer qualifies for both Book Mail and Video Game Mail, the email with the higher average revenue-per-mail sent will win. So, the customer will receive only one email. 41.5 % This tactic prevents email mailboxes from being flooded, at least at Amazon. At the same time, it dramatically increases purchasing opportunities. In fact, the exchange rate and effectiveness of such messages is "very high", significantly more effective than the recommendations on the site. Amazon's conversion rate for referral sales on the site could be 60% higher in some cases if it were based on the performance of other e-commerce sites.

In addition to improving the accuracy of its recommendations, Amazon can also explore more ways to reach consumers. Already, the company has begun selling items previously sold in bulk that were too economical to sell individually, such as a deck of cards or a jar of cinnamon. 62.4% Customers could buy them, but only if they had an order totaling \$25 or more. But the company can actively recommend these additional products during checkout when the order will exceed the price threshold, similar to traditional supermarkets that have impulse purchases such as chewing gum and candies.

In that sense, Amazon customers do the same thing they might do in a supermarket, thinking "It's just a few more dollars why not?"

The most important takeaways from personalized recommendations that we see at Amazon include:

1. Increased Sales Revenue

2. Increase Site Traffic
3. Increased user satisfaction
4. Increased customer loyalty
5. Increased engagement of buyers

Recommendation algorithm of Amazon is one of the most complex and efficient in the e-commerce market.

## 4 Conclusion

E-commerce is a process of selling and buying items via internet. E-stores is available 24/7 every day and there are no country barriers. Everyone can buy something from everywhere in the world with some shipping fees. Recommendation algorithms are best known for their use on web sites used for e-commerce. According to customer input they generate list of recommendation products. To personify the online store for each client recommendation algorithms were used by Amazon. The store is based on customer interest, and changes according customer situation. If Amazon know that we work in education, then the recommendation for us will be books, education tools, notes, pens and so on. Recommendation algorithms are good for e-commerce and their use is indispensable. For almost 20 years the Amazon has been regularly developing its system for recommendation and today is responsible for a large percentage of sales.

## REFERENCES

- [1] CNNMoney. (2013). Retrieved from <http://tech.fortune.cnn.com/2012/07/30/amazon-5/>
- [2] Industry Report. (2013). Retrieved from <http://www.cs.umd.edu/~samir/498/Amazon-Recommendations.pdf>
- [3] Wordpress. (2013). Retrieved from Software Programming: <http://kunik.wordpress.com/2012/03/04/how-does-the-amazon-recommendation-system-work-analyze-the-algorithm-and-make-a-prototype-that-visualizes-the-algorithm/>
- [4] Techradar. (2013). Retrieved from <http://www.techradar.com/news/internet/how-recommendation-algorithms-know-what-youll-like-1078924>
- [5] Linden, G., Smith, B., & York, J. (2003). Amazon.com recommendations: item-to-item collaborative filtering. *IEEE Internet Computing*, 7(1), 76–80. doi:10.1109/mic.2003.1167344
- [6] Smith, B., & Linden, G. (2017). Two Decades of Recommender Systems at Amazon.com. *IEEE Internet Computing*, 21(3), 12–18. doi:10.1109/mic.2017.72
- [7] Sadhasivam, J., & Kalivaradhan, R. B. (2019). Sentiment analysis of Amazon products using ensemble machine learning algorithm. *International Journal of Mathematical, Engineering and Management Sciences*, 4(2), 508.
- [8] Shin, J., & Valente, T. (2020). Algorithms and Health Misinformation: A Case Study of Vaccine Books on Amazon. *Journal of Health Communication*, 1–8. doi:10.1080/10810730.2020.1776423

# A corpus-based functional analysis of the usage of Macedonian marker *pa* by high officials in statements during COVID-19

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## ABSTRACT

This paper adheres to the idea that language does not solely serve to exchange information by describing and thoroughly analyzing linguistic elements referred to as *markers or phatic expressions*. These linguistic elements are socio-pragmatic and are typically expressed in situational instances that call for social cues. We analyze such elements within the framework of Speech Act Theory and Politeness Theory seeking to gain deeper understanding on their role and functions in constructing interpersonal relations. The element at hand is the Macedonian marker *pa* observed in spoken statements given during the COVID-19 pandemics by high officials.

## KEYWORDS

Pragmatic marker, pragmatics, discourse, speech act, politeness

### 1 Introduction: Discourse markers as social cues

The most common definition on discourse markers is found at the Oxford Dictionary, saying that these linguistic elements are words or phrases with the function to organize discourse into segments. Even though they are considered optional in the utterance due to lack of propositional meaning, they are nonetheless important devices that contribute to the natural flow of conversations.

In the social context, discourse markers serve as important devices in expressing common ground, hesitation, seeking approval from the interlocutor, expressing interest on the topic at hand, expressing involvement in conversation, signaling paying attention to the conversation etc. It is because of the importance that they have in several social contexts that such elements are also called *interpersonal markers*, meaning that they assist in marking interpersonal relations among interlocutors.

Social situations may be of various types, and each context may require usage of specific register or sometimes even impose usage of various linguistic elements. Having in mind that social situations and social turmoil bring about changes not only in the way people think – but also in the language they use – we decided to take a closer look in the way that high officials in our country composed their statements during the period of the COVID-19 pandemic.

The literature on discourse markers in spoken interactions in Macedonian language is humble in its own right, making it problematic to study such elements in such recent and unprecedented period such as the pandemic. However, we consider that every effort to study linguistic elements that are so instrumental in building social relations brings forward

more insight into the way that language is used in every-day life by different actors.

In the current paper, we are examining usage of a certain marker to take a look at the way that high officials (usually politicians) construct utterances in order to convey messages or to provide comfort and security to the people.

## 1.1 The Marker *pa* in Macedonian

Traditional dictionaries of the Macedonian language place *pa* under the category of conjunction, adverb, or particle (*Толковен речник на македонскиот јазик*). As a conjunction it may serve to connect similar parts of a sentence, whereas as an adverb it is usually used as a synonym of ‘again’.

When defined as a particle (2008:7), this linguistic element serves for boosting the utterance (*Е, **на** не може тоа така. ‘Well, it does not go like that.’*). However, it may be used independently to „, express a vague situation as a response (*Како оди на работа? – **Па**... – How is work? – **Well**...*). Furthermore, it may be used in „posing questions even as an independent question’.

In The Digital Dictionary of Macedonian Language *pa* is defined as a particle used for functions such as strengthening the utterance or for expressing surprise, with the example given *Zosto da dojdam? **Paznaes**. ‘Why should I come? **Pa**, you know...*

Another given function is to express an indefinite situation, with the example given *Kakosi? **Pa**... How are you? **Pa**...*, as well as serving as an independent question in the example *Kejasvrsamitaarabota – **pa**? I will do that too – **pa**?*

Definitions provided by the dictionaries do not precisely define the functions of *pa*, they merely discuss its distribution. This is why there is a need for detailed examination of the particle *pa* in order to gain more concrete data on its pragmatic use.

Koneski (2003:536) mentions *pa* as a conjunct placing it in the same group as *i*– and. Topolinska (1997) examines *pa* as a predicate conjunct stating that „it is not always synonymous to *i* and *ta*’. She also talks about the distribution of this linguistic element noticing that it appears in central position ‘overreaching the limits of the sentence’, i.e. it can also appear in initial position (Topolinska 1997 cited in Kusevska 2014).

In the vast majority of its pragmatic occurrences, *pa* is considered as the translation equivalent to the English marker *well* (Kusevska 2014). Thus, existing research on *well* can be taken as decent foundation to go into further detail in analysing the marker *pa* in Macedonian.

*Well* as a discourse marker has been examined and written about, and today it is considered as one of the most analysed markers (Beeching 2016). As an element, it has been examined through different lenses: diachronically, semantically, as well as from the point of view of its usage in spoken discourse of speakers who speak English as a second language.

Lakoff (Lakoff 1973) is among the first authors to notice the pragmatic functions of this marker, describing it as having the function to appear in indirect responses or in cases when the interlocutor is avoiding a direct response, or to partially respond to a given question. Svartvtik (1980) agrees, adding to these functions expressing agreement, positive



enforcement, boosting, hedging and partial response. Furthermore, the author states that *well* serves discourse functions as well as conversational strategies: to keep the floor, to mark hesitation or to initiate a new topic.

Similarly, Schiffrin (1987) analyses *well* from the interactivity point of view, as an element contributing to discourse coherence. Owen (1981) on the other hand, proposes that *well* has a function to precede or announce utterances with illocutionary force of disagreement or partial agreement with the interlocutor, refusal of requests. Having said this, it may be concluded that Owen suggests that *well* serves to precede face threatening speech acts. Watts (1987) agrees with this function, highlighting the role of the marker to minimize face-threatening acts in an analysis implemented from the approach of the Relevance Theory. Within the same theory, Jucker (1993:440) states that *well* marks the so called *partial responses* to interlocutor's questions, hedges speech acts that are considered as face-threatening, and notifies that the speaker intends to change the topic.

A different analytical approach for *well* is used by Schouroup (2001) who uses as a starting point Bolinger's hypothesis (Bolinger 1989), even though not fully agreeing, that *well* signals epistemic modality. According to Schouroup, by using *well* the speaker relates to what is relevant, or signals hesitation.

As far as the functions of the Macedonian *pa* go, an examination is done by Kusevska (2014:15), integrating Speech Act Theory with Relevance Theory to analyse the procedural meaning of this linguistic element. By analysing authentic examples in use, the author proposes several functions for this marker:

- Marks common experience between the speaker and the interlocutor;
- Clarifies interlocutor's intentions, by making the implicit meaning explicit;
- Expresses disagreement;
- Highlights the speaker's opinion;
- Presents emotions etc.

The paper talks about the multi-functionality of the element, as well as the necessity for further research, or as the author puts it „analyses in other types of discourses” in order to define the functions more closely.

The marker is also examined within a doctoral dissertation analysing interpersonal functions of several particles in authentic conversations (Vinca 2021), offering several speech acts where *pa* is evidenced to occur.

The current paper uses this table of distribution as a starting point, trying to find out if the results will replicate having in mind the peculiarity of the social context of the pandemic.

Namely the face-threatening speech acts defined according to the Speech Act Theory that are used to examine *pa* are the following:

- Warning
- Polite request



- Suggestion
- Promise
- Ridicule
- Admission of guilt
- Criticizing
- Announcing bad news
- Refusal
- Disagreement
- Reminding
- Opposing
- Emotional reaction
- Bragging
- Announcing good news
- Expressing admiration
- Invitation
- Offer
- Responsibility
- Self- underestimation

Previous research in spoken interactions has shown that the distribution is more frequent in speech acts of suggestion and agreement (Vinca 2021).

## 2 Methodology

Studying the interpersonal character of discourse markers imposes empirical methodology, which is why this paper follows an empirical approach and brings conclusions that are based on analysing authentic speech. The research approach through sampling authentic speech is deemed as appropriate while analysing spoken language, especially when the subject of analysis is a language element that cannot be described solely through the traditional grammar approach. The examination of the sample of authentic speech by high officials during the COVID-19 pandemic enables analysing the usage of the marker during that particular period of time.

As was said earlier, there is no existing corpus for the language at hand (Macedonian). This is why the analysed sample was composed for the needs of this paper. The sample material was gathered through collecting statements that were given during the pandemic, available on the internet. After the material was gathered and stored, it was transcribed following anonymization principles and saved following criteria of the software used for the analysis.

### 2.1 Transcribing the sample

In modern linguistics, authentic material gathered in transcripts is analysed through empirical methods and for the needs of various fields of sciences. Conversation analysis serves as a way to seek patterns that relate to different aspects

of the way that people interact through language. There are several transcription models, but the model principles are still considered the ones brought forwards by Jefferson (2004), one of the founders of conversation analysis as a discipline (together with Sacks and Schegloff).

### 3. Discussion

The occurrence of the discourse marker proved to be evident in public figures' speech during the pandemic, thus demonstrating that language with all its composing elements is used to signal interpersonal relations, especially during times that are trying for the human beings.

To put it in more accurate terms, our software detected the occurrence of the said marker in speech acts signalling illocutionary force of criticizing, suggesting and disagreeing. This proves the hypothesis that speakers use marker as hedges for face-threatening utterances. The chart below shows the distribution of the marker in the above-mentioned speech acts. As can be seen, the marker predominantly appears to precede the speech act with the illocutionary force of suggesting, followed by criticizing and disagreement.

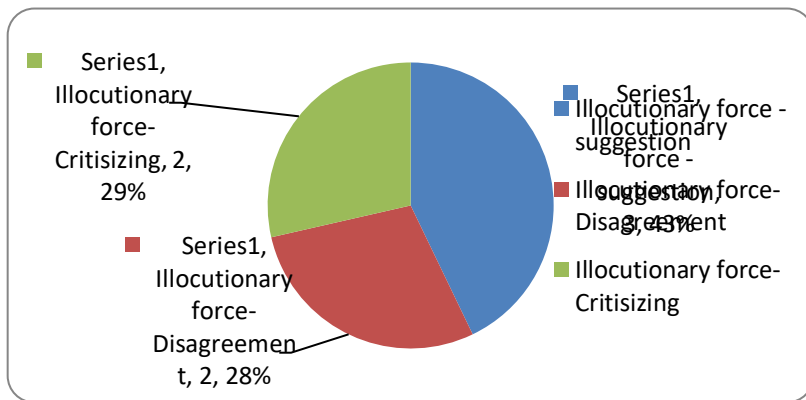


Fig.1 Occurrence of marker Pa in speech acts of suggesting, disagreeing and criticizing

Figure 2 below shows the syntactic position of the marker in the sample. As will be reiterated further in the paper, all occurrences detected by the software are in initial syntactic position, thus proving the hypothesis that discourse markers precede speech acts with face-threatening illocutionary force.

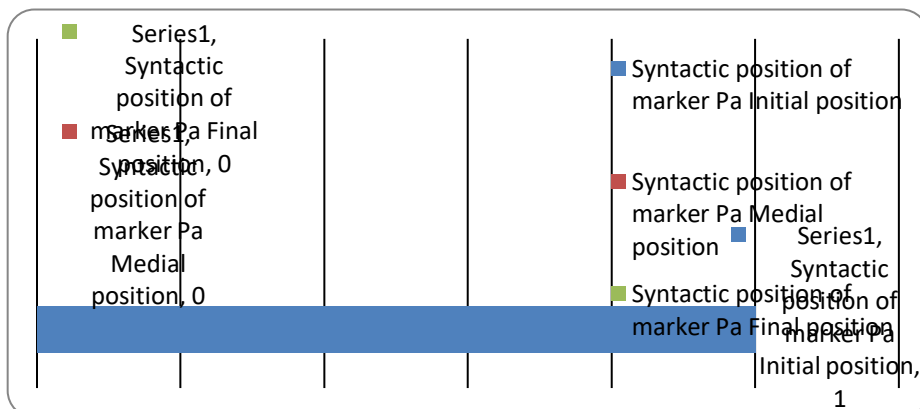


Fig. 2 Syntactic position of marker *Pa*

### 3.1. *Pa* signaling subjectivity

Within the scope of expressing the speaker's subjective stance, we discuss the marker *pa*'s functions in three possible occurrences: preceding the speech act of suggesting, disagreeing and that of criticizing.

Prefacing an utterance with the illocutionary force of suggesting, the marker is usually used in initial position, and usually enhanced by the linguistic element *e*, making the marker the complex *e pa*. In everyday speech, it is not rare that the speaker seeks to convince the interlocutor. This need becomes especially evident during periods of social turmoil. The sample for this paper is gathered for the period during the pandemic. The following example is an example of usage of the marker to introduce a suggestion by a high official during an interview for a news agency. It is obvious that the official does not want to sound too imposing, which is why they opt for introducing the utterance with the marker *pa*. In this case *pa* serves both as a hedge and as a conversational element to signal interpersonality.

(1) *Многу моменти се битни, **па** да речеме и оние сајтови кадешто се чита, **па** има и лажни вести **па**... многу моменти*

'There are lots of important factors, *pa* let's say those sites where we read, *pa* there are fake news *pa* ... lots of things.

Another example of expressing subjective stance can be given with the speech act of disagreement. It is considered very important that high officials display a public image of being friendly. However, difficult times such as the pandemic, call for the obligation to be faced with difficult challenges, as well as with interlocutors who are ready and eager to pose difficult questions, and sometimes even accusations. These interlocutors in our sample are journalists, and we can see in example (2) that the politician does not agree. However, the disagreement is not expressed in a direct way, but is rather 'hedged' by using the marker *pa*. This shows that public figures take into account the social context and they make sure to use language that is not considered harsh, by trying to make face threatening speech acts smoother.

(2) А: Новиот заменик министер за здравство денеска на Фејсбук се пофали дека наскоро ќе може да пиеме кафе во Приштина без ПЦР тест. Како го коментирате тоа? Дали е политика?

Б: *Па* не би рекол дека е политика.

А: The new Deputy Minister of health posted on Facebook today saying that soon we'll be able to have coffee in Prishtina with no PCR test. How would you comment on that? Is this politics?

Б: *Па* I wouldn't say it's politics.

The following example shows another function of marking interpersonal relations in spoken interaction when the speaker is not using the marker in order to sound softer or to 'hedge' the utterance. On the contrary, in cases of public debate, especially between politicians of opposing sides, the speaker strives to make it clear that they do not agree with the interlocutor. Such cases make the multifunctionality of the marker visible and prove once more the conclusion that this is

one of the main features of such linguistic elements.

- (3) ...И зошто ги трошеа парите? **Па** и за трошоци што рече тој и за сè, **па** многу е бре тоа бре.  
Многу е бре.

...And what did they do with the money? **Pa** for expenses that were mentioned before and everything,  
**pa** it's still too much. It's just too much.

### 3.2. Syntactic position

The sample analysis showed dominance of the initial syntactic position of the marker **pa** in the utterance. The marker is rarely distributed in medial position, and never in final position. This can be seen in the figure below.

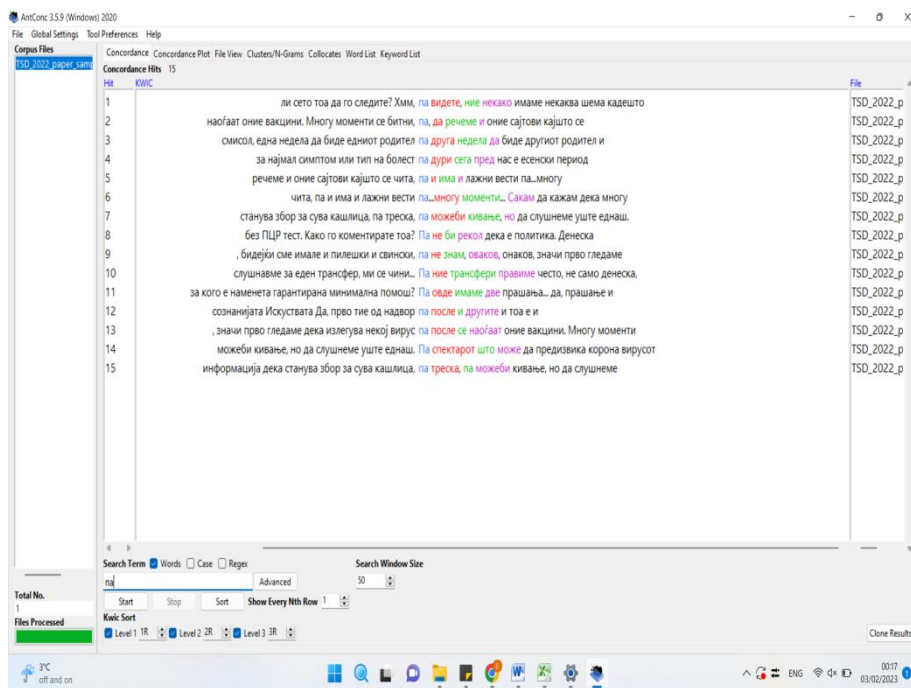


Figure 3: Distribution of **pa** as seen in AntConc

The analysis proved the positive correlation between initial positions of the marker with specific speech act categories. If the underlying assumption is that markers in initial syntactic position signal certain face-threatening speech acts, it can be said that our analysis proved that the speakers choose **pa** to signal speech acts serving to express subjectivity.

## 4. Conclusion

This empirical study of authentic speech strives to fill the gaps in current scholarship for such studies. Subjects of examination were statements given by high officials during the outbreak of the Coronavirus. By analyzing specific periods and contextual realities we can easily prove that language follows certain social norms, but is also a changing matter. Namely, as this analysis showed, during times of health hazards and social instability, high officials- usually politicians- choose to be more careful, by using hedging devices while expressing face-threatening speech acts.

## REFERENCES

- [1] Halliday, M.A.K. Explorations in the functions of language. 1973
- [2] Halliday, M.A.K. Learning how to mean. In *Foundations of language development*. Academic Press. 239-265. 1975
- [3] Halliday, MAK. An Introduction to Functional Grammar, 2<sup>nd</sup> edition. London: Longman. 1994
- [4] Jakobson, R. Linguistics and poetics. *Style in language*. MA: MIT Press. 350-377. 1960
- [5] Malinowski, B. The problem of meaning in primitive languages. Supplement to C.K. Ogden and I.A. Richards, *The meaning of meaning*. London: Routledge and Kegan Paul. 146-52. 1923
- [6] Malinowski, B. *Coral Gardens and Their Magic*. New York: Dover. 1935
- [7] Searle, J.R., 'Speech acts'. Cambridge University Press. 1969
- [8] Searle, J.R. 'Expression and meaning'. Cambridge University Press. 1979
- [9] Austin, J.L. 'How to do things with words'. Oxford University Press. 1962
- [10] Schiffrin, D., 'Discourse Markers'. Cambridge University Press. 1987
- [11] Кусевска, М. Улогата на „па” како адверсативен дискурсен маркер. *Македонски јазик*, 253-264. 2014
- [12] Owen, M. Conversational units and the use of 'well...' In Paul Werth. *Conversation and Discourse*. London: Croom Helm. 19-116. 1981
- [13] Vinca, E. Анализанаинтерперсоналните дискурсни маркери во македонскиот и во албанскиот говорен јазик во споредба со англискиот. [thesis]. 2021
- [14] Beeching, K. *Pragmatic markers in British English: Meaning in social interaction*. Cambridge University Press. 2016
- [15] Lakoff, R. T. The logic of politeness; or minding your p's and q's. *Papers from the Ninth Regional Meeting of the Chicago Linguistic Society*. Chicago: Chicago Linguistic Society. 292-305. 1973
- [16] Svartvik, J. Well in conversation. In Sidney Greenbaum, Geoffrey Leech and Jan Svartvik. *Studies in English Linguistics for Randolph Quirk*. London: Longman. 167-177. 1980
- [17] Watts, R. Relevance in conversational moves. A reappraisal of well. *Studia Anglica Posnaniensia* 19. 37-59. 1987
- [18] Jucker, A.H. The discourse marker well: A relevance-theoretical account. *Journal of Pragmatics* 19/5: 435-452. 1993
- [19] Schourup, L. Rethinking well. *Journal of Pragmatics* 33: 1025-1060. 2001
- [20] Jefferson, G. Glossary of transcript symbols. *Conversation analysis: Studies from the first generation*. Amsterdam: John Benjamins. 13-31. 2004

# Application of Markov Chains in Epidemiology

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## ABSTRACT

Recently, mathematical models are used to describe epidemic disease spread. Epidemic disease transmission outbreaks are modeled among Markov chain in order to monitor and control epidemic spreads. In this paper SIS (Susceptible- Infections- Susceptible) and SIR (Susceptive- Infectious- Recovered) models with discrete Markov chain are represented. These models are developed to see how the number of infected individuals changes over time. In this paper a review of a discrete model of Markov chain for describing epidemic spread is represented. The aim of this review is to explain the formulation of SIR and SIS epidemic models for the spread of infectious disease and to estimate transmission rate and recovery rates.

## KEYWORDS

Epidemiology, mathematical method, Markov chain

## 1 Introduction

Epidemiology studies the cause, distribution and control of disease in a given population or region (city, state or globally). Mathematical models are used to understand disease outbreaks and spread, predict future occurrence of events and the effect on the population. By analyzing these mathematical models certain measures can be taken in order the disease to be controlled. In this paper, depending on the dependence between susceptible, infected and recovered individuals, two types of mathematical models are considered.

The Susceptible- Infected- Susceptible (SIS) model divides the population into two subgroups: susceptible and infected individuals. This model, presumes that recovered individuals from the population do not have permanent immunity and immediately may and can become infectious again. The results for stochastic SIS model in [1] show normal distribution nature of the quasi- stationary distribution when the population size is large and the reproduction number is greater than 1. In [2] transmission parameter is considered to be function of the population size.

The Susceptible- Infected- Recovered (SIR) model divides the population into three subgroups: susceptible, infected and removed/ recovered (dead, immunity) individuals. In this model a susceptible individual that has been infected, recovers the infection and obtains permanent immunity. The main aim of this model is to predict the trajectory of

epidemic transmission as transitions are made from one to another subgroups. This model was developed by [3]. More complex SIR models are obtained from [3] by making more assumption and more parameters are considered [5, 6].

## 2 SIS Epidemic Model

In discrete- time stochastic SIS epidemic model, shown on figure 1, susceptible individual (S) becomes infected (I) but after recovery does not develop immunity and can immediately become infected again,  $S \rightarrow I \rightarrow S$ . The first assumption in this model is that newborns aren't born infected and are placed in susceptible subgroups which means that there is not vertical transmissions. Secondly, infected individuals are infectious and can pass the infection to other individuals from susceptible subgroup. Thirdly, the total population size remains constant over time. This means that the number of births is equal to number of deaths at any time stamp,  $N = S(t) + I(t)$ .

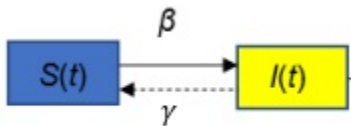


Figure 1: Markov chain of transition in SIS epidemic model

The SIS epidemic model is formulated using discrete time Markov chain. Let with  $S(t)$  and  $I(t)$  are denoted random discrete variables at time  $t \in T = \{0, \Delta t, 2\Delta t, \dots\}$  with  $S(t), I(t) \in \{0, 1, 2, \dots, N\}$ . Because the total population at any time is assumed to be constant follows:

$$\frac{dN}{dt} = \frac{dS(t)}{dt} + \frac{dI(t)}{dt} = 0$$

By choosing enough small time steps can be assumed that at most one transmission occurs during each time step. For small enough time step  $\Delta t$  and for  $I(t) = i$  only one of the following states can occur:

$$i \xrightarrow{\Delta t} i + 1, \quad i \xrightarrow{\Delta t} i - 1, \quad i \xrightarrow{\Delta t} i$$

These means that at every time change, one new individual may get infected, recover and become susceptible again or there may not be change in the number of infectious individuals in the population. The number of susceptible individuals decreases if a new individuals get infected. A recovery of infected individuals' part of the population means that the infection subgroup decreases and susceptible subgroup increases, but the total population remains constant. Several factors affected the transmission of infection disease such as contact transmission, pathogen factors, environmental factor, climate etc. The transmission and recovery rates of the population are denoted as  $\beta > 0$  and  $\gamma > 0$ , respectively. The transmission rate  $\beta$  does not change with population size and transmission rate remains constant even as the number of infected individuals increases. The number newly infected susceptible individuals at time step  $t$  is given as:

$$\frac{\beta S(t) I(t)}{N}$$

The number of infectious individuals that become susceptible depends on the number of infected individuals in a population and is determined by the recovery rate. The rate of infected individuals that become susceptible at any time  $t$  is given by  $\gamma I(t)$ . Time changes of susceptible subgroup is defined as:

$$\frac{dS(t)}{dt} = -\frac{\beta S(t) I(t)}{N} + \gamma I(t)$$

The probability of transiting from  $i$  to  $i + 1$  is:



$$p_{i+1 \leftarrow i}(\Delta t) = \frac{\beta i(N - i)}{N} \Delta t$$

where  $S = N - I$ . The number of individuals recovering at time  $t$  is given by  $\gamma I(t)$  and for every recovery the changes of the infectious subgroup is:

$$\frac{dI(t)}{dt} = \frac{\beta S(t)I(t)}{N} - \gamma I(t)$$

The probability of transiting from  $i$  to  $i - 1$  is:

$$p_{i-1 \leftarrow i}(\Delta t) = \gamma i \Delta t$$

The sum of probabilities of all possible transitions states must be equal to one. Thus, the probability that the number of infection subgroup remains unchanged after a time step is:

$$p_{i \leftarrow i}(\Delta t) = 1 - \left[ \frac{\beta i(N - i)}{N} + \gamma i \right] \Delta t$$

For simplification  $b(i) = \frac{\beta i(N-1)}{N}$  and  $d(i) = \gamma i$ . In order transition probability to be between 0 and 1, the time step  $\Delta t$  should be sufficiently small enough so that following condition is satisfied:

$$\max_i = \{[b(i) + d(i)]\Delta t\} \leq 1$$

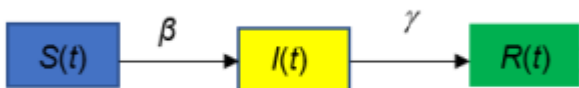
The transition matrix  $P(\Delta t)$  that gives the probabilities of transitioning from one state to another in one time step is defined as follows:

$$\begin{pmatrix} 1 & d(1)\Delta t & 0 & \dots & 0 & 0 \\ 0 & 1 - [b(1) + d(1)]\Delta t & d(2)\Delta t & \dots & 0 & 0 \\ 0 & b(1)\Delta t & 1 - [b(2) + d(2)]\Delta t & \dots & 0 & 0 \\ 0 & 0 & b(2)\Delta t & \dots & 0 & 0 \\ \vdots & \vdots & \vdots & \ddots & \vdots & \vdots \\ 0 & 0 & 0 & \dots & d(N - 1)\Delta t & 0 \\ 0 & 0 & 0 & \dots & 1 - [b(N - 1) + d(N - 1)]\Delta t & d(N)\Delta t \\ 0 & 0 & 0 & \dots & b(N - 1)\Delta t & 1 - d(N)\Delta t \end{pmatrix}$$

The state  $p_{00} = 1$  is an absorbing state of the transition matrix that denotes the probability that the epidemic will die-off. If transitions from  $i$  to  $j$  and from  $j$  to  $i$  are possible than  $i$  and  $j$  are part of same communicating class. The state  $i = 0$  forms a communicating class and another communicating class is formed for states  $i > 0$ . In the class when  $i > 0$  the probability of transitioning between any two states in the population is positive, and also the probability of transitioning from any one of the states out of the class to  $i = 0$  is positive.

### 3 SIR Epidemic Model

In the discrete- time stochastic SIR model, shown on figure 2, the total population is assumed to be constant and divided into three subgroups: susceptible, infected and recovered. Let  $S(t), I(t)$  and  $R(t)$  are random numbers that denotes the number of susceptible, infected and recovered (immune) individuals at time  $t \in T = \{0, \Delta t, 2\Delta t, \dots\}$ , respectively. The total population at any time is  $N = S(t) + I(t) + R(t)$ . The assumption in this model is that there is no latent period, which means that infected individuals are also infectious.



**Figure 2: Markov chain of transition in SIR epidemic model**

The population size is constant at any time, so that follows:

$$\frac{dN}{dt} = \frac{dS(t)}{dt} + \frac{dI(t)}{dt} + \frac{dR(t)}{dt} = 0$$

In order dimension of the system to be reduced, the number of recovered individuals is computed by means of susceptible and infected subgroups as:

$$R(t) = N - S(t) - I(t)$$

The other assumption is that at most one transition can occur during each time step if the time steps are sufficient small enough. The process is bivariate because the recovered subgroup depends on susceptible and infectious subgroups so that for time step  $\Delta t$  only one of the following transitions can occur:

$$(s, i) \xrightarrow{\Delta t} (s - 1, i + 1), \quad (s, i) \xrightarrow{\Delta t} (s, i - 1), \quad (s, i) \xrightarrow{\Delta t} (s, i)$$

Only one individual from the population may get infected, recover from the infection and not becoming susceptible again or there may not be any changes of the number of infectious individuals for every time step. When new infection occurs in the population, the number of susceptible individuals decreases while the number of infection individuals increases.

For discrete time Markov chain SIR model, the change of susceptible subgroup at time  $t$  is defined as:

$$\frac{dS(t)}{dt} = -\frac{\beta S(t)I(t)}{N}$$

Because it is presumed the recovered individuals develop immunity, the susceptible individuals are transiting to infection subgroup with no individual returning to the susceptible subgroup. This means that over time the number the susceptible individuals in the population decreases and the probability of new infection is defined as:

$$p_{(s-1, i+1) \leftarrow (s, i)}(\Delta t) = \frac{\beta si}{N} \Delta t$$

Infected individuals are recovering and transiting to the recovery subgroup, so thus the time change of infection subgroup at time  $t$  is defined as:

$$\frac{dI(t)}{dt} = \frac{\beta S(t)I(t)}{N} - \gamma I(t)$$

Recovery is transition from state  $(s, i)$  to state  $(s, i - 1)$  with probability:

$$p_{(s, i-1) \leftarrow (s, i)}(\Delta t) = \gamma i \Delta t$$

The total population size is constant so that each death is accompanied by a birth. Thus, the probability that the number of infectious individuals remains unchanged after one time step is:

$$p_{(s, i) \leftarrow (s, i)}(\Delta t) = 1 - \left[ \frac{\beta si}{N} + \gamma \right] \Delta t$$

The transition matrix for SIR epidemic model cannot be expressed in a simple form, but there is a single absorbing state at the origin for  $s = 0$  and  $i = 0$ .

## 4 Conclusion

SIS and SIR epidemic models are most simple mathematical models that are used analyzing the spread of infectious diseases. Markov chains are important tool for mathematical modeling of epidemiology results. The mathematical

models which are based on Markov chains can be used for prediction of spreading diseases and for prediction on outcomes of taking measures for stopping the spread of infections. On the other hand, binominal epidemics models as Greenwood model and Reed- Frost model can be used for estimate duration size of the epidemic. In the future, the authors will consider more complex mathematical models like SEIR, SEIR+D for prediction of epidemiological process in their research.

## REFERENCES

- [1] Nassel, I. (1999). On the quasi- stationary distribution of stochastic logistic epidemic. *Mathematical Bioscience*, pp.21-40
- [2] Wierman, J., Marchette, D.J. (2004), Modeling computer virus prevalence with susceptible- infected-susceptible model with reintroduction. *Computational Statistics and Data Analysis*, pp.3-23.
- [3] Kermack, W.O. (1927). A contribution to the mathematical theory of epidemics, *Proceedings of the Royal Society of London*, pp. 700-721.
- [4] Allen J.S. Linda (2010). *An Introduction to Stochastic Process with Application in Biology*, Pearson Education.
- [5] Lazarova K.L., Stojkovicj N., Stojaniva A., Miteva M.(2021). Application of differential equations in epidemiological model, *Balkan Journal of Applied Mathematics and Informatics*, Vol 4, No. 2, pp.91-102.
- [6] Lazarova K.L., Stojkovicj N., Stojaniva A., Miteva M., Ljubenovska M. (2021). Mathematical model for predictions of COVID-19 dynamics, *International Journal of Applied Mathematics*, Volume 34, No.1, pp. 119-133.

# Analysis Of The Effects Of Mobile Educational Games On Students' Success In Programming

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## ABSTRACT

The goal of this study is to investigate how mobile learning using games and gamification affects the field of programming education. Investigated how it increase students' success and understanding of the subject of programming through an educational game that they utilize for learning. Based on background research of published research evidenced was that further research is needed to determine the optimal design and use of mobile educational games in programming education. Therefore, the following research questions are the main focus of the study: The effects of mobile educational games on students' focus and interest in learning. The effects of mobile educational games on students' success in programming; Research on how students and teachers adapt to mobile learning; Research on how mobile educational games foster competition among students. The triangulation technique, which integrates qualitative and quantitative methodology, is the research methodology used within the study. The problems, results, and insights are discussed and provided.

## KEYWORDS

mobile learning, educational games, mobile games, programming, learning process

## 7 Introduction

The research study focus is on the application of mobile in education, to be more specific, the teaching of the subject of Programming by means of the educational application and game. Through the educational game, students will gain knowledge in an easy and fun way.

The impact of the mobile phone on society is significant. Social life, business, health, and education are important spheres. Teaching, learning, and research are all benefited by the integration of IT into the educational system. It'll make it easier for instructors and students to access educational resources regardless of their location or available time. Teachers today use technology to pique students' interest and motivate them to learn. Teachers should find interactive tools to make their classrooms more engaging and to encourage students to learn more because kids perceive the standard learning methods to be tough and dull. Numerous studies have shown increased interest in learning on the part of students when mobile devices are integrated into learning environments. Over 80,000 apps are classified as educational and learning based (Apple, 2015). This instructional game and application will make a little contribution to our educational system because there aren't many educational applications available in Albanian. It will serve as an example for teachers and a fresh learning tool for pupils.

## 8 Research Method

The research topic of the master's thesis will aim to achieve several important research objectives by providing answers and arguments: Researching the impact of Mobile Educational Games on increasing students' attention and interest in the learning process Investigating the impact of Mobile Educational Games on improving student achievement. Researching the adaptation aspect of the game by students and teachers. Research on how Mobile Educational Games affect students' motivation and willingness to learn Investigating whether Mobile Educational Games promote competition among students. The research study has been based on main hypotheses: H1: Mobile educational games have an impact on increasing students' attention and interest in learning

## 9 Research Objective

The purpose of the research study is to find out how the Educational Mobile Game will affect the learning process and achieve more positive results in the subject of Programming. Learning the subject of Programming from the game will be more interactive and will have a positive effect by increasing students' interest in learning.

Another goal of the study is to find out how students and teachers will adapt the mobile learning methodology in the learning process. Because children today have access to entertainment environments through games, this application and educational game will not be difficult for them to adapt. Using this new method for learning, we will see if there will be a significant increase in the motivation of the students for learning.

Nowadays, children use mobile phones for entertainment purposes, so another aim of the thesis is to increase the motivation and interest of learning by not wasting their time playing, but learning and playing at the same time. This research aims to make a sublime contribution in the field of M-learning in the educational system.

## 10 Literature review

There have been several studies conducted on the effects of mobile (m-learning) educational games on students' success in programming education. These studies have shown that mobile educational games can have a positive impact on students' learning and motivation in programming. In the term M-Learning, the M stands for mobile, and the same concept is often referred to simply as mobile learning. M-learning is any type of learning that takes place through a portable, hand-held electronic device. Although the term immediately conjures up images of smartphones, it actually also refers to learning through other types of mobile devices, such as tablets, netbooks, and e-readers. According to Clark Quinn, mobile learning is "the intersection of mobile computing and e-learning: accessible resources wherever you are, robust search capabilities, rich interaction, powerful support for effective learning, and performance-based assessment - learning electronic location-independent in time and space (Ramdas B. Tekale & Balasaheb U. Jadhav, 2020).

Learning enables students to bring their learning experiences together in a collaborative environment. The main goal of the next generation of learning systems is to use current and modern technologies to provide new learning, training and education techniques that will be easily accessible to all who want to learn. Although M-Learning has begun to be used to support a wide range of learning activities, not much research has been done to identify student requirements or to understand what types of mobile applications students should use on their mobile devices and how they can to be an effective mobile learning program (Laila Elgamel, Hamza Aldabbas, & Mohamed Sarrab, 2012).

The concepts of M-learning were given by Alan Kay in the 1970s. He joined the Palo Alto Research Center of the Xerox corporation and formed a group to develop the "Dynabook", which is a portable and protative computer. It aimed to let children have access to the digital world. This project ultimately failed due to the lack of technological support at the time. By 1994, the first smart phone, the IBM Simon, was created by Mitsubishi Electric Corp. He was defined as a personal communicator. Since that time, technology companies began to design the so-called "smartphones". The invention of the smartphone provided the platform for learning through the phone.

Chronologically, M-learning research has been characterized in three phases:

The first stage is to focus on equipment

The second phase is to focus on learning outside the classroom. At this stage, around 2005, a large number of projects were completed. The four largest projects are: "Leonardo da Vinci Project from E-learning to M-Learning led by Ericsson Education Dublin,

"Leonardo da Vinci Project M-learning: the next generation of learning by Ericsson Education Dublin, "The IST M-Learning project led by the government of M

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Side panels United Kingdom and Learning and Skills Development Agency (LSDA)" and "IST project led by GuintiRicerca from Genoa, Italy". The third stage is the focus on student mobility. M-learning is a subset of e-learning. E-learning is the macro concept that includes e-learning and mobile learning environments (Brown, 2003).

## 11 Findings and Results

The expected findings and arguments of the work provides sufficient information on the factors that influence the digitalization transformation and different digital skills and assessment of the different requirements from different public administrations. This research targets the first-year high schools' students, for gymnasium PancePoposkiGostivar. One class have been included in the research. The demographic statistics are presented below, where these questions were answered by the students of parallel 1 in the fifth grade. These questions belong to the first questionnaire, where the students were surveyed before using the educational game for the subject of Programming . The questions are related to the gender to which the students belong, then about their access to digital educational materials, and whether they can use the educational game on any mobile with the Android operating system.

### Question 1 :What is your gender?

The first question that belongs to the first questionnaire is about gender. Figure 1 below shows that out of 20 surveyed students, 60% are female while 40% are male.

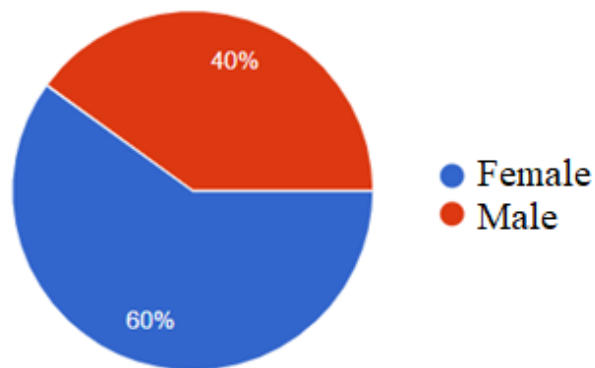


Figure 2Its distribution respondents according to gender .

### Question 2: Do you have access to digital educational resources?

The second question, which also belongs to the first questionnaire, is about digital resource approaches. In figure 2 we notice that **very good access** , **excellent** access and access to **the field of Technology** lead with 20% each. While with 10% we have insufficient access, sufficient access, access in the field of pedagogy and good access. Most students have access to digital educational resources.

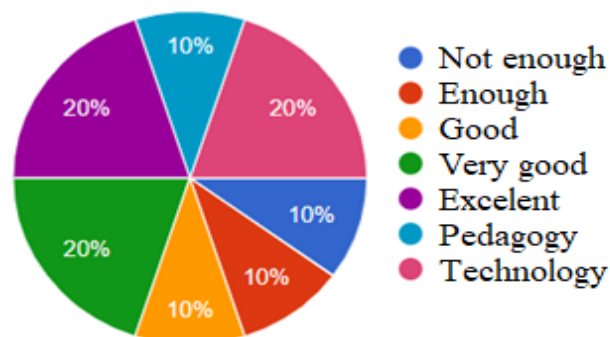
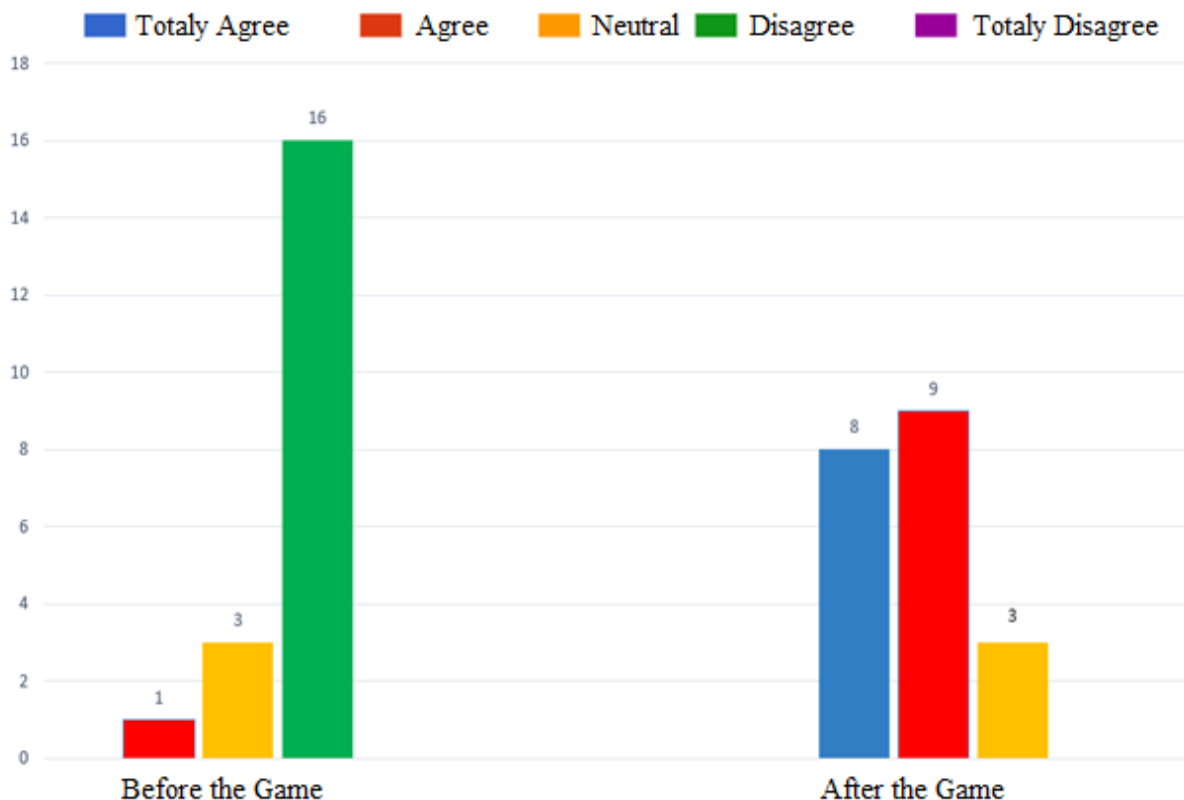


Figure 3Statistics about ACCESS the source educational digital

### Question 3: Impact of educational mobile gamesin improving success of pupils is high?

In figure 3 we can see that the graph before using the game shows that almost all the surveyed students do not agree intially that the impact of

games educational mobile in improving success it's of high impact. We see that **16** of the students disagree, **3** are neutral, and **1** disagree. In the graph after using the game, most of the surveyed students agree that the impact of games educational mobile in improving success \_ it's of high , where **9** of the students agree, **8** of them completely agree and only **3** have a neutral attitude. From these positive results, we see that the educational game has had a positive impact on improving success \_ of students in higher education.



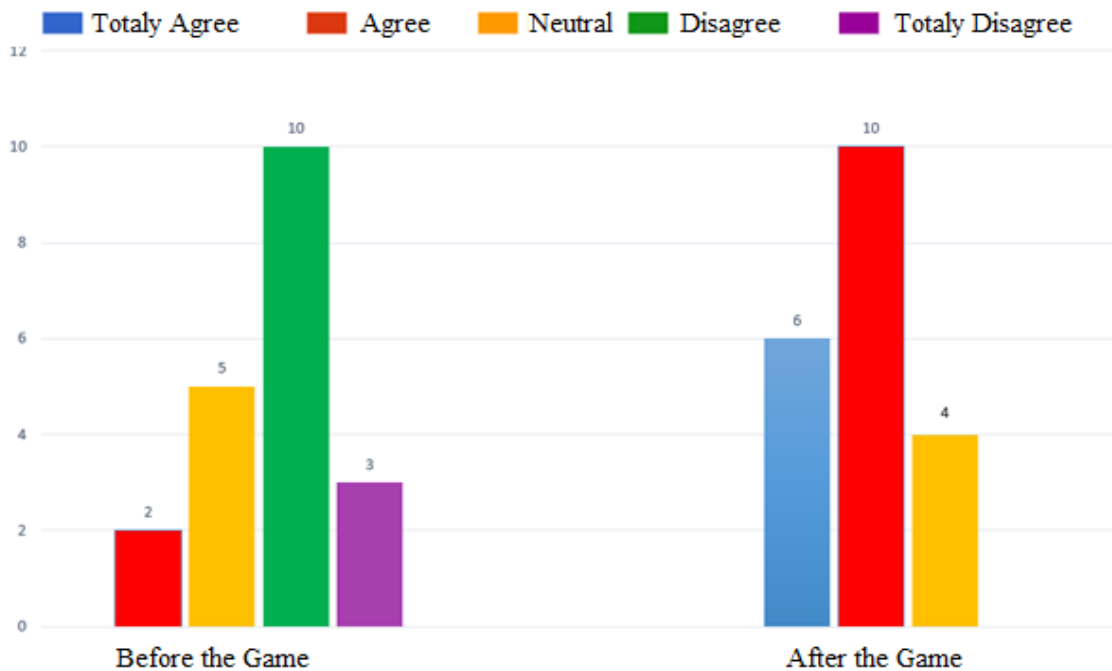
*Figure 4. How much up it's the impact of games educational mobile in student success*

Descriptive statistics are presented below for the two questionnaires. The figures present the data in the form of columns which are divided into two summary graphs. The first graph presents the summary columns of the responses from the first questionnaire (before using the game), while the second graph shows the summary columns of the responses from the second questionnaire (after using the game). In the figures we can see and compare that the attitudes of the students before using the educational game are completely different from the attitudes after using the game.

**Question 4 :** Do you think that the games educational mobile you help learn better ?

In figure 4 we can see that the graph before using the game shows that half of the surveyed students do not agree that educational games influence them to learn better, where **10** of the students disagree, **5** are neutral, **3** do not agree at all and **2** did not agree. In the graph after using the game, half of the surveyed students agree that educational games influence them to learn better, where **10** of the students agree, **6** of them completely agree and only **4** have a neutral attitude. From these positive results, we see that the educational game has had a positive impact, helping students to learn better.





*Figure 4. the impact of game educational mobile in learning more qualitatively*

## 12 Conclusion and Recommendations

The research study provides a review of the published literature as well as an analyses of the emerging trends of different mobile educational games.

Mobile learning is a new technique in the education system. Teaching and learning through mobile devices must be planned before being implemented in the classroom. First of all, the goal that we want to achieve with the implementation of learning through mobile devices should be clear. The following are the steps that must be followed in order to implement M-learning in the classroom.

- Before the curriculum or plan for mobile learning can be made, the infrastructure must be provided. Some of the main components of the infrastructure:
- Internet installed in the school
- Hardware devices (computer, laptop, mobile), if the school does not have money to provide furniture, the BYOD (Bring Your Own Device) method can be used.
- Classroom management system which is hardware and software that allows the teacher to have control over digital classroom components such as smart boards, audio/video elements, projector, lighting and mobile hardware devices

One of the key findings from these studies is that mobile educational games can increase students' engagement and motivation in learning programming. The interactive and gamified nature of these games can make programming concepts more accessible and appealing to students, helping them to better understand and retain the material. Additionally, the ability to play and learn programming on a mobile device makes it more convenient for students to engage with the material outside of traditional classroom settings.

Another important finding from these studies is that mobile educational games can improve students' problem-solving and critical thinking skills. Through playing these games, students are able to apply programming concepts in real-world scenarios, allowing them to develop their critical thinking and problem-solving skills in a fun and engaging way.

However, it is important to note that the effectiveness of mobile educational games on students' success in programming education can depend on several factors, such as the design of the games, the level of difficulty, and the pedagogical approach used. It is also important to ensure that the games are used as a supplement to, and not a replacement for, traditional classroom instruction.

From the empirical study of the data and their analysis from a quantitative and qualitative point of view, which were carried out in the experimental group and in the control group, after comparing the results, the influence of the Programming educational game has shown itself by making differences in the achievements of the students in the subject relevant. The experimental group that used the educational game for learning reached a significantly higher level of Programming knowledge. Through the educational game, students found it easier to prepare for subjects in general. After using the game, the students felt motivated, more attentive, more interested and more willing to learn. The students have challenged each other through the game, inciting competition against each other. The educational game has been welcomed and easily adapted by students and teachers. All the mentioned features prove the purpose of this research on the impact of mobile educational games on the subject of Programming.

In conclusion, the analysis of the effects of mobile educational games on students' success in programming education shows that these games have the potential to be a valuable tool in promoting student engagement, motivation, and critical thinking skills. However, further research is needed to determine the optimal design and use of mobile educational games in programming education.

## REFERENCES

- [18] Amhag, L., Hellström, L., & Stigmar, M. (2019). Teacher educators' use of digital tools and needs for digital competence in higher education. *Journal of Digital Learning in Teacher Education*, 35(4), 203–220. <https://doi.org/10.1080/21532974.2019.1646169>
- [19] Blau, I., Shamir-inbal, T., & Avdiel, O. (2020). How does the pedagogical design of a technology enhanced, collaborative academic course promote digital literacies, self-regulation, and perceived learning of students? *The Internet and Higher Education*, 45(December 2019), 100722. <https://doi.org/10.1016/j.iheduc.2019.100722>
- [20] Bucea-Manea-Țoniș, R., Bucea-Manea-Țoniș, R., Simion, V. E., Ilic, D., Braicu, C., & Manea, N. (2020). Sustainability in higher education: The relationship between work-life balance and XR e-learning facilities. *Sustainability (switzerland)*, 12(14), 1–19. <https://doi.org/10.3390/su12145872>
- [21] GJ Hwang, , CL Lai. "Seamless flipped learning: a mobile technology-enhanced flipped classroom with effective learning strategies." <https://link.springer.com/article/10.1007/s40692-015-0043-0>
- [22] GJ Hwang, , SJH Yang, , GH Hwang. "A two-tier test-based approach to improving students' computer-programming skills in a web-based learning environment." <https://www.jstor.org/stable/pdf/jeductechsoci.18.1.198.pdf>
- [23] Horak, D., & Horakova, D. (2017). Educational Games for Programming Learning: A Systematic Mapping Study. *Computers & Education*, 114, 96–111.
- [24] Liu, Z. J., Tretyakova, N., Fedorov, V., & Kharakhordina, M. (2020). Digital literacy and digital didactics as the basis for new learning models' development. *International Journal of Emerging Technologies in Learning*, 15(14), 4–18. <https://doi.org/10.3991/ijet.v15i14.14669>
- [25] Martínez, J. M., Gonzalez, E. G., & Perez-Sanagustin, M. (2014). Using mobile games to improve learning programming skills. *Computers & Education*, 72, 139–150.
- [26] P Panjaburee. "A mobile game-based C programming language learning: results of university students' achievement and motivations." <https://www.inderscienceonline.com/doi/abs/10.1504/IJMLO.2019.098184>

# Public procurement in the schools of the Republic of North Macedonia

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## ABSTRACT

The financing of education is considered one of the most important factors in the education system, and within that, the financing of primary and secondary schools is the basis of their functioning. Primary and secondary education is provided with funding from the Budget of the North Macedonia, according to established legal rules and norms. These obtained funds are used by the schools to cover their expenses in order to be able to function in an efficient manner and to be able to achieve their goals. The majority of purchases of goods, services and things necessary for the functioning are subject to the Law on Public Procurement. Modern, innovative, fair and open public procurement systems are an important segment of the economy of every country, which contribute to transparency and accountability in the spending of public funds. This paper will investigate the methods and procedures used in public procurement, for the procurement of goods, services and works for primary and secondary schools in the Republic of North Macedonia. The data will be collected through a survey questionnaire that will cover over 100 respondents from the entire country.

## Keywords

primary and secondary schools, public procurement, Bureau of Public Procurement, methods and procedures

### 1. Introduction

In today's period of constant changes, globalization and opening of the capital and labor market, public procurement is increasingly attracting interest in its study and monitoring.

The public procurement system is necessary to regulate the process of using public funds by public authorities, due to obtaining the necessary resources from external, commercial resources.

The tendency and purpose of the process of using these funds is striving for a fair process and obtaining the best value for the invested money. They are of exceptional importance due to the fact that the public sector, i.e. the state, through public procurement spends a large percentage of the National Budget, hence the need to introduce mechanism that demonstrate transparency, competitiveness, economy and non-discrimination and enable the realization of the best value.

The continuous raising of public awareness about the need for correct application of public procurement procedures is very important. Professionalization of staff working on public procurement is an instrument for successful implementation of procedures. This approach enables efficiency in the implementation of procedures, a higher level of expertise and a reduction of critical points for corruption, in the long term.

Modern, innovative, fair and open public procurement systems are an important segment of the economy of any country. According to World Bank data's, in highly developed countries, which have a high income per capita, public purchases exceed 14% of the Gross Domestic Product.

In North Macedonia, in 2021, total public purchases amount to 10.8% of the GDP (R.Gligorijevska, 2022).

The Republic of North Macedonia, through the Bureau of Public Procurement, undertakes a series of activities to improve and modernize the system of public procurement in the country, as well as to harmonize the regulation with the European Union countries.

### 2. Theoretical aspect

In North Macedonia, in accordance with Article 101 of the Law on secondary Education (Official Newspaper of the Republic of North Macedonia, No.44/1998,24/1996. 34/1996/35/1997), the funds for financing public secondary education are provided from the Budget of the Republic of North Macedonia, in the manner and according to the procedure determined by the Law on the Budgets of the Republic of North Macedonia, the Law on Execution of the Budget of the Republic of North Macedonia and the Law on the Financing of Local Self-Government Units.

In accordance with the Law on Secondary Education, funds from the budget are distributed to municipalities through block-grants and dedicated grants.

In order to achieve transparency, the methods for the allocation of funds are regulated by the Decree on the methodology for determining the criteria for the allocation of block grants and the Decree on the methodology for the allocation of capital and special grants established in the Law on Financing of Local Self-Government Units (Official Newspaper of the Republic of North Macedonia).

The municipality, distributes the funds received from the state to secondary schools in its territory to ensure the implementation of the educational process, in accordance with the established standards and norms.

The issue of corruption and transparency of public spending represents one of the biggest challenges for the Republic of North Macedonia. In several relevant documents published in the last few years (EU Progress Report for the Former Yugoslav Republic of Macedonia, 2015), the need to implement the principles of responsibility, transparency, as well as the need to reform the management system was emphasized with public finances.

In addition, the last progress report for 2016 emphasized that, transparency and accountability of public institutions and state-owned enterprises, are still not sufficient (EU Progress Report for the Former Yugoslav Republic of Macedonia, 2015).

Every modern public procurement system is based on generally accepted standardized principles that determine the concept of public procurement. Namely, such prevailing principles are: transparency, accountability, efficiency and economy of spending of public funds.

On the other hand, the system should ensure equality between economic operators, in a way that all interested economic operators will compete against each other on the call for public procurement under fair conditions in an equal fight.

According to Article 2 (Official N.(24/2019) of the Law on Public Procurement, the public procurement system ensures: competition between economic operators; equal treatment and non-discrimination of economic operators; transparency and integrity in the process of awarding public procurement contracts and efficient use of funds in procedures for awarding public procurement contracts.

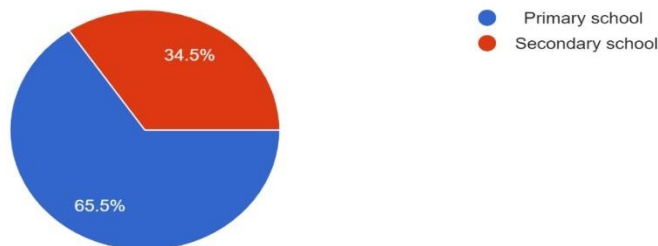
### 3. Methodological approach

A survey questionnaire was used to collect the data, which was delivered to the respondents electronically using Google form platform. The survey was conducted on an anonymous and voluntary basis. The questionnaire is composed of 28 questions that are divided into three parts; the first part covers the organization of financial planning, the second part covers knowledge of the legal provisions of the Law on Public Procurement, the Bureau of Public Procurement and the Electronic System of Public Procurement, while the third part covers the planning and implementation of public purchases in schools. The received questionnaire was answered by 116 respondents from the Republic of North Macedonia, of whom 65.5% are employed in primary schools while 34.5% in secondary schools (chart 1). Forty of the respondents are persons employed in secondary schools of which 57.7% in secondary schools of which 57.5% in secondary vocational schools and 42.5% in general high schools.

**Chart 1. Type of schools**

1. Your school is:

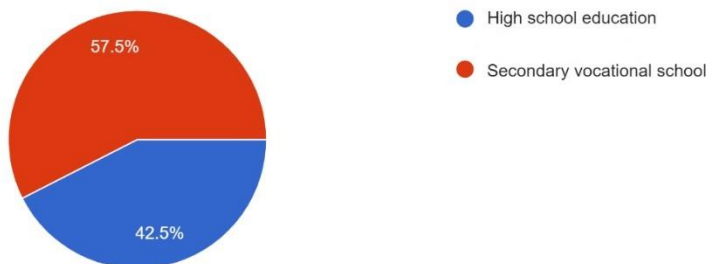
116 responses



**Chart 2. Type of secondary schools**

1.1. If is I high school, is it:

40 responses



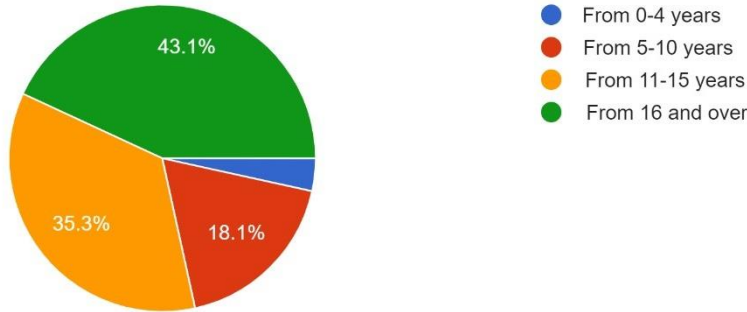
The respondents who answered the offered questionnaire have longer work experience, i.e. 43.1% have been working in education (primary or secondary) for 16 years or more, 35.3% have work experience between 11-15 years and the percentage of people who have work experience less

than for years (chart 3).

**Chart 3. Work experience**

2. You work at the school:

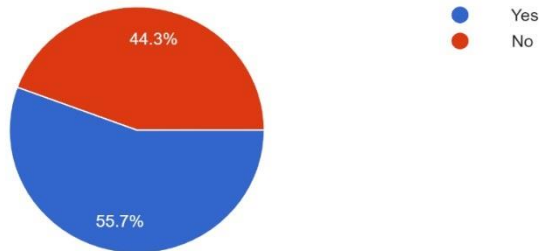
116 responses



**Chart 4. Structure of the financial committee**

3. Is there a committee on financial issues in your school?

115 responses



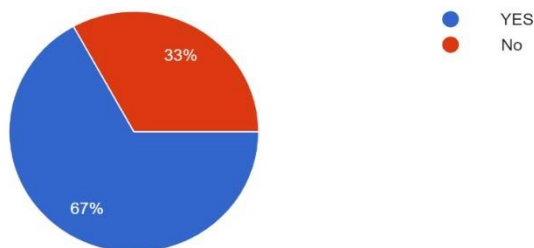
On the question if there is a special committee in their school that deals with financial issues, 44.3% answered that there is no such committee, which represents a large percentage where the financial part is not managed in the best possible way. This can also be concluded from the received answered the following question (chart 5) where 33% answered that although they are part of the assets in their schools, when it comes to the financial part, their needs are not taken into account when drawing up the school’s financial plans.

The whole procedure of financial planning is not transparent enough because about 40% answered that they do not agree with the level of transparency in their schools (chart 6).

**Chart 5. Participation in the financial plans of the school**

4. As a member of a working group, is your opinion taken into account in the financial plans?

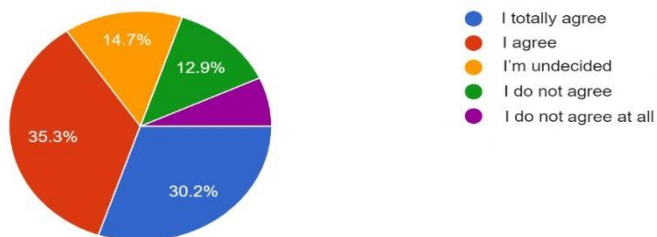
115 responses



**Chart 6. Transparency in schools**

5. The process of financial planning in your school is transparent:

116 responses

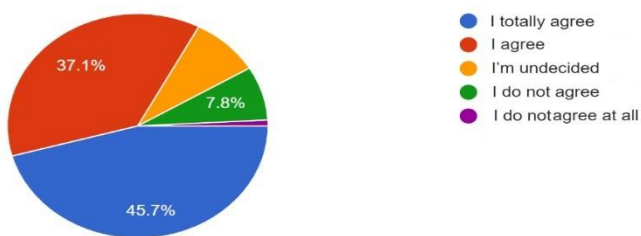


The low percentage of realization of public procurement plans and their frequent changes followed by the absence of a system for monitoring their realization means that is a poor planning of public procurement and inefficient management of public funds, especially in schools where about 20% of the respondents do not agree with the statement that public purchases cover the real needs of schools (chart 7).

**Chart 7. Success of public procurement**

6. Public procurement covers the real needs for the school:

116 responses



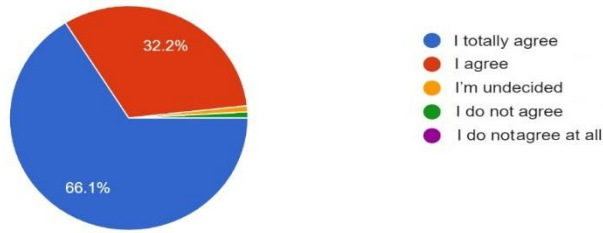
The second part covers the issues related to Knowledge of the legal provisions of the Law on Public Procurement, the Bureau of Public Procurement as an institution responsible for performing public procurement, as well as the way of organizing electronic public procurement, through the system of Public Procurement Office.

Respondents have knowledge about the Bureau of Public Procurement, 98.2% have knowledge, some fully agree, some partially agree on this question (graph 8), which concerns whether schools uses the Bureau of Public Procurement’s services, 87.9% answered affirmatively, while 10.3% are undecided (chart 9).

**Chart 8. Knowledge about the Bureau of Public Procurement**

7. Ncy in the implementation of public procurement:

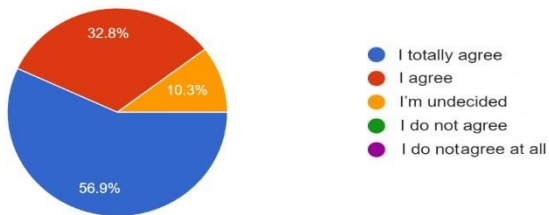
115 responses



**Chart 9. Using services from the Bureau of Public Procurement**

8. The school uses the services of Public Procurement Bureau:

116 responses

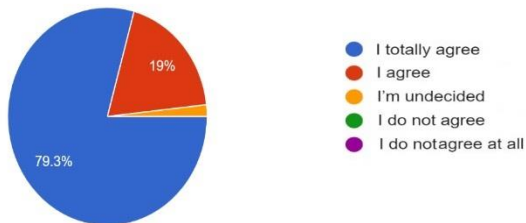


To the following question about the legal obligations for using Electronic Public Procurement of schools, as many respondents answered that they know about the legal obligation (chart 10), and that schools respect the obligation for purchases over 1000 Euros according to which the law on public procurement should be respected. 94.8% answered affirmatively (chart 11).

**Chart 10. Legal obligation of the school for using the Electronic System for Public Procurement**

9. The school has a legal obligation through the Electronic System of Public Procurement:

116 responses

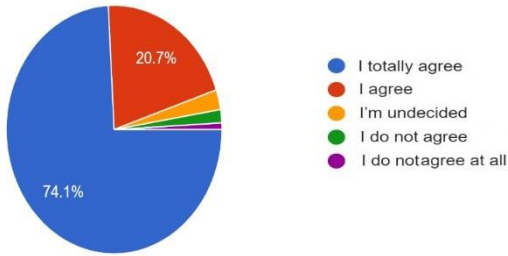


**Chart 11. Compliance with the Law on Public Procurement**



10. The school respects the law on Public Procurement for purchases over 1000 Euros:

116 responses

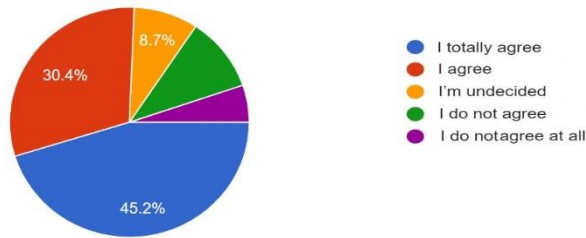


The third part of the questionnaire includes questions about the procedures for planning and implementing public procurement in the school, where questions were asked whether the employees of the school are familiar with the annual plan for public procurement, the answer was affirmative with 75.6% (graph 12), while 77.4% are familiar with the procedures (chart 13). More than 10% are not familiar with the implementation of public procurement and the meaning of the public procurement commission (chart 14, 15), and some respondents refrain from giving an answer, 9.7% are undecided, but some of the respondents agree to be part of the commission for public procurement after they have undergone a training, namely 79.1% (chart 15). Although, on the question of public procurement commission being permanent or changing, half of the respondents agree, the other half does not see efficiency if the commission is changed (chart 17).

**Chart 12. Plan for public procurement in schools**

11. I have knowledge of the school's annual public procurement plan:

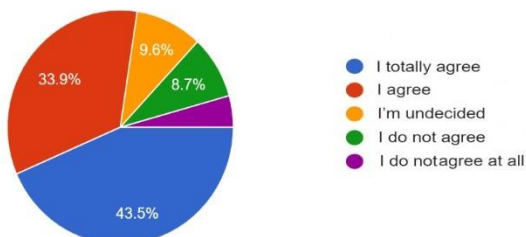
115 responses



**Chart 13. Procedures for public procurement in schools**

12. I have knowledge of the procedure for implementing public procurement in the school:

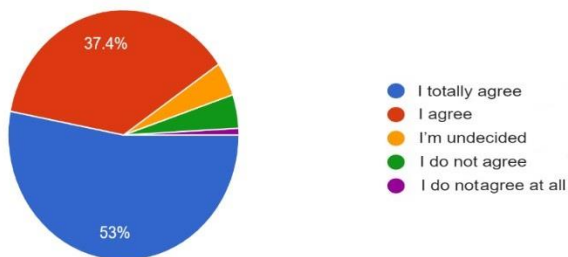
115 responses



**Chart 14. The role of the public procurement committee in the school**

13. I know the role of the school's Public Procurement Commission:

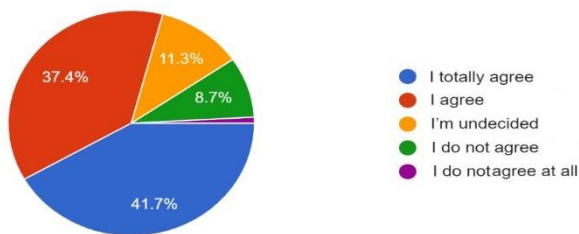
115 responses



**Chart 15. Participation in a public procurement commission**

14. I would join the Public Procurement Commission of the school if I previously had appropriate training:

115 responses



Although the law on public procurement does not emphasize whether the members of the commission should receive compensation for the performed obligations, 37.4% are either undecided or refuse to be part of it, knowing the responsibility which has the commission (chart 16).

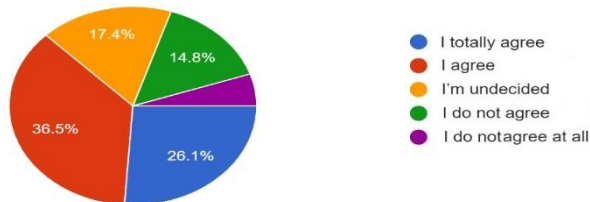
As for the transparency of the schools in spending the funds, 1/4 are either undecided or do not agree with the level of transparency (chart 18). The following questions refer to the procedures used for public procurement in schools and undoubtedly it is a procurement of low value, due to the easiest procedure to complete and the short time frame to complete the whole procedure, another reason is that the amount of procurement is lower, only 10 000 Euros.

The following question states the participation and significance of a responsible person in public procurement, which presents another challenge due to the fact that in some schools there are no persons there are not licensed (responsible) people for public procurement (chart 18,19,20 and 21).

**Chart 16. Participation in a commission for public procurement with compensation**

15. I would join the Public Procurement Commission of the school if I receive financial compensation for it:

115 responses



**Chart 17. Participation in a school’s public procurement committee**

16. The School Commission for Public Procurement, to be effective, should be:

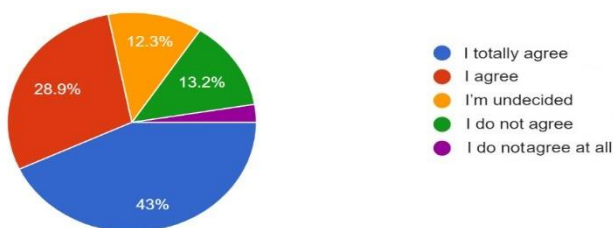
115 responses



**Chart 18. Transparency of schools in spending funds**

17. The school is transparent in spending funds

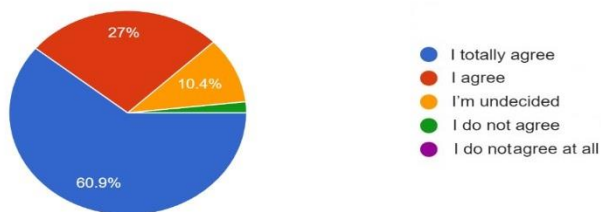
114 responses



**Chart 19. There is a responsible person for public procurement**

18. The school has a responsible person for public procurement

115 responses

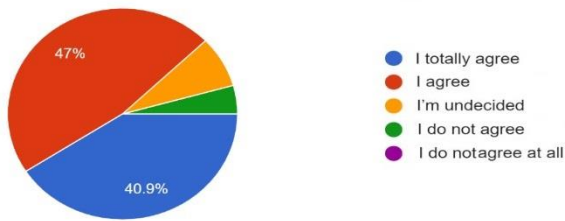


Out of 115 respondents, 87.9% answered that public procurement is efficient, therefore the legal provisions are observed when awarding public procurement contracts. But although the director does not chose who should be an active participant in the implementation of public procurements, 30.4% of the respondents answered that the director, apart from being a participant, also influences the decision to award contracts during public procurements (chart 23). According to the Law on Public Procurement, the basic criterion in awarding the contract for public procurement is the lowest price, according to the results obtained (chart 24) 48.2% do not agree with that the lowest price offers us the best quality of goods and services (graph 25).

**Chart 20. Efficiency of public procurement**

19. The school acquires through public procurement sufficient goods and services to work efficiently

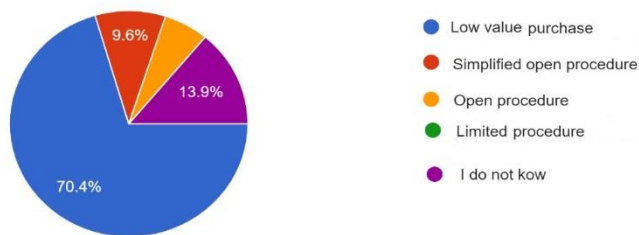
115 responses



### Chart 21. Procedures used in public procurement in the school

20. Which of the following procedures is most often used in school's public procurement?

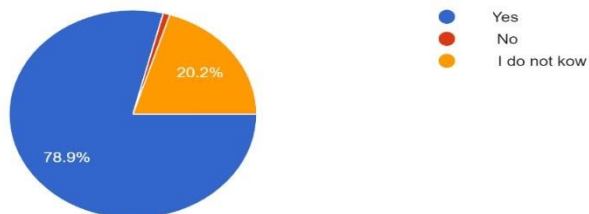
115 responses



### Chart 22. Legal compliance in contracts

21. Is the legal procedure for public procurement observed in your school?

114 responses



### Chart 23. Participation of the director's in public procurement procedures

22. Is the director an „ active participant“ in the decision to award a public procurement?

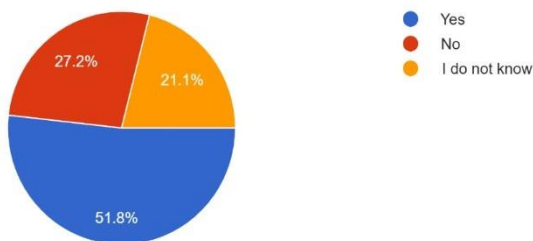
115 responses



### Chart 24. Criteria for awarding public procurement

23. Does the lowest price criterion provide an opportunity to avoid selective decision making?

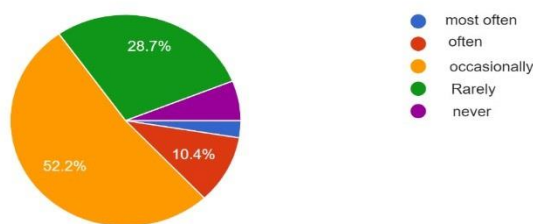
114 responses



**Chart 25. Lowest price and quality**

24. Does the criterion of lowest price always satisfy quality and service?

115 responses



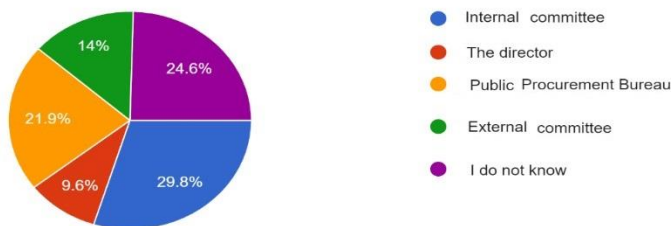
When asked who decides on a complaint of an economic operator, 29.8% answer an internal committee, but the percentage of 9.6% who answered that it is the director is not too small (chart 26). One of the challenges faced by schools is the way of managing the so-called free funds, which are 12 000 Euros<sup>1</sup>. From the obtained results, it can be seen that the way of distribution is different (chart 27).

The last questions are about the purposes for which these funds are used, as well as how the persons participating in the public procurement commission are compensated (chart 27, 28, 29), where the answers are different from a monthly basis to an annual basis.

**Chart 26. Making a decision on an appeal**

25. Who decided on a complaint from a certain economic operator?

114 responses



**Chart 27. Distribution of “free money”**

<sup>1</sup>Up to 1000 Euros, the Public Procurement Law does not apply (1000 Euros x 12 months)

26. How do you distribute the “free funds” of 12 000 Euros on an annual basis?:

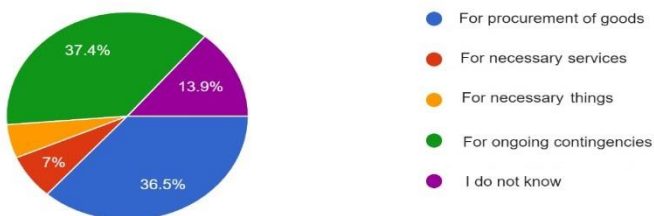
112 responses



**Chart 28. Objectives of using “freemoney”**

27. For what do you most often use those funds for?

115 responses



**Chart 29. Method of compensation for public procurement**

28. How is compensated the person responsible for public procurement?

114 responses



**Conclusion**

According to the conducted research and the answers received from the questionnaire conducted in the Republic of North Macedonia, where 116 respondents participated, the following conclusions and recommendations can be reached.

Schools, regardless of whether they are secondary or primary schools, should improve transparency in their work, especially in the context of spending public funds, better management of the public procurement system is needed, by strengthening the capacities of responsible persons (licensed persons), public procurement officers and public procurement commissions in schools as contracting authorities.

Although the Law on Public Procurement sets the rules for the implementation of public procurement, as well as the special procedures. In that direction, it is necessary to strengthen their professional competencies and skills needed to implement the public procurement procedure, increase inclusiveness in the process of creating the annual plan for public procurement, as well as increase transparency in the implementation of the annual plan for public procurement.

School management should support the involvement of all interested parties in the cost planning process and the selection of priorities to be funded at the school level.

The more transparent the process of creating the budgets, the more transparent and more accountable the spending of the money will be. We saw that transparency was one of the weakest points of the schools, as well as the centralized management, where part of the financial decisions were made by the directors.

### **Bibliography**

*EU Progress Report for the former Yugoslav Republic of Macedonia*. (2015, octomber 15). Retrieved from EU Progres

[https://ceas.europa.eu/neighbourhood-enlargement/sites/near/files/pdf/key\\_document](https://ceas.europa.eu/neighbourhood-enlargement/sites/near/files/pdf/key_document)

[s/2016/20161109\\_report\\_the\\_former\\_yugoslav\\_republic\\_of\\_macedonia.pdf](https://ceas.europa.eu/neighbourhood-enlargement/sites/near/files/pdf/key_document/2016/20161109_report_the_former_yugoslav_republic_of_macedonia.pdf) и Urgent Reform Priorities

РИТА ГЛИГОРИЈЕВСКА, К. П. (2022). *Биро за јавни набавки*. Retrieved 12 9, 2022, from [https://www.bjn.gov.mk/wp-content/uploads/2022/07/Graganska-brosura\\_BJN\\_2022.pdf](https://www.bjn.gov.mk/wp-content/uploads/2022/07/Graganska-brosura_BJN_2022.pdf)

*Службен В. (24/2019)*. (2019, february 1). Retrieved from

<https://dkzjn.gov.mk/sites/default/files/dokumenti/Sluzben%20vesnik%20na%20RM%2024-2019.pdf>

Службен весник на Република Македонија, б. 6. (n.d.).

*Службен весник на Република Македонија, бр. 44/1995, 24/1996, 34/1996, 35/1997.*. (n.d.).

<https://www.bjn.gov.mk>[пристапено на 08.10.2022]

[https://www.bjn.gov.mk/wp-content/uploads/2018/11/Priracnik-za-javni-nabavki\\_cetvrto\\_izdanie-2017.pdf](https://www.bjn.gov.mk/wp-content/uploads/2018/11/Priracnik-za-javni-nabavki_cetvrto_izdanie-2017.pdf)[пристапено на 08.10.2022]



# The Process of Post-legislative Scrutiny in the Assembly of the Republic of North Macedonia

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**Abstract:** Post-legislative scrutiny in the Assembly of the Republic of North Macedonia is a parliamentary instrument of supervision which is little known in our country but quite developed in some western democracies. Through the post-legislative process, the efficiency and quality of the legislative contents can be increased and with this the efficiency of the work of the law-enforcement bodies can be increased, but above all effective legislation that will protect the rights of citizens and society in general. Strengthening the post-legislative process will increase the weight of the assembly not only as a creator of legislation but also as its evaluator. Currently, there is no post-legislative scrutiny in the republican assembly, except for a certain project from the international organization. The scrutiny of the legislation is carried out by the bodies of the executive power and this creates the perception of imbalance in the division of powers and the dominant position of the executive power over the legislative power. The paper will also compare the post-legislative experiences of advanced western democracies.

## Keywords

*legislation, evaluation, effectiveness, scrutiny, democracy,*

## Introduction

The topic is important to address because it strengthens the role of the assembly in the process of evaluating legislation, but at the same time increases the independence and efficiency of the assembly as well as the quality of legal texts. Post-legislative scrutiny makes the executive more accountable and ensures that the expected changes are implemented. This paper will be of great value in contribution to aligning the country's legislation with the best standards of western democracies.

Parliaments make and change laws. They also have a role in checking the implementation of laws and evaluating whether they achieve their intended outcomes. Implementation is complex and does not happen automatically. What is more, parliaments and elected representatives often have little information on what happens after a law is adopted. So, parliaments need mechanisms to effectively monitor the implementation of legislation.

Post-legislative scrutiny (PLS) is the practice of monitoring the implementation and evaluating the impact of laws. The aim is to ensure that laws benefit citizens in the way originally intended by lawmakers. PLS is often carried out by parliamentary committees and is a prominent feature of UK parliamentary democracy. As PLS is recognized as an integral part of the legislative cycle, it is emerging as a new dimension within the legislative and oversight role of parliament<sup>2</sup>.

The Constitution of the Republic of Macedonia, Article 68<sup>3</sup> states: "The Assembly exercises political control and supervision over the Government and over other public office holders who are responsible to the Assembly." This constitutional provision gives the Parliament a broad function of strengthening the rule of law by imposing responsibility on the executive power for the way it determines and implements its policies and programs. At the same time, for the first time, the Parliament is given the authority to even "force" someone to participate in the supervisory hearings, because the invited persons have an obligation to attend the session where the supervisory hearing will be held. In addition, when an oversight hearing is scheduled, the President of the Assembly notifies the Government of the holding of the oversight hearing, which should determine authorized representatives for the issues that are the subject of that hearing.

## Purpose of Study

The research study should highlight the shortcomings of the existing system and the benefits from the installation of the parliamentary instruments of scrutiny over the approved legislation.

The Assembly introduced parliamentary control in the form of a supervisory hearing on laws, in completely or in part, with the Law on the Assembly in 2009<sup>4</sup>. The lack of political will for parliamentary supervision among political actors is obvious, given the fact that parliamentary supervision over the implementation of laws and its influence is not regulated by the Rules of Procedure, which is the main document that prescribes all procedural aspects of the Parliament's work. The supervisory procedure is regulated in its entirety by the Law on the Assembly, which only

<sup>2</sup>The Post-Legislative Scrutiny: guide for parliaments has been drafted by Franklin De Vrieze on behalf of the Westminster Foundation for Democracy (WFD), <https://www.wfd.org/accountability-and-transparency/post-legislative-scrutiny>

<sup>3</sup>Constitution of Republic of North Macedonia (official Gazette 1991)

<sup>4</sup>Law of the Parliament, (official Gazette 2009)

provides for the general aspects of the procedure. The gap due to the absence of procedural aspects in the legislation has been filled with the help of the donor community, which helped to develop a manual for conducting supervisory hearings, which is now used in practice every time a supervisory hearing is organized. An initiative to hold a supervisory hearing can be submitted by one member of the parent committee or working body, and to hold a supervisory hearing, the working body decides with a majority vote of the number of members present. However, if 15 MPs request in writing to hold a supervisory hearing - through the President of the Assembly to the President of the working body - the President of the working body is obliged to immediately call for its holding. This is an exceptional right of the opposition in the parliament, which can exercise parliamentary control over the executive power through supervisory hearings. After the conclusion of the supervisory hearing, the working body which organized it, submits to the Parliament a report on the held supervisory hearing, which includes the essence of the presentations, and may propose conclusions, which are also submitted to the Government of the Republic of Macedonia. The conclusions, as a rule are published on the website of the Assembly<sup>5</sup>.

The human capacities in the Parliament in charge of the process of PLS or ex post assessment of laws can be considered the weakest link, because the home working bodies are insufficiently staffed. Usually in a working body, there are one or two employees who are in charge of all issues and procedures in the scope of work of that working body. Therefore, the home working bodies are served with the capacities of other working bodies, including the Parliamentary Institute. This organizational unit of the Assembly has the largest research and analytical capacities in the Assembly. In addition, a practice of cooperation between the services of the different working bodies has been established, especially in cases where two or more commissions have a common topic for supervisory discussion. The Parliamentary Institute participates in the preparation of analyzes for all MPs and working bodies, as needed, for various activities. Therefore, the possibility of fully engaging the services of the Parliamentary Institute for the needs of the supervisory hearings is limited.

The Law on the Assembly provides the opportunity for the working body that conducts parliamentary supervision to submit the adopted conclusions to the Government. This possibility refers exclusively to a situation in which the working body, during the discussion or after its completion, adopts relevant conclusions. The law further does not provide an obligation for the Government to submit a response to these conclusions to the working body of the Assembly. In practice, the working body can ask the Government to respond to the findings/conclusions of the supervisory hearing and organize a session to present the actions taken in response to those findings/conclusions.

The legislation governing the work of the Assembly leaves enough room for the committees to be successful in fulfilling the above roles. As is often noted about the work of the institutions of Macedonia, it is not always a matter of lack of legal opportunities for better work, but it is necessary to use the legal opportunities available to them as much as possible. Such is the situation with the working bodies of the Assembly of whose members, despite the large number of opportunities offered by the Rules of Procedure of the SRM and the Law on the Assembly, rarely use them in order to better perform the function of the working bodies.

The transparency and inclusiveness of the supervisory sessions is at a high level due to the cooperation and coordination between the parliamentary committees and non-governmental organizations, civil society organizations, the academic community, experts and other external stakeholders. Ex-post parliamentary supervision has no mechanisms for implementing the findings and conclusions of the hearings, nor for monitoring the action taken after them. The Law on the Assembly does not provide for the possibility of thematic focus of the supervision, while gender aspects are considered only in the ex-ante impact assessment as part of the Regulatory Impact Assessment Report (RIA). Within the framework of ex-post control, there is no methodology or practice for conducting supervision from a gender perspective, although the Parliament has bodies that are fully focused on the gender sensitivity of the laws passed in the Parliament. In conclusion, we can say that the practice of supervisory mechanisms in the form of supervisory hearings is rarely used in the Assembly of North Macedonia. However, when oversight hearings were organized, considerable political interest could be observed during the oversight sessions, indicating that parliamentary oversight, and thus the PLS, can be further developed as one of the regular mechanisms for parliamentary control by of the Assembly.

Since 2013, the Government has established a system for ex-ante control, called "regulatory impact assessment", for each draft law that the Government submits to the Parliament. In practice, this mechanism, which is well established, is only partially used and there is a serious anomaly that hinders the system of legislative supervision as a whole. The anomaly consists in the fact that the report from the assessment of the impact of the regulation is not part of the draft law that is submitted to the Parliament, which would allow the Parliament to have a starting point for implementing ex post control of the laws.

The constitutional and legislative system of North Macedonia does not foresee any obligation or duty of the executive power, primarily of the Government, to regularly submit information to the Assembly about the implementation of the laws or their impact. As stated earlier, the Law on the Government stipulates that the Government and each of its members are accountable to the Parliament for their work, including the implementation of laws and monitoring their impact. There is no established practice of providing information at regular time intervals from the Government or relevant ministries to the Parliament. The Law on the Government stipulates an obligation for the Government to take measures within its competences or to propose to the Assembly to respond appropriately if it determines that certain laws are not implemented. In practice, some institutions or the Government produce reports on the level of implementation, but only if the impact of implementation can be measured.

In the legislation, there are very few provisions of primary and secondary regulation that refer to the way of initiating parliamentary oversight. Article 9 of the Law on the Government<sup>6</sup> foresees an obligation for the Government, in the event that it assesses that the laws and other regulations are not being implemented, to propose to the Assembly appropriate measures that should be taken in the direction of implementing the relevant laws.

In practice, the petitioners of an initiative to hold a supervisory hearing state only the topic in their request. Sometimes, the topic of the oversight hearing can be provided by external stakeholders, usually civil society or other non-governmental organizations. For example, in the Conclusions of the supervisory hearing on the Ohrid Region, it is stated that "on the initiative of the non-governmental organizations Front 21/42 and NDI Macedonia, in February 2017, an informal group, Deputies - friends of the Ohrid Region, was formed in the Parliament of the Republic of

<sup>5</sup>Edition: The application of laws under scrutiny Parliamentary control over the Government in the Republic of Macedonia, Publisher: Open Society Foundation - Macedonia, Author: Neda Korunovska Avramovska

<sup>6</sup>Law of the Government, (official Gazette nr59/2000)

Macedonia, which, bearing in mind the previous initiative for a supervisory hearing in 2016, pledged to open a supervisory hearing for the Ohrid Region in the Assembly".

As part of the HUGEN project, where the human rights commissions from the parliaments of the Western Balkan countries were involved, a project of post-legislative supervision (PLN - PLS) was implemented on a certain legal project which is applied in the country's legal system for a certain period of time.

During the determination of the legislation for which supervision should be carried out through the PZN, the Permanent Inquiry Commission for Human Freedoms and Rights at the Assembly of the Republic of North Macedonia selected the Law on General Administrative Procedure, which is one of the procedural system laws, which requires a qualified majority for adoption by the deputies. The choice of the legislation, ie the Law on the general administrative procedure, has a special significance due to the fact that this procedural law essentially regulates most of the relations between people and the state and vice versa as well as a smaller part of the relations between people. Literally, every person from the moment of birth to the very death is part of the administrative procedure through registration in the registers of births or deaths. On average, a person is a participant in an administrative procedure at least dozens of times at his own request or at the request of the state, by extracting personal documents, travel documents, exercising certain rights, scholarships and others from one side and determining taxes, fees or customs duties from the other side<sup>7</sup>.

The Assembly of the RSM and the Permanent Inquiry Commission for the Protection of Freedoms and Rights of the Citizen have started the process of post-legislative supervision by publishing a public call on their website for submission of proposals and comments on the current application of the ZOUP<sup>8</sup>. In order to ensure participation, the consultative process was open and addressed to citizens, organizations, think-tank organizations, members of the academic community, institutes, faculties, state bodies, civil servants and all other interested persons, the Permanent Commission of Inquiry invited them to submit own comments and opinions regarding the effects that resulted from the initial application of the Law on the general administrative procedure, i.e. whether the objectives of the law have been met, what are the possible difficulties in the application and proposals for its improvement.

Findings that we came to through the analysis of the initial application of the ZOUP of a legislative nature are - The law on the general administrative procedure is normatively well regulated with high quality - ZOUP is directly implemented by a growing number of public bodies, .Insufficient service orientation of public bodies towards citizens and other persons in the administrative procedure. - Failure to comply with the deadlines stipulated in the Law of General Administrative Procedure (LGAP), especially when it comes to social protection procedures. - Insufficient readiness and familiarity of public authorities for the application of LGAP. - Failure to comply with the duty to collect documents on official duty and legal assistance between public authorities, There is a serious attempt to establish the possibility of using modern information and communication technologies for the delivery of administrative services (e-administration);

However, there are also positive exceptions and that of the parliamentary committee for culture. In the supervisory hearing on the Law on the Management of World Natural and Cultural Heritage in the Ohrid Region and the related regulation in the context of the UNESCO Convention for the Protection of Natural and Cultural Heritage, the Culture Commission invited the Minister of Culture and the President of the Commission for the Management of the Ohrid Region to inform the home working body about the activities carried out by these two institutions in relation to the conclusions of the supervisory hearing.

In 2018, the Commission for Culture also unanimously adopted the Decision to hold a supervisory hearing on the status of Ohrid and the Ohrid region as a world natural and cultural heritage. Witnesses from various state authorities, scientific institutions, public enterprises and non-governmental organizations were invited to the supervisory hearing in order to give statements and answers regarding the practical application of the laws and by-laws relating to the management of the Ohrid region as a world natural and cultural heritage. In this way, the Commission for Culture received relevant information, opinions and clarifications regarding the implementation of the legislation and the situation in which this significant natural and cultural region protected by UNESCO is located<sup>9</sup>.

Deputies in the Assembly can do much more in the direction of supervision and control of the executive power and in actualizing certain problems in the country than they have done so far. The Rules of Procedure abound with procedural possibilities for such activities of the MPs, which remained generally unused by several previous parliamentary assemblies.

One of the remarks of the international institutions as in the report of the European Commission on the progress of the country. What is missing and what is the practice of the countries in the world and in the region is that the reports of the audit and other independent bodies should be considered at the sessions of the parliament. Parliament has a key and supervisory role and should supervise on behalf of the citizens. In this direction, the World Bank evaluates the way of presenting public finances with the help of a special indicator that does not deal with the work of the State Audit Office but with the supervisory work of the parliament with these reports. Unfortunately, Macedonia is at the lowest level because Macedonia does not have a strict legal framework that states that the Macedonian Assembly has an obligation to review individual audit reports. We want to work in the direction of considering possibilities and modalities for the parliament to start considering the reports. What interests citizens is to open a discussion about how citizens' money is spent.

"Parliaments should not oppose changes in society, but adapt to social and technological development, while guaranteeing the stability of democracy by building a strong relationship between the institutions of representative democracy and citizens." Since national parliaments are the embodiment of the outcome of the vote, they should, first, improve 'representativeness' by creating a closer connection between the will of the people and the outcome of the vote<sup>10</sup>."

Parliament should organize oversight hearings more often and monitor the implementation of policies and legislation. Also, the Assembly should

<sup>7</sup>Центар за правни истражувања и анализи, Скопје, 30 June, 2020

<sup>8</sup><https://www.sobranie.mk/povik-za-pribiranje-komentari-i-predlozi.nspix> 13

<sup>9</sup>Roadmap for the successful management of the Parliamentary Committee and Report on the quality of the debate at the Oversight hearing of the Culture Committee on the management of the Ohrid region, idscs.org.mk-<https://idscs.org.mk>

<sup>10</sup>Conference of the Council of Europe, September 2012, dedicated to the topic "Are parliaments in a democratic crisis?"

create a mechanism for monitoring the implementation of its conclusions and recommendations by the responsible institutions. The Assembly should familiarize citizens, organizations and institutions with the possibility of initiating supervisory hearings on issues of their interest or subject of work. The parliamentary channel can be an extremely important tool in this process<sup>11</sup>.

### Research Methods

Research methods will be applied that will answer the research problem, should the republican assembly need to strengthen its scrutiny position over the legislation already approved and how can I achieve this. The basic research question is: Does the legal framework provide the Parliament of the Republic of Macedonia with appropriate legal and procedural procedures that enable post-legislative supervision?

In the preparation of this paper, a combined analytical-methodological approach was used, which includes both qualitative and normative methods of study. Supervision as a legal and political instrument, among other things, can be grouped based on two criteria, supervision is carried out before (ex-ante) or after (ex-post) a policy proposed by the Government is adopted, and the second refers to whether the supervision is carried out inside or outside the parliament

### Findings and Results

The results found will be argued and supported with scientific methodology that will verify or deny the hypothesis presented.

Post-legislative supervision over the laws involves evaluating the results and effects of their implementation, but at the same time, it is also an evaluation of whether the laws that have been adopted have achieved the results and goals for which they were intended. The Parliament has the obligation to monitor the implementation of the adopted laws in the way it was originally planned and to give an answer if the expected effects and goals of the law were achieved, which means that the PLS can be an important tool for increasing the Government's responsibilities. Hence, even when there is no obligation for post-legislative supervision in the process of adoption of the law, the Parliament should have the possibility to carry out the PLS on any issue that is considered relevant.

### Conclusions and Recommendations

Conclusions and Recommendations will be drawn as a result of research and analysis of the topic and will serve for further research in the field of parliamentarism.

The Assembly in PLS has the competences to organize supervisory hearings after the commissions, to adopt conclusions, but it does not have clear competences to force the government to follow the conclusions. Regarding the conclusions, the assembly can use other mechanisms of parliamentary control.

The supervisory hearing process is inclusive and transparent; the Assembly strives to include all relevant institutions, civil associations, the academic community, experts and others in the supervisory hearings. The process and its outcomes are publicly available through the Parliament's website and the Parliament's TV channel.

The Parliament has no legal basis for establishing a mechanism through which it will force the Government and other bodies of the state administration to provide adequate answers and information about the status of the implementation of the conclusions of the parliamentary supervision.

### Recommendation

The Assembly of North Macedonia should consider introducing additional parliamentary mechanisms in order to enhance its supervisory role - one of the potential mechanisms could be post-legislative supervision.;

Policy making should be more inclusive, by sharing reports on PVR with stakeholders and the Parliament;

Obligation for ministries to submit annual reports on their work and on the implementation and impact of the laws in their scope, with an overview of the fulfillment of key goals and performance indicators, submitted for inspection to the Parliament and the relevant committees;

The Parliament should increase the supervision over the implementation of the laws by establishing a reporting system for special laws;

Strengthening coordination and cooperation between parliamentary and official bodies with a mandate to monitor gender inequality;

### References

1. The Post-Legislative Scrutiny: guide for parliaments has been drafted by Franklin De Vrieze on behalf of the Westminster Foundation for Democracy (WFD), <https://www.wfd.org/accountability-and-transparency/post-legislative-scrutiny>
2. Edition: The application of laws under scrutiny Parliamentary control over the Government in the Republic of Macedonia, Publisher: Open Society Foundation - Macedonia, Author: Neda Korunovska Avramovska
3. Center for Legal Research and Analysis, Skopje, 30 June, 2020
4. <https://www.sobranie.mk/povik-za-pribiranje-komentari-i-predlozi.nspix> 13
5. Roadmap for the successful management of the Parliamentary Committee and Report on the quality of the debate at the Oversight hearing of the Culture Committee on the management of the Ohrid region, [idscs.org.mk](https://idscs.org.mk)·<https://idscs.org.mk>
6. Conference of the Council of Europe, September 2012, dedicated to the topic "Are parliaments in a democratic crisis?"
8. Constitution of Republic of North Macedonia (Official Gazette 1991)
9. Law of the Parliament, (Official Gazette 2009)
10. Law of the Government, ( Official Gazette 67/2000)

<sup>11</sup>Edition: The application of laws under scrutiny Parliamentary control over the Government in the Republic of Macedonia, Publisher: Open Society Foundation - Macedonia, Author: Neda Korunovska Avramovska



## PERCEPTION AND INFLUENCE OF TRAFFIC SIGNS ON THE TRAFFIC FLOW

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### ABSTRACT

Traffic signalisation is consisted of system of means, devices and signs that play an important role in regulating traffic safety. Traffic participants are obliged to act in accordance with the traffic signals placed on the road even when they deviate from the regulations on traffic rules.

The messages of Traffic sign's affect driver's behavior, so they should have clear and unambiguous content. Any deviation from the regulations and standards for traffic signaling, the participants in the traffic are put into situation of incorrect message reception and inappropriate further traffic behavior. Such deviations from the standards can have serious consequences for the traffic system.

The increased degree of motorization is a requirement for the application of complex and modern strategies for traffic flow regulating, as well as techniques that will satisfy the traffic system and will improve the quality of service. Effective and safe regulation of traffic is possible by applying modern techniques and methods for regulating traffic, which largely depend on the quality of traffic signals.

From the aspect of traffic safety, the reception and perception of the message, the traffic signalization is important for the management of the traffic and is of special importance for the traffic safety.

In this paper through practical examples are shown the influences of the traffic signals and the retroreflection of the perception and the receiving of the messages which are of great importance for the road safety.

### KEYWORDS

Vertical signalization, Horizontal signalization, Retro-reflectio, Perception, Psychology.

## 1 Introduction

The increased degree of motorization conditions the application of modern and contemporary strategies for managing the flow of traffic, as well as more numerous and more complex techniques. Efficient and safe traffic management is possible by applying modern traffic regulation techniques, which largely depend on the quality of traffic signals, namely horizontal, vertical and other non-standard signals. For every traffic participant (driver, pedestrian, cyclist, etc.), traffic signals are of particular importance. It aims to clearly and unequivocally indicate to the users in which part of and in which way they should move, in order to realize an efficient and safe movement to the desired location.

The peripheral part of the eye helps in detecting traffic signs, where the visual acuity is lower. For this reason, it is important to detect them at a time when the angle difference between the view and the sign is not yet large. Perception and understanding of traffic signs also depends on the amount of information. If there are many details on the sign, it is more difficult to understand the messages and the possibility of making a mistake increases.

The group of elements that mark the purpose of the traffic surface, direct the flow of vehicles, bicycles and pedestrians,

provide the participants with various information, issue certain orders, warnings, etc., are making road traffic signalization.

Traffic signalization is divided into:

1. Vertical traffic signals.
2. Horizontal traffic signals.
3. The rest of the equipment

## 1.1 Purpose of traffic signals

- To indicate to the traffic participants the way of movement and behavior in order to achieve safe movement.
- To indicate to the traffic participants the way of movement and behavior in order to achieve safe movement.
- To enable traffic participants to quickly orientate themselves in space and easily determine the direction of movement;
- Traffic signaling should be clear and unambiguous, so that road users can easily receive the message and act according to the appropriate traffic
- Spatial definition of the purpose of the traffic areas;
- Leads and directs traffic flows in the zones of the road net;
- Including on roadsides, including physical islands;
- Transmission of written information.

## 1.2 Subject of research perception of traffic signs

Since the perception of traffic signs is a very complex process, various methods are applied in the research, which originate from experimental psychology, and aim to find an adequate measure of the perception of traffic signs.

In the majority of the research, an effort is made to express an aspect of a complex process which, roughly speaking, refers to the detection, recognition and action of the signs after the reception of the message.

Perception measurement is performed in two ways:

- Laboratorial
- Practical on the field.

The most important tasks studied by traffic psychology are:

- The personality trait on which the efficient and safe management depends means of transport;
- Mental processes that are related to reception, processing, and transmission of the information;
- Behavior of the driver when receiving the information from the traffic means and their transfer to commands;
- External conditions (temperature, noise, vibration) that act on drivers and contribute to the reduction of efficient and safe management;
- The psychophysical condition of drivers, fatigue, effect of alcohol, effect of psychotropic substances, medications, use of cigarettes that change it the behavior of drivers and contribute to unwanted traffic offences.

## 2 Traffic sign identification process

- First the sign becomes visible as a very small object
- Then, the object is identified and categorized as a traffic sign with a clear shape, color and position

- Finally, the message of the sign (symbol and/or text) is recognized, followed by the reaction of the drivers.

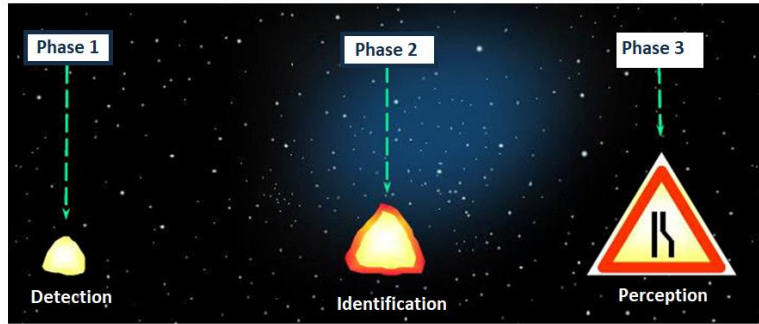


Image 1. Phase of traffic sign identification



Image 2. The time it takes for a driver to be able to detect the sign and act on its interaction

### 3 FIELD RESEARCH

Field research was also done at several locations in Skopje, in which the retroreflection of traffic signs was measured using a measuring instrument - REFLECTOMETER.

The Retroreflectometer are the main solution for ensure the road safety, as it reflects the traffic sign, road marking quality to ensure the drivers safety, These instruments measure the visibility of markings and signs, measure the coefficients.



Image 4. Retro reflectometer For Traffic Signs

With the field measurements, it was observed that the traffic signs that were the subject of measurement meet the necessary standards and meet the technical conditions for creating the signaling.





**Image 4. Field measurement**

## 4 CONCLUSIONS

- With this we can conclude that the traffic signals should promptly and constantly direct the participants in the traffic
- The message sent by the signs must be clear and unambiguous to indicate to the road users which way they should move to reach the desired destination.
- The quality of the traffic signals is also an important element in the perception and reception of the message from the signals.
- In order to be able to perceive the signs as much as possible while driving, regardless of the environment, climatic conditions and age, materials prescribed by standards should be used.
- Traffic signs of class II and class III of retroreflection significantly increase the timely perception and reception of the message of the signs regardless of the speed of movement, climatic conditions, environment and age of drivers.

## 5 REFERENCES

1. D-r Stanisa MILOSEVIC, Percepcijasaobračajnihznakova, Univerzitet u Beogradu, Saobračajnifakultet, Beograd, 2005.
2. D-r Elena A. Leshkovska, d-r VioletaArnaudova – Psihologija I kulturavosoobračajot, Skopje 2014.
3. Kontrolakvalitetasaoobračajnihznakova – AndrijaNovakovic

## Dynamics of digitalization of financial markets in pandemic conditions

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**Abstract:** The motive for writing this paper is to answer the question of how digital technology moved and how it affected the digital financial markets in conditions of great turbulence caused by the COVID 19 pandemic. But, also to answer how much the possibilities for the advancement of digital technology and digital financing affected the markets in those conditions. Several motives are the cause of the international tendencies, changes and effects of the movements of the global digitalization of the international financial markets. This paper connects the issues of the relationship between financial globalization, financial liberalization to financial integration by analyzing the movements of digitalization of financial markets and their transformation in pandemic conditions. The work is divided into two parts, the theoretical structural-methodological studies, the role, the problems and the conditions of global processes and it is indicating how digitalization reshaped financial markets and monetary systems. The basic research question is what dynamics, tendencies and movements the digitalization of the financial markets faced and what impact did the digitalization have after the major market turbulences caused by the pandemic. In the paper, the advantages and disadvantages of the digitalization era of the financial markets are emphasized. The paper also aims to emphasize the reasons for the ascertained turbulences. Of essential importance was the need to adapt various elements in the domestic policies of the countries to international movements and developments, which affected the overall conditions for the development of digital international trade. The following results are expected from the research: greater correct conceptualization of underdeveloped digital economies that will be able to create new high-quality institutions.

### Keywords

Digitalization of financial markets, digital transformation, digital technology financing, international trade.

**JEL Classification:** G21, G24, M15, O32, F630.

### Introduction

Today, there is a fundamental change taking place in the financial markets. What is happening with the digitalization of markets, finance and international trade is beginning to challenge the current understanding of monetary and financial systems, as countries move more aggressively towards cashless systems, which loom as a potential technological underpinning.

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Digital business models, which are traditionally associated with expanding access to financial products such as payments, credit, insurance, etc., have attracted the most funding and attention. But they experienced the most innovation that led to new business models in their real economies. Also, private investors, often through the capital markets, have begun to create innovative financing instruments, mostly in sectors such as climate action, clean environment, etc. The electronic international movement of capital also got such a scale, with which the technological industry got a faster development for easier locating of the desired countries. This allowed for a greater volume and speed of transfer of capital, information from one place to another, and the aim was to encourage even economic growth.

Therefore, this paper explores the need, the role and the importance of the digitalization of financial markets, which have primarily become more visible in key segments of countries' economies. With the beginning of the pandemic, electronic networks began to appear that carried out international trading over the Internet.

During the pandemic, the concept of the digital economy became the basic source for the way of organizing activities aimed at the creation of (goods and services). The goal was to simplify people's consumption, and to develop and implement digital computer technologies. This made it possible to process a large amount of information and develop the range of services and markets through (providing online services, electronic payments, transfer, etc.).

The aim of the paper is to identify the dynamics of the digitalization of financial markets on the economic growth of developing countries in comparison with developed countries, but also to indicate the greater tendency of growth of their financial platforms. As a problem, it can be argued that the international digital economy is in a position where opportunities and risks were in balance during the pandemic.

This is largely due to the dynamics of the digital economy in different countries, as well as the systemic nature of the forces driving new digital development. Undoubtedly, developed and developing countries have greatly benefited from the combination of the use of digitalization as well as the participation of authorities in the formation of their digital economies. The reason for this is that many current bodies were with legacy systems and structural complexities that were not well suited for the upcoming development of digitization during the pandemic.

The final goal is to gain knowledge that all countries in the world strive for the development of a digital economy and for the digitalization of markets because it also contributes to the growth of GDP. It is also believed that the digital economy is the future not only of the economies of individual countries, but also of the international economy as a whole.

## **1. NEW TENDENCIES OF FINANCIAL DIGITALIZATION ON FINANCIAL MARKETS**

The integration of digital and network technologies has made the digital economy prominent in the economic and social activities of countries that have begun to develop this activity globally. The concept of the digital economy developed in the age of networked intelligence was not only about networking technology, but also about networking people through technology. During the COVID 19 pandemic, the development of the digital economy was oriented towards the innovation of several important components, namely: e-business infrastructure, e-business, e-commerce, digital technology, digital transformation, etc.

Although technological advances are not new to finance and financial markets, digital innovation has brought great improvements in connecting systems to computing power and cost reduction, but also to newly created and usable data.

Digital technology during the pandemic has also contributed to new financial services, enabling consumers to find and assemble their favorite bundles of products. While, digital transformation oriented towards the change of business business, provided better playing conditions in terms of competition, regulatory parameters and innovation of financial services. The digital innovation during the pandemic has transformed all financial services as a whole. As such, for example, were innovations in financial technology, such as electronic money, peer-to-peer (P2P system), electronic market lending, insurance technology (insurtech), crypto-assets that appeared around the world, financing and the so-called.

However, it is important to note that during the pandemic, fintech services also gained a tendency to grow, which encouraged greater access to the convenience and facilitation of financial services, especially for retail users. Therefore, large banks quickly closed the gaps in the digitization of internal processes and customer offers and began to compete with fintechs and large technology firms. Characteristically, Fintech thrived especially in markets where the financial system was less developed.

These developments have the potential to make financial markets more diverse, competitive, efficient and inclusive. The reason for this was that innovation introduced greater concentration and increased involvement, especially in emerging markets and developing economies.

For this purpose, the implementation of digital finance was of great importance, especially among micro and small enterprises and those that promote entrepreneurship and innovation, in order to encourage their economic growth. For example, during the pandemic, developed and developing countries played an important role in the financial sector to support the economy and investment in public services.

On the other hand, it can be singled out, that as a great strategic economic resource was the increased role of the combined effects of the financial sectors, more precisely of the financialization and digitalization of economies. This has resulted in both positive and negative effects on economic stability and has raised questions as to what capacity it can effectively serve the real economy in the markets.

This was especially true after the outbreak of the COVID-19 pandemic, with which the role of the digital economy in the economic recovery of the financial markets played a huge positive role in the prevention and control of the pandemic. Thus, during the COVID-19 pandemic, digital services received a large share of resources reallocated from traditional industries, becoming a strong driver of accelerated growth.

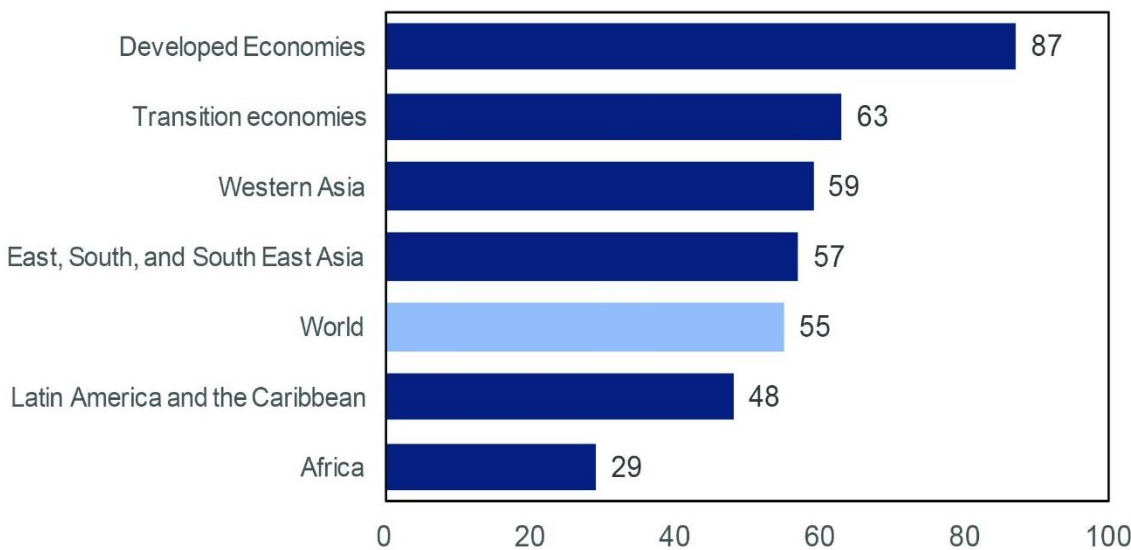
It can also be determined that, as a driving factor during the pandemic, e-commerce contributed greatly, allowing those businesses that opened or strengthened digital sales channels to remain viable during the crisis. Therefore, the experience of some developing countries in adopting digital solutions in response to the COVID-19 pandemic has shown the potential that e-commerce can foster resilient economic growth and facilitate economic integration.

The implementation of information and communication technologies (ICT) over the last few years has driven important changes in the way people and businesses produce, consume and exchange goods and services, increasing the importance of e-commerce in overall economic activity.

According to (UNCTAD, 2020) in 2018, the value of global sales of B2B (business-to-business) and B2C (business-to-consumer) e-commerce amounted to 25.6 trillion US dollars, reaching 30% of the world GDP, with about 1.45 billion people shopping online. Comparatively in 2017, the increase was 8%.

While, during the pandemic in 2020, according to UNCTAD the development of digital trade was uneven with significant differences between countries and regions. So for example, the most significant differences were: the USA with 34%, Japan with 13% and China with 9%, but still, these countries remained the largest markets in terms of the value of the total global e-commerce sales. While, by region, eMarketer's Global Report 2020 estimates, Asia-Pacific accounted for 62% of global e-commerce sales compared to North America (19%) and Western Europe (13%). Central and Eastern Europe, Latin America and the Caribbean, the Middle East and Africa, e-commerce sales were around 6%.

*Chart No. 1 Value of e-commerce in the world and by region with business-to-business (B2B) and business-to-consumer (B2C) sales, for 2020 (with Index 0 to 100)*



Source: [https://www.cepal.org/sites/default/files/publication/files/46858/S2100269\\_en.pdf](https://www.cepal.org/sites/default/files/publication/files/46858/S2100269_en.pdf) UNCTAD (2021), accessed on 10.01.2023

It is evident from Chart 1, that the average value of B2C e-commerce index of developed economies for 2019 was three times higher than that of Africa and 80% higher than that of Latin America and the Caribbean. In addition to this, it can be noted that the US continued to dominate the overall e-commerce market in 2019-2020. They topped the list for both B2B and B2C e-commerce. For B2B e-commerce sales, the US was joined by Japan and South Korea, while for B2C e-commerce sales, China was ahead and the United Kingdom was in third place. However, the US and China together account for over 40% of all e-commerce sales to both consumers and businesses globally. Furthermore, three of the top five largest e-commerce markets are in Asia.

Accordingly, it can be determined that e-commerce has shown high growth rates worldwide in the context of overall contractual physical retail outlets. So for example, in Europe, online orders increased by about 50% year-on-year on

average in the first quarter of 2020. While in North America in contrast to 2019, towards the end of 2020, orders were up 120%, compared to the beginning of 2020. Thailand also saw a 60% increase in shopping app downloads immediately after the restrictions. Meanwhile, in Latin America, consumers shopping online at Mercado Libre saw a 49% year-over-year increase between the end of February and the end of May.

These differences reflected the degree of digitalization development, maturity and growth tendency of the enabling environment for e-commerce in each country and region. As such development differences, several can be singled out, namely: the availability and quality of digital connectivity, the reliability of logistics networks and the trade facilitation framework, the development of digital payment systems, the level of trust of consumers and businesses in digital transactions, digital skills and the presence of established online platforms and marketplaces.

Also, disruptions in global supply chains caused by the differences, as well as restrictions on cross-border air, sea and road transport have adversely affected international e-commerce of goods and services, including those transactions made through e-marketplaces and platforms. - trade B2B and B2C. To this end, cross-border e-commerce and domestic e-commerce of goods and services have increased during the pandemic.

## 2. GLOBAL TRENDS OF DIGITALIZATION DURING THE PANDEMIC

The digital revolution, which especially intensified during the worldwide COVID-19 pandemic, contributed to the increasingly frequent use of digital solutions, which are most suitable for their simple, affordable, secure and technologically modern (smart) execution.

Digitalization has significantly changed the way people manage their finances, how they spend, save, buy and sell, but also how they develop their financial behavior. A big contributor to that was mobile banking, which allowed people with low incomes to have more control and less stress about their money. But according to some research, digitalization may pose a risk to consumers, especially to adults who lack the essential digital skills needed for everyday life. Therefore, the lack of digital skills can also lead to major financial damages (eg fraud, problem debts through online credit, etc.), so building security skills is essential.

During the pandemic, two important forms of the digital economy appeared: *digital industrialization and industrial digitalization*. *Digital industrialization* meant the development of ICT industries, such as: the production of electronic information, telecommunications, e-banking, software and services for information technology and the Internet industry.

*Industrial digitalization* has deeply integrated advanced digital technologies with traditional industries and markets. To this end, this accelerated the transformation and upgrading of traditional industries and improved their production efficiency (58). However, these new digital business models can also drive the disintegration of processes that financial institutions once relied on and play a key role. This will allow the democratization of access to finance through the growth of platforms such as exchanges between, industry, banking, businesses, transport, e-commerce, but also on the scale of the insurance industry.



For this purpose, it can be determined that, according to the conditions described in Table No. 1 with the development and dynamics of digitalization of financial markets during the COVID 19 pandemic, there was a significant positive impact on the overall economic growth of developing and developed countries.

*Table No. 1 Comparative indicators for digital economic development of developed and developing countries, for the period from 2009 to 2019*

Ranking	Country	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
1	Singapore	75	77	74	74	76	76	80	84	90	90	100
2	Israel	61	59	61	61	60	61	68	69	71	71	74
3	Malaysia	59	60	60	62	62	66	68	67	67	67	71
4	Estonia	42	47	51	51	51	53	54	55	57	57	66
5	The Czech Republic	40	42	43	43	43	46	46	49	52	52	62
6	China	35	38	40	41	45	45	46	50	53	53	58
7	Vietnam	18	20	22	28	33	36	40	44	48	48	52
8	Hungary	44	46	44	40	39	38	36	42	45	45	50
9	Lithuania	34	34	35	37	37	38	40	41	43	43	49
10	Thailand	31	31	28	31	33	34	38	43	46	46	49
11	Slovenia	37	37	34	34	34	33	37	38	42	42	48
12	Latvia	27	27	30	34	37	40	43	41	40	40	45
13	Cyprus	46	47	42	36	35	36	34	34	39	39	41
14	Bulgaria	23	23	25	27	27	26	28	31	36	36	39
15	Greece	28	27	29	28	27	30	32	33	34	34	38
16	Saudi Arabia	28	33	37	35	34	32	35	34	34	34	38
17	Poland	29	29	28	29	29	32	33	34	36	36	38
18	Russian federation	23	25	22	25	28	31	33	33	33	33	37
19	Croatia	25	27	27	28	29	28	28	30	29	29	34
20	Romania	24	23	22	20	20	24	24	25	26	26	32
21	Kazakhstan	20	23	26	33	38	38	38	32	29	29	32
22	Oman	20	24	27	28	29	28	26	21	28	28	31
23	Azerbaijan	12	15	16	21	26	25	24	24	29	29	30
24	Armenia	1	9	10	14	15	16	18	21	21	21	25
25	Ukraine	15	14	16	20	19	20	22	20	21	21	25
26	Mongolia	6	6	9	10	10	12	7	12	10	10	22
27	India	14	13	15	14	14	11	13	17	18	18	21
28	The Republic of Egypt in Arabia	10	10	11	12	12	9	11	11	15	15	20
29	Moldova	3	7	10	11	13	16	16	15	18	18	20
30	Kyrgyzstan	2	0	3	4	5	8	13	15	16	16	14
31	Pakistan	1	3	4	4	4	2	3	3	8	8	13

*The ranking is based on the comprehensive score of 2019 digital economy development indicators for each country. Data sources: SPSS22.0 software calculations.*

*Source: <https://www.frontiersin.org/articles/10.3389/fpubh.2022.856142/full>, accessed on 22.01.2023*

According to Table No. 1, the development of the digital economy of developed countries and developing countries that showed a growth tendency after 2009 is evident. However, it can be noted that there is a regional imbalance in the development of the digital economy. For example, such a difference exists between the countries of East and Southeast Asia, Central and Eastern Europe, while South Asia and Central Asia had a growth tendency.



Also, the comprehensive score of China's digital economy ranked sixth on the list, the score has increased rapidly since 2015. This shows that China has been paying much more attention to the digital economy in recent years, deepening the popularization and application of information technology.

According to the degree of development of the digital economy by group of countries, it can be determined that Singapore, Israel and Malaysia were ranked as the first three countries with scores above 70 in comparison with the rest of the countries according to comprehensive results for digital economic development. As a reason for this growth tendency, it was primarily due to several components: the availability of the latest technology, the penetration of the fixed broadband Internet and the percentage of Internet users, a well-established information infrastructure, advanced information and communication technologies, the high popularity and openness of the digital economy.

While, for Estonia, the Czech Republic, China, Vietnam and others that had scores from 30 to 70 by 2019, it indicates that the development of the digital economy in these countries needs to be further strengthened. With which, these countries still need to improve the infrastructure of the digital economy and introduce favorable policies for the digital infrastructure, scientific and technological innovation, providing strong guarantees for the realization of high-quality development of the digital economy.

Also, Armenia, Ukraine, Mongolia, India, Egypt, Moldova, Kyrgyzstan and Pakistan were relatively lagging behind in the digital economy, with an overall score of 30 by 2019. Namely, in these countries, it is pointed out that the main reasons for the slow digital development are several, namely: infrastructure, non-professional talents, ICT capabilities and the environment for innovation in digital technology, the level of electronic readiness and the degree of digitalization in each country specifically for during the pandemic, as well as with the insufficient transition to digital environments. According to this, it can be determined that there is a big digital economic gap between developed countries and developing countries.

To this end, governments, the private sector and the IT sector of many countries have taken measures to overcome the challenges in several policy domains, such as: ICT services, electronic payments, adoption of legal regulatory frameworks, development of digital skills, as well as towards financing and supporting digital entrepreneurs. These trends and technologies have significantly influenced the digitalization of financial markets, however, some countries have not fully developed it.

*Therefore, it is pointed out that digitization is synonymous with the transformation of society, processes, markets, businesses, but also the way of doing business.*

## **Conclusion**

The digitalization of financial markets has prompted a new way of thinking about how to preserve the privacy and security, the rise of financial platforms in the markets, as well as monetary and financial stability. This has enabled the democratization of access to finance through the growth of platforms such as exchange between, industry, banking, businesses, transport, e-commerce and scale in the insurance industry. Therefore, this can help how to harness the opportunities of the digital economy to mitigate economic losses and propose differentiated development strategies, in

order to realize economic recovery and growth in the post-COVID-19 pandemic era. Therefore, today there are many different sectors that are ready for an immediate collision with the new digital revolution.

The purpose of the article was to indicate that digitization has significantly affected global financing and that with the changes, many countries have gained great opportunities to participate in the movement of financial flows. With the advent of digital programs, it has been possible for many foreign managers to invest all over the world, controlling their investments, which was previously impossible. With digital programs, the analysis of financial markets was facilitated, which reduced the risk of financial flows. The goal was to facilitate the implementation of financial activities that will lead to further development of financial integration.

This paper aims to provide guidance that policy vigilance will be needed to make economies more resilient and inclusive to reap the full benefits. In response, policy-making should be active, innovative and cooperative and, most importantly, should strike the right balance between ensuring financial innovation, on the one hand, overcoming challenges to market and financial integrity, while on the other hand, protecting of consumers and financial stability. This balance is essential to ensure social goods from financial innovation and to avoid stagnation in the development of digital finance with the risk that some of this will be left behind.

In order for digitalization to achieve the potential impacts described in the paper, the need for investments in the basic digital infrastructure is required. These investments and the services that support the markets are critical to creating the core activity of digital finance, which can begin to have an impact immediately, especially towards the capital markets.

It can be concluded that innovations in digital finance that underpin the link between digitization and finance offer wide opportunities that authorities want to manage. This is especially important for low-income countries, but also for populations that have insufficient access to services. Ongoing innovations and technological advances during the pandemic have supported broad-based economic development and inclusive growth, enabling cross-border payments and remittances, thereby strengthening regulatory compliance and supervision.

As the most significant conclusions of the latest empirical researches that are mentioned in the paper, they determined an increase in the competitiveness of the countries of the Asian region, in which there is an active development of new technologies. In this region, financial exchanges have developed significantly in the last few years. In addition to this, it can be pointed out that there has been a great drive and coordinated effort on developing countries to embrace e-commerce, to take advantage of digital commerce as an enabler for economic recovery.

Therefore, countries lagging behind in the digital economy need to strengthen cooperation with other developed countries to compensate for deficiencies in infrastructure and technological innovation capabilities.

As an essential problem, it is stated that digitalization alone will not overcome the gaps in financing, but therefore, today there are more significant opportunities for its mobilization in financing with a greater impact and improving efficient distribution.

## References:

1. **Bekert Geert, Hodrick Robert J.**, (2009). International financial management, 2nd ed.
2. Cataloging in Publication Data, Joint Bank-Fund Library – World Economic Outlook. – International Monetary Fund, World Economic and Financial Surveys, 2019 y;
3. European Central Bank (ECB), (2019). “Box 2: Financial, Vulnerabilities of Euro Area Households.” Financial Stability, Review (May 2019);
4. Global Financial Stability Report, World Economic Outlook, 2020 year;
5. World Bank, Retrieved from: [www.worldbank.org](http://www.worldbank.org), Materials from international organizations 2021
6. <https://www.frontiersin.org/articles/10.3389/fpubh.2022.856142/full>
7. <file:///C:/Users/Miki%20Runtev/Downloads/fpubh-10-856142.pdf>
8. [https://www.cepal.org/sites/default/files/publication/files/46858/S2100269\\_en.pdf](https://www.cepal.org/sites/default/files/publication/files/46858/S2100269_en.pdf)
9. <https://link.springer.com/article/10.1007/s42398-022-00231-y#Fig1>
10. [https://www.ilo.org/wcmsp5/groups/public/---ed\\_dialogue/---sector/documents/meetingdocument/wcms\\_824708.pdf](https://www.ilo.org/wcmsp5/groups/public/---ed_dialogue/---sector/documents/meetingdocument/wcms_824708.pdf)
11. <https://www. Kearney.com/foreign-direct-investment-confidence-index/2019-full-report>
12. <https://www.frontiersin.org/articles/10.3389/fpubh.2022.856142/full>
13. <file:///C:/Users/Miki%20Runtev/Downloads/fpubh-10-856142.pdf>
14. <https://www.oecd.org/investment/investment-policy/FDI-in-Figures-April-2022.pdf>
15. [https://unctad.org/system/files/official-document/wir2022\\_overview\\_ru.pdf](https://unctad.org/system/files/official-document/wir2022_overview_ru.pdf).
16. <https://www.oecd.org/investment/FDI-in-Figures-April-2021.pdf>

# THE CHALLENGES AND OPPORTUNITIES OF NORTH MACEDONIAN COMPANIES DURING THE TRANSITION FROM OHSAS 18001 TO ISO 45001

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**Abstract:** This paper is focused on identifying and analyzing the challenges and opportunities that North Macedonian companies faced while migrating from OHSAS 18001 to ISO 45001. The most common challenges identified were the lack of expertise, corporate culture, cost, low top management support and the redefinition of health. These challenges were pretty similar to the ones companies in other countries faced. On the other hand, there were opportunities that arose during this transition such as proactive approach and the redefinition of health, but there were some companies that didn't recognize any opportunities. The proactive approach is one of the differencing elements between OHSAS 18001 and ISO 45001, which results in implementing preventive measures that lower the number of work-related injuries, which is the main goal of any Occupational Health and Safety Management System.

## Keywords

*sustainable development; awareness; high school students*

## Introduction

The pandemic extended the deadline for the transitioning process from OHSAS 18001 to ISO 45001, a few times and the last extension was January 2022 which gave companies a period of almost four years to complete this process fully and in an effective manner. The main differences between these two standards were the approach, 45001 has a way more proactive one versus the OHSAS approach, which is considered to be more reactive, as well as the scope in which the term health was defined, OHSAS had a traditional meaning that only includes physical health while ISO 45001 has expanded the definition to include mental health. Every process that acquires a major change can bring its share of challenges especially for companies, which already have significant challenges while operating in developing countries such as North Macedonia.

## Purpose of Study

The main purpose of this study is to identify the biggest and most common challenges for North Macedonian companies, establish whether any opportunities have emerged during the migration from OHSAS 18001 to ISO 45001, and if so, what were these opportunities.

## Research Methods

The main research method was a questionnaire that included a necessary listing of all the challenges that their company faced during the transition process from OHSAS 18001 to ISO 45001, as well as evaluating through a numerical scale from one to five to evaluate the most difficult challenges, where five is used to mark the most difficult challenge. The research aimed at exploring whether the people involved in this migration identified any opportunities and what they were.

## Findings and Results

After questioning 13 companies in North Macedonia the five most common challenges that they faced during this transition are as listed on figure 1, as well as the percentage of North Macedonian companies that have listed it as a challenge.

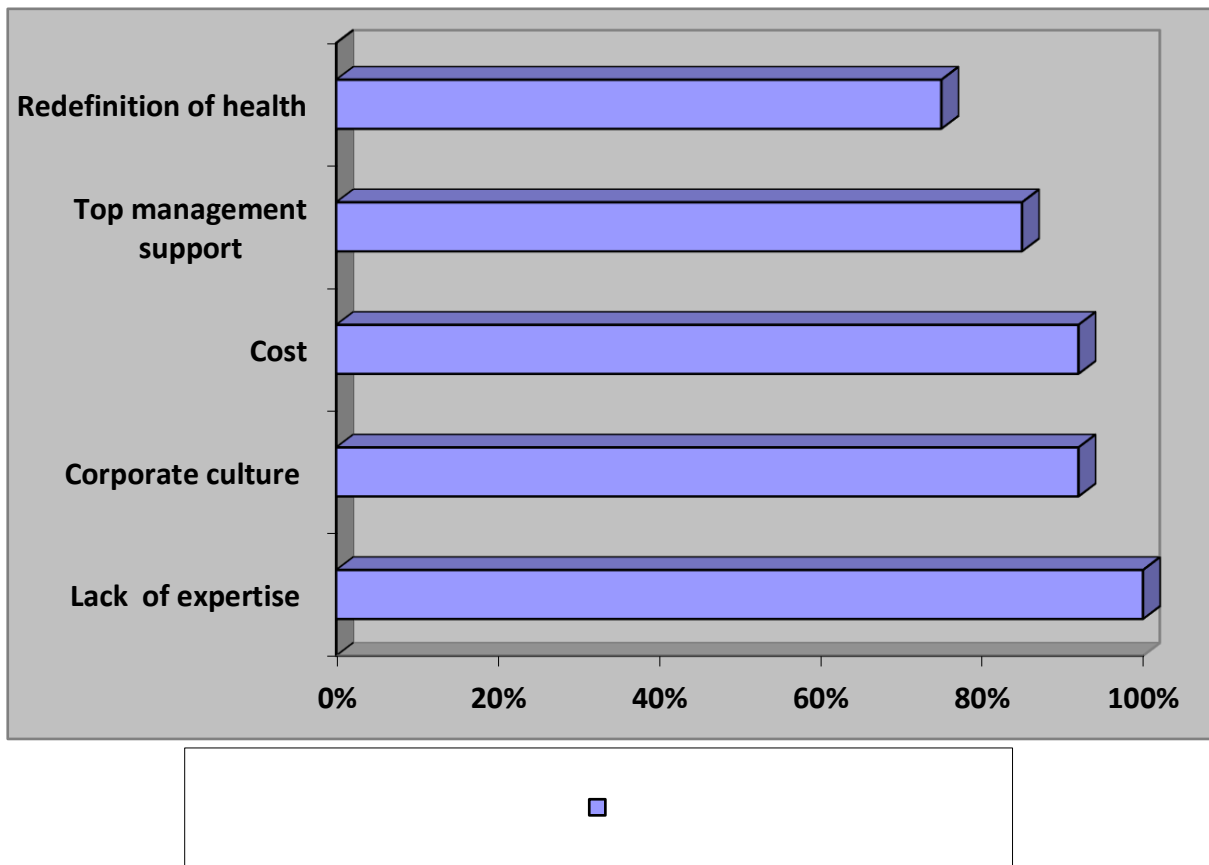


Figure 1 – Challenges

while transitioning from OHSAS 18001 to ISO 45001

Out of 13 companies all of them listed the lack of expertise as a challenge, which is expected since ISO 45001 is a new standard and there are a handful of experts in the world that have fully grasped the scope and context of the standard. Even though North Macedonia has the advantage of having a significant number of Occupational Health and Safety experts, very few of them have had official training in ISO 45001 and most of them work within the Standardization Institute of the Republic of North Macedonia. There is no accredited body for a certified implementation of ISO 45001 and all of the companies questioned have acquired their certification through accredited organizations from neighboring countries mostly from Bulgaria and Greece.

Corporate culture and cost were named as a challenge by 12 companies, there was only one company that didn't list them as challenges, a successful mid-size company that is a product of foreign investment and mostly employs engineers. Cost is a challenge that is often named with every ISO certification process and considering that having no national accredited organization increases the implementation costs for North Macedonian companies it is expected to cause difficulties. Corporate culture on the other hand is connected to two main factors, such as:

- nonchalant mentality among workers related to Occupational Health and Safety
- ISO certification in North Macedonia is mostly implemented as a requirement for exporting to developed countries mainly within the EU and far less because of a fundamental understanding and belief in its considerable benefits.

Top management support was listed as a challenge by 11 companies and most of them in their top management structure have managers with a financial background who mostly focus on the short-term cost of the certification.

Ten companies named the redefinition of health as a challenge which is a common issue with other companies operating in other countries, and even anticipated in countries like North Macedonia where health implies first and foremost physical health.

The summarized ranking of the challenges previously listed are presented in figure 2.

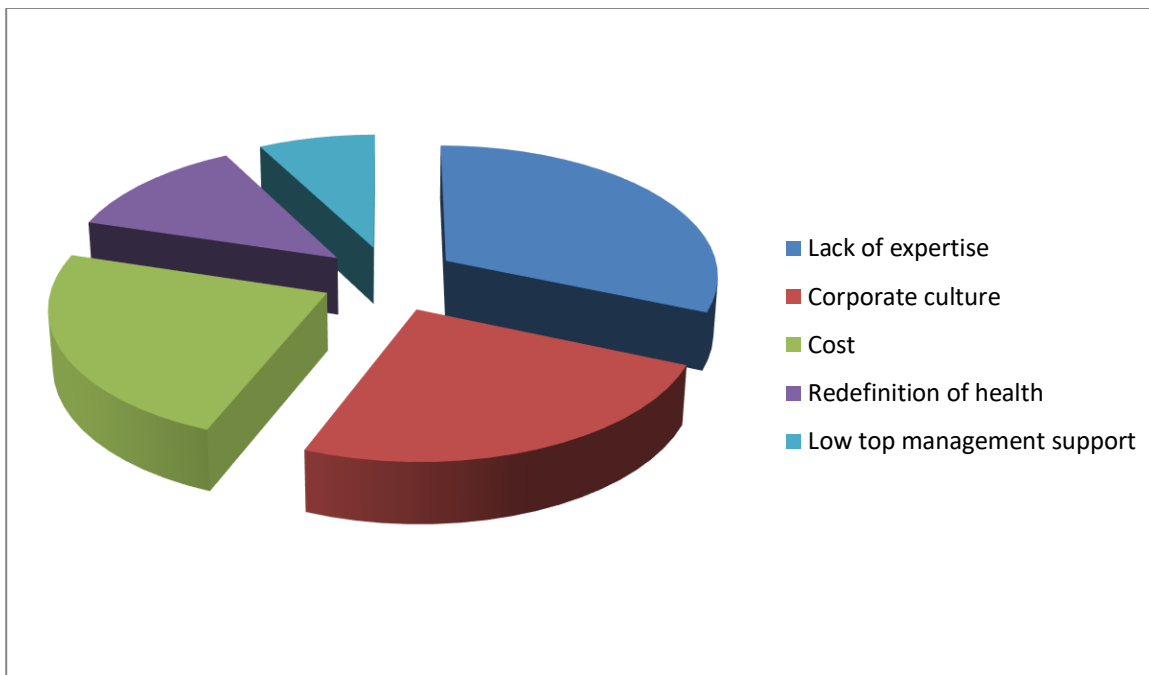


Figure 2 – Ranking of the challenges faced during the migration process from OHSAS 18001 to ISO 45001

The summarization of each company’s individual ranking of the difficulty level of the different challenges shows that North Macedonian companies biggest and most difficult challenges in the process of transition from OHSAS 18001 to ISO 45001 are:

1. Lack of expertise
2. Corporate culture
3. Cost

The opportunities the companies identified are presented in figure 3. Most of the companies managed to identify the possible benefits that arise from a proactive approach which tends to prevent accidents which results most importantly in saving lives and maintaining the well-being of employees which is in direct correlation with efficiency and productiveness, as well as cost reduction. Redefinition of health is viewed as an opportunity by only two companies, while the majority of the companies classified it a challenge. The fact there was two companies that see no opportunities in this transition confirms the fact that North Macedonian companies implement ISO standard mainly for international recognition and expect no internal benefits.

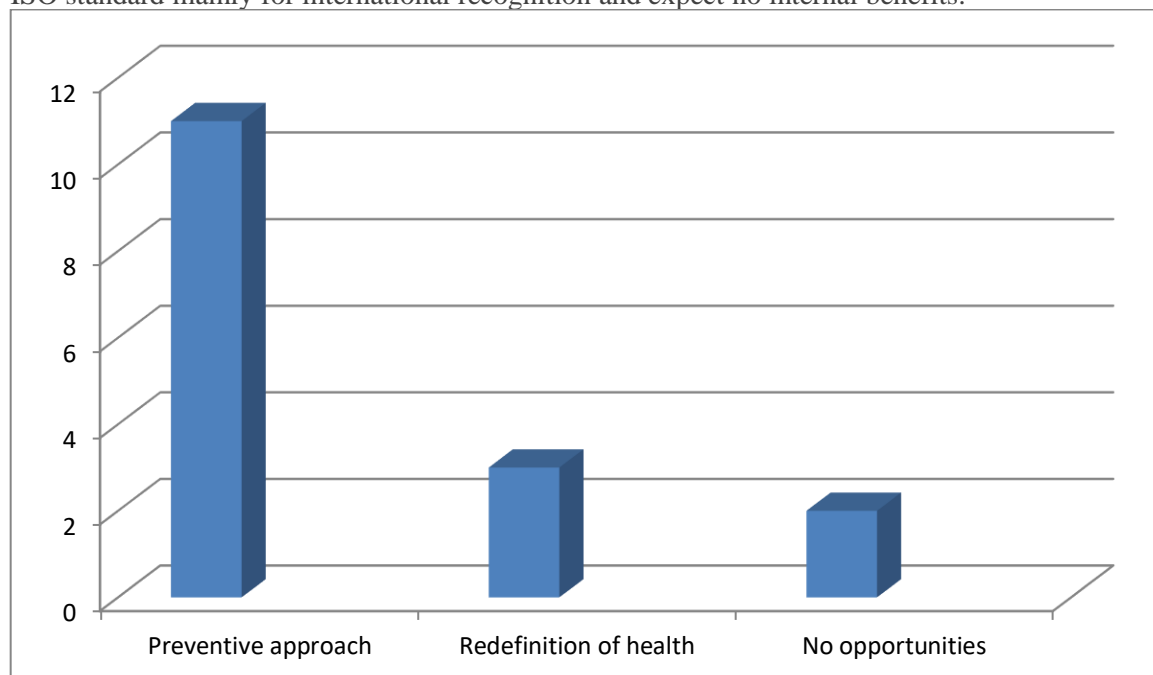


Figure 3 –Opportunities identified during the transition process from OHSAS 18001to ISO 45001

**Conclusions and Recommendations**

The research suggests that in general North Macedonia's companies, as few as they are, faced the similar challenges as most of the companies around the globe that have went through the process of transitioning from OHSAS 18001 to ISO 45001. The biggest challenge, the lack of expertise is to be expected if we take into consideration the fact that ISO 45001 is a new standard. Cost, low top management support and corporate culture are well known challenges that appear during the implementation of ISO standards. The surprising element is that redefinition of health is viewed as a challenge, as well as an opportunity. The companies that viewed it as an opportunity have learned that a productive employee needs to be mentally healthy; therefore, a standard that guides the process of implementing policies and procedures that focus both on mental and physical health will bring considerable benefits for the companies. The main opportunity identified is the preventive approach which is the best way to preserve the health of the employees as well as lower costs for companies.

## References

- [1] Yahya, Ramy, Naniek Utami Handayani, and Bambang Purwanggono. "Analysis of OHSAS 18001: 2007 standard renewal towards ISO 45001: 2018 at PT. Power Plant Indonesia by using gap analysis method." *SHS Web of Conferences*. Vol. 49. EDP Sciences, 2018.:
- [2] Palačić, D.: Sustaviupravljanjasiurnošću, IPROZ, Zagreb, 2011. Palačić, D.: Sustaviupravljanjazdravljemisigurnošćunaradupremazahtjevimaspecifikacije OHSAS 18001:1999, Rad isigurnost, 10, 2006., 1, 59-72. Palačić, D.: The impact of implementation of the requirements of Standard No. OHSAS 18001:2007 to reduce the number of injuries at work and financial costs in the Republic of Croatia, *International Journal of Occupational Safety and Ergonomics*, Taylor & Francis Online, 23, 2017., 2, DOI: 10.1080/10803548.2016.1211860
- [3] ALLENDER, H. Use ISO 45001 to improve safety & process efficiency: Here's how one company went about becoming certified, and realizing the standard's many benefits. *Industrial Safety & Hygiene News*, [s. l.], v. 53, n. 4, p. 29, 2019. Disponívelem: <https://search.ebscohost.com/login.aspx?direct=true&db=buh&AN=135568157&site=ehost-live>. Acessoem: 23 nov. 2022.
- [4] Belov SV, Davisilov VA, Initskaya AV, Belov SV, et al. (Ed.) (2009) *Life Safety: A Textbook for High Schools*. 8th edition, stereotypical. Higher School. 616 p.
- [5] Bocharova LM (1990) *Professiographical characteristic of workers' labor in the production of vegetable oil. II Actual issues of occupational health and occupational pathology: Abstracts of reports*. Plenum of the section of young scientists and specialists of the Problem Commission "Scientific basis of labor and occupational pathology", Volgograd: 12-13.
- [6] Davarpanah M, Abbasi H, Nabati M, Sabahnoo H, Bodaghi-Namileh V, Mazidi M, et al. (2019) Kit formulation of active pharmaceutical ingredient d, 1-HMPAO as a brain perfusion diagnostic system. *Progress in Chemical and Biochemical Research* 2(4): 185-191.
- [7] Devisilov VA (2009) *Labor protection: textbook*. 4th ed., revised and updated. FORUM. 496 p.
- Dmitruk VI, Galchenko SA (2004) Identification of sources of industrial danger and risk assessment of accidents. *Journal of Product Quality Control*.
- Eidelman BM, Bunakov OA, Zaitseva NA, Larionova AA, Nayda AM, Dmitrieva NV, Dashkova EV (2019) Problems and Prospects for the Development of Ecological Tourism in the Russian Federation. *Journal of Environmental Treatment Techniques* 7(4): 566-571.
- [8] GOST 12.0.003 -2015 "Occupational safety standard system. Dangerous and harmful production factors. Classification"
- [9] GOST 12.1.007-76 Occupational safety standards system. Harmful substances. Classification and general safety requirements. Hosseinzadeh Z, Ramazani A, Razzaghi-Asl N (2019) Plants of the Genus *Heracleum* as a Source of Coumarin and Furanocoumarin. *Journal of Chemical Reviews* 1(2. pp. 78-170): 78-98.
- [10] ISO 45001: 2018 Occupational Health and Safety Management Systems. Requirements and application guide"
- Labor Code of the Republic of Kazakhstan dated November 23, 2015 No. 414-V (with measurements and additions as of 01/01/2019) PR 5110PK00393301-012-2005 Process regulations for the production of cotton oil, Shymkentmay JSC, 2005
- [11] Uali AB, Naukenova AS, Kenzhekhanova MB, Asanova AR (2017) Identification methods of occupational risks based on the requirements of OHSAS 18000. *Scientific works of M. Auezov SKSU* 3(42): 78-85
- [12] Bakri, A., Mohd Zin, R., Misnan, M.S. & Hakim, A. 2006. Occupational safety and health (OSH) management systems: Towards development of a safety and health culture. *Proceedings of the 6th Asia-Pacific Structural Engineering and Construction Conference (APSEC 2006)*, 5-6 September 2006. Kuala Lumpur, Malaysia, 19-28.
- Cadioux, J., Roy, M. & Desmarais, L. 2006. A preliminary validation of a new measure of occupational health and safety. *Journal of Safety Research* 37(4): 413-419.





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